THURSDAY, MAY 16, 1912.

RECENT WORKS IN EUGENICS.

(1) *Heredity and Society.* By W. C. D. Whetham, F.R.S., and Catherine D. Whetham, his wife. Pp. viii+190. (London: Longmans, Green, and Co., 1912.) Price 6*s.* net.

(2) *An Introduction to Eugenics.* By W. C. D. Whetham, F.R.S., and Catherine D. Whetham, his wife. Pp. viii+66. (Cambridge: Bowes and Bowes; London: Macmillan and Co., Ltd.; Glasgow: James Maclehose and Sons, 1912.) Price 1*s.* net.

(3) *Heredity in Relation to Eugenics.* By C. B. Davenport. Pp. xi+298. (New York: Henry Holt and Co., 1911.) Price $2.00 net.

(1) THE authors of this volume record that one of them, on being presented to "a distinguished bishop and penetrating scholar of the last generation," was asked: "What is your opinion of the theory of politics?" The chapter entitled "Heredity and Politics" contains the answer, which was not ready at the time, namely, that the ultimate object should be to improve the innate qualities of the race; for if this be done improvement in environment will follow as a necessary consequence. It contains also an examination of the probable results of some of the more recent humanitarian legislation, which, hurriedly aiming at the relief of distress, does not stop to inquire whether that relief will not produce a few years hence a manifold increase of the distress which it is intended to eliminate. Yet the hurry manifested in some forms of legislation is no more noticeable than the delay in others. The case of the feeble-minded quoted in the following paragraph will serve as an example for the present:—

"A Royal Commission has taken voluminous evidence and issued a report in favour of compulsory care and detention. Nothing stands in the way of reform save the apathy of our legislature on a question where all competent opinion is agreed, but which does not appeal to the votes of the multitude, and the perversity of some of our educationalists, who persist in thinking that they can make a silk purse out of a sow's ear."

We rejoice that this reproach on our legislature is shortly to be removed.

Among the other points dealt with in this chapter is the eugenic effect of the present incidence of local and imperial taxation, tending as it does to penalise marriage and parenthood among the self-supporting. Separate chapters are devoted to the biological influence of religion, the birth-rate, and the position of women both in the past and in the present. To attempt to summarise them would be to do them an injustice. We can cordially recommend them to anyone interested in the bearing of these questions on the future of the race; the treatment is thoughtful and sincere, and could not be in any way offensive to people whose views are strongly opposed to those expressed by the authors.

(2) This volume should form a useful introduction to the study of eugenics, and should go far towards spreading eugenic ideas. It contains the short and simple annals of the subject, a statement as to what constitute "racial qualities," and an account of the various methods by which knowledge has been or may be acquired. It concludes with a chapter on the construction of society and a descriptive bibliography.

(3) The point of view of the author of this book is that Mendel's laws are universally applicable and the best, indeed the only, guide in practical eugenics. The chapter somewhat inappropriately headed "The Method of Eugenics" contains an illustration of these laws drawn from the results of crossing red- and white-flowered four o'clocks, together with an account of the phenomenon of karyokinesis, particularly in the maturation of the germ-cells. The reducing divisions are described as the mechanism by which segregation is brought about. The author rightly insists that it is the germ-plasm which is transmitted, and in order to avoid falling into the verbal error of describing somatic characters as inherited, the word germ-plasm is used very freely, and sometimes a little awkwardly, as, for instance, in the phrase on p. 207, "a germ-plasm which easily developed such traits as good manners, high culture, and the ability to lead in all social affairs."

More than half the volume is occupied by "The Inheritance of Family Traits." As something like one hundred different characters are dealt with, including many out-of-the-way diseases like congenital traumatic pemphigus, in 150 pages partly occupied with pedigree charts and photographs, it can be supposed that the treatment is not in all cases exhaustive; indeed, it may in parts be described as scrappy, but this is partly compensated for by the fullness of the bibliography. After this more general questions are discussed, such as the geographical distribution of inheritable traits and the modification of racial characters brought about by immigration and emigration. The extraordinary influence for good or evil which may be exerted by the descendants of a single individual forms the subject-matter of an interesting chapter, and the work concludes with a discussion of the relation between heredity and environment and some suggestions as to the organisation of applied eugenics.

With regard to the subject of immigration, the author makes a somewhat startling proposal for legislative action, namely, that the Federal Government should organise an army of "field workers" in foreign countries who would inquire into the family histories of all intending immigrants in order to ascertain whether their germ-plasms are suitable for introduction into the United States.

E. H. J. S.

STUDIES IN BIOLOGY.

(1) *Anleitung zum praktischen Studium niederer Tiere: Protozoa, Coelenterata, Vermes, Echinodermata.* By Dr. W. Schleip. Pp. vii+154. (Berlin: Gebrüder Borntraeger, 1911.) Price 3 marks 50 pfennig. (Bibliothek für naturwissenschaftliche Praxis.)

(2) *First Book of Zoology.* By T. H. Burlend. Pp. viii+159. (London: Macmillan and Co., Ltd., 1911.) Price 1*s.* 6*d.* (First Books of Science.)

(3) *More Animal Romances.* By Graham Renshaw. Pp. x+252. (London and Manchester: Sherratt and Hughes, 1911.) Price 7*s.* 6*d.* net.

(4) *Lehrbuch der Biologie für Hochschulen.* By M. Nussbaum, G. Karsten, and M. Weber. Pp. xi+529. (Leipzig: Wilhelm Engelmann, 1911.) Price 12 marks.

THERE is something in these new biological books for every class of reader, except for those whose interest is bounded by the study of genetics in the narrower sense of the word. The amateur microscopist will find in the first volume helpful practical instruction. The organiser of education in country areas will do well to recommend the second to the teachers of nature study in his district. Those who seek a melodramatic presentation of episodes in the wilds can have their fill of excitement by reading Dr. Renshaw's latest volume; and lastly, there is the magistral essay with full references for the specialist and university worker in the remarkable work that stands last on this list, for, as is explained below, the book is quite unsuitable in its present form to be adopted as a text-book in high schools, and we are anxious that its great merits should not be overlooked, as indeed may easily happen if the inadequacy of the title is not emphasised.

(1) Dr. Schleip sets out to assist the beginner in methods of microscopical technique as applied to the study of accessible examples of simple invertebrates, and proceeds to give short descriptions of each example selected. He begins by showing how to collect, mount, and cultivate different kinds of Amœbæ, which are certainly not easy objects for a beginner to find or manipulate. From this starting point the author proceeds to other groups of Protozoa (including such unusual forms as the ciliates of the ruminant stomach), and then to a brief consideration of the Hydrozoa. Sponges and Turbellaria are dismissed with a few words, whilst the more modified Cestodes and Trematodes are dealt with at some length.

A curious mistake seems to have crept into the section on "Earthworms-Nematodes." It is an excellent idea to obtain these eelworms by allowing earthworms to decay, but the author improves upon this idea, and advises the worker to fill up the body-cavity with soil. He then will find in a few days that the earth contains many adult and young specimens of Nematodes belonging to the genera Diplogaster and Rhabditis. Two precautions are here overlooked. In the first place, the Diplogaster is almost certainly not an earthworm-nematode, but a soil-form which the experimenter has introduced. In the second, Rhabditis, whilst possibly a true earthworm-nematode, will only develop if Lumbricus is used, and will not appear (or only very rarely) if the equally common Allolobophora is employed as a nutritive medium. A brief account of these Annelids follows, and the book closes with a very sketchy chapter on Echinoderms. Care has been taken to make the treatment throughout as simple as possible, and the book will be found useful to those who wish to begin the study of the lower animals.

(2) Teachers of elementary biology in rural schools will be glad of Mr. Burlend's brightly-written and well-arranged introduction to the study of animals. An attempt is made to interest the reader in such a way as to lead him or her to observe and record observations in an orderly manner. Many of the examples selected are such as are not usually described in so cheap a work (for example, the house-fly, garden snail, and brown trout), whilst all are obtained without difficulty. The figures appear to have lost something of their sharpness of outline and detail in the process of reproduction, but the three coloured plates are attractive. The remark about the different disposition of the wings in moths and in butterflies during repose on p. 62 needs altering, and the word Fritillaries as synonymous with Nymphalidæ is misleading, but these points do not detract from the value of the work as a means of stimulating powers of observation and of arousing an intelligent interest in the subject.

(3) Dr. Renshaw is known to many readers as an ardent naturalist and an imaginative writer. In this volume, a companion to an earlier one of similar title, he attempts ambitiously to "restore" the animal life of bygone times in a series of word-pictures, and he includes also a number of gorgeous descriptions of present-day episodes in dif-

ferent parts of the world. In his scene-painting the author shows an alert mind, in which the memory of his own travels and the knowledge that he has industriously acquired from direct observation and from books are ingeniously blended together.

In his own special line—that of describing the association and interaction of animals against a suitable background—Dr. Renshaw displays a notable gift, and his heart is in the work of attracting his readers to that which he himself finds so absorbing. The vividness, the fullness, the tenseness of tropic nature are ever in his mind, but the attempts to depict them would have been more successful had more restraint been exerted. "War to the adjective" might well be his motto. The gory element is certainly too obtrusive for most readers' tastes, and we could well have spared some of the tales of blood and fury which end in clouds of flies. However, the careful observation and the attractive illustrations make amends, and we can confidently recommend this volume to all who have found the earlier works by Dr. Renshaw a stimulating account of moving incidents by flood and field.

(4) This book differs from all other text-books of biology with which we are acquainted in describing organisms from the point of view of experimental morphology; that is to say, it takes for granted a knowledge of general anatomy, physiology, and classification, and proceeds to show what factors are at work in the production and maintenance of form and of structure. From the modernity of its point of view and its wide scope, this work goes far to provide what is so greatly needed—a really biological text-book; and it is only the immense and increasing amount of material and the rapid changes of knowledge involved thereby, that have prevented the authors from effecting a still more intimate association between the factors that govern the zoological side of the problem and those that condition the botanical one.

The book consists of three parts, which are severally the work of distinguished biologists. Prof. Nussbaum, of Bonn University, has written the opening section, and deals with that special aspect of experimental animal morphology which presents itself upon consideration of the regenerative and regulatory processes in animal tissues; Prof. Karsten deals in the second section with the ecology of plants; and Prof. Max Weber has written the concluding part upon the factors of animal life. From the student's point of view, the middle section should have come first, since it is not only simpler in its subject, but also because it is written in a more simple manner. For the same reasons the chapter on animal biology should have preceded Nussbaum's section on special problems. The order, however, is of comparatively little importance to those who wish to consult rather than to read the work consecutively.

On their several topics these writers are indisputable authorities, and write out of the fullness of their knowledge and experience. The result is a work of unusual value.

PLANT PHYSIOLOGY FOR AGRICULTURAL STUDENTS.

Plant Physiology, with special reference to Plant Production. By Prof. B. M. Duggar. Pp. xv+516. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1911.) Price 7*s.* net. (The Rural Text-Book Series. Edited by L. H. Bailey.)

"PLANT physiology," the author states in his preface, "finds its practical application in plant production. . . . It is somewhat strange, therefore, to find that as a separate course plant physiology is not yet offered in some of the colleges whose purpose is primarily to train persons for practical or rural pursuits." In helping to remedy this state of affairs, the author has produced a very readable book, useful to the student whose life is to be passed among plants and whose living is to be got out of them, and at the same time interesting to the general reader who loves his garden and has an appreciative eye for flowers and trees.

That the book is American goes without saying; the large proportion of our modern books for agricultural students comes from the States. Its distinguishing feature is that at every turn it brings in such practical applications of particular facts or principles as have been made, thus emphasising the economic importance of the subject while adding considerably to the interest. The general plan of the book is as follows:—After a description on the usual lines of the plant cell, the student is led on to the water relationships of the plant, to the root and soil, to absorption, transpiration, and water requirements of crops; then to a consideration of mineral nutrients and their special functions and relations. The student is now directed to the leaf, the intake of carbon and the making of organic food, the assimilation of nitrogen and the working up of simple nitrogen compounds into protein, and the general phenomena of nutrition, respiration and growth. Next comes the discussion of seed formation and reproduction. Then come three chapters that look out of place, dealing respectively with the effects of temperature, of light, and of deleterious chemical agents on plant life. Finally we get back to the

main argument, with chapters on variation and heredity.

A general criticism, applicable not only to this but to many other American books, is that too little is made of the classical researches that have created the subject and too much of the latest results of the latest bulletin. To some extent this defect is remedied in the lists of papers given at the end of each chapter, where the classical papers are usually included, but there are some omissions; for instance, at the end of the chapter dealing with nitrogen fixation by bacteria there is no reference to Winogradsky's papers. This is a defect that the teacher will have little difficulty in remedying if he wishes to do so, while the inclusion of newer work has, at any rate, the advantage of familiarising the student with the work going on at the various experiment stations.

At the end of each chapter a number of practical exercises are given, bearing on the work that has been discussed. The experiments are simple and convincing, and cannot fail to be helpful to the student. References are also given to larger works so that any particular point can be looked up. The illustrations are numerous and very good.

Probably few teachers of plant physiology realise how many practical applications of their subject there are, or how much is added to the interest of the discussions by bringing in a few illustrations from agricultural or horticultural practice. Particularly in these latter days, when numbers of botanists and mycologists in different parts of the world are applying science to crop production, is there a great amount of material accumulating which must soon react on the study of plant physiology. The teacher, at any rate, will be well advised to look through this volume in search of illustrations, and he may find it worth while to adopt some of the methods.

NON-EUCLIDEAN GEOMETRY.

Bibliography of Non-Euclidean Geometry, including the Theory of Parallels, the Foundations of Geometry, and Space of N *Dimensions.* By Dr. D. M. J. Sommerville. Pp. xii + 404. (London: Harrison and Sons, St. Martin's Lane, 1911, for the University of St. Andrews, Scotland.) Price 10*s.* net.

CONSIDERING its subject, this bibliography seems at first sight extraordinarily large; but there are several reasons why it is not so formidable as it looks. The actual list of titles occupies pp. 1–261; this is arranged chronologically, each year's titles being indexed by the authors' names. Then (pp. 261–310) we have a subject index, an alphabetical list of subjects, and an author index. Finally, Mr. Sommerville has included various topics not strictly belonging to the subject, but more or less closely connected with it; for instance, quaternions, Cantor's theory of aggregates, Minkowski's "Geometrie der Zahlen," and so on. At the other extreme, we have reviews of books, references to the subject in fiction, and even "the realm of spirits."

In a work of this kind it is better to be inclusive than exclusive; so long as the list is reasonably complete, and the subject-index arranged on sound principles, the compiler has done his duty. There is every reason to believe that, in both respects, Mr. Sommerville has achieved success. As a few examples out of many that could be given, we may note the entries under "time of two or more dimensions," and "time as the fourth dimension," the latter including a reference to Lagrange; those on the philosophy of geometry, significantly headed by Bergson; and, on the lighter side, those on the extension of magic squares and cubes to *n* dimensions.

After making all deductions, we cannot fail to be impressed by the astonishing growth of this theory in recent times. Most remarkable of all, perhaps, is the fact that some eminent men of science are seriously suggesting time as, in a sense, a fourth dimension, the effect of which is to bring the physical universe *sub specie eternitatis* as a given configuration, parallel sections of which are realised by us as successive events, or aspects, in time. How far this is a mere way of speaking, or how far it may lead to a radical change in our assumptions of the ultimate undefinables of physics, it is too early to attempt to decide. Meanwhile, attention may be directed to M. Bergson's "Creative Evolution," in which a distinction is drawn, on purely philosophical grounds, between time as a metaphysical notion and the *t* of mathematical physics. This contention is not to be lightly dismissed, urged as it is by a philosopher who differs from the bulk of his profession in really understanding the methods and results of physical, biological, and mathematical science.

It is to be hoped that Mr. Sommerville's excellent index will help to arouse even wider interest in the subject, which is not only fascinating and educative in itself, but, as we have just seen, not unlikely to be of wholly unexpected importance in the applications of mathematics to physics. The very last entry that we find is that of Minkowski's collected mathematical memoirs; could anything be more suggestive? G. B. M.

OUR BOOKSHELF.

Our Weather. By J. S. Fowler and William Marriott. (The Temple Primers.) Pp. xi+131. (London: J. M. Dent and Sons, Ltd., 1912.) Price 1*s.* net.

THIS book belongs to a series of small volumes intended to form introductions to the subjects of which they treat. Into its 120 pages Messrs. Fowler and Marriott have compressed a great deal of useful information. After a brief introductory chapter explaining why a popular book about weather is a practical necessity, they discuss in turn pressure, temperature, humidity, wind, and allied phenomena. They then deal with weather-forecasting, the upper air, and phenological observations, and conclude with a chapter on proverbs and rhymes.

The book is very readable, and the authors have carefully refrained from explanations or reasoning which might puzzle or bore the uninitiated reader. There are, however, a few points to which it may be useful to direct attention. The chapter on pressure contains a table showing the heights at which pressures of 29, 28, . . . 21 inches are reached when the pressure at sea-level is 30 inches, but the temperature with which the values correspond is not stated, nor is there any indication to the reader that temperature affects the results. In connection with the curve of annual variation of temperature, it is stated that the most noticeable irregularities are the cold days about the middle of May, and the warm spell at the end of November, but a reference to the curve shows that only the slightest irregularities occur in May. The most marked feature is the cold period in the second and third weeks of June, which is also mentioned by Hann as the general outstanding irregularity in the annual variation of temperature in Europe.

Months of unequal length are a general source of trouble in meteorological statistics, and the authors repeat the common mistake of including February with March as the driest of the twelve months at Greenwich, although the daily rainfall in the former month is greater than in April. In connection with forecasting, the statement that the information received by telegram is plotted on two maps, one for pressure and wind, and one for temperature and weather, is erroneous: the information is plotted on one working chart.

E. G.

Philips' Comparative Series of Wall Atlases. Edited by J. F. Unstead and E. G. R. Taylor. *Europe.* 8 maps. (Mounted complete as a wall atlas, on cloth, with roller.) Price 21*s.* Explanatory Handbook (to accompany the above). Pp. 16. Price 6*d.* net. (London: G. Philip and Son, Ltd.; Liverpool: Philip, Son, and Nephew, Ltd., 1912.)

THIS series of maps should prove of great service to teachers of regional geography, as they show political conditions, railways and configuration, climate, density of population, and economic conditions. The map showing communications illustrates admirably the influence of mountain ranges, passes, and river valleys on transport. It is generally complete, though for some reason the Algerian railways have been omitted. The Density of Population is a graphic map with sufficient detail for the comparison of regions with one another. Used with the other maps, it should help to indicate the dependence of population on manufacturing areas, railway lines, river valleys and lowlands, and the comparative isolation of mountain areas, tundra, and desert. Unfortunately, this comparison is not possible in Africa and Asia, as the map stops short at the boundaries of Europe.

The climate maps show winter and summer conditions of temperature, pressure, winds, and rainfall. Actual temperature conditions are not shown, but the orographical features are printed on the map of summer and winter lines of temperature, so that reference can be made to real temperatures by allowing for elevation at any particular place or along any given line of temperature. Detailed maps of actual temperature must, like detailed orographical maps, be very complex, but we cannot help regretting that some simple maps of this kind have not been added to the series for summer and winter, with perhaps only a few selected lines of critical temperatures, as their value is incontestable as a means of comparison between regions.

On the whole, we have nothing but praise for this series, which affords most valuable material for the study of regional geography. The textbook which accompanies the maps points out clearly the general way in which they may be used.

The Fauna of British India, including Ceylon and Burma. Edited by Dr. A. E. Shipley, F.R.S. Assisted by Guy A. K. Marshall.—*Coleoptera.* General Introduction and Cicindelidæ and Paussidæ. By Dr. W. W. Fowler. Pp. xx+529. (London: Taylor and Francis; Calcutta: Thacker, Spink and Co.; Bombay: Thacker and Co., Ltd.; Berlin: R. Friedländer & Sohn, 1912.) Price 20*s.*

THE volume before us differs somewhat in plan from most of those which have preceded it. The first half (up to p. 218) consists of a very elaborate introduction to the Coleoptera, giving a detailed account of the whole series of families (103, exclusive of Strepsiptera) recognised by the author in the order, whether represented in the Indian region or not. The "Abnormal Coleoptera: Strepsiptera or Stylopidæ," incidentally alluded to, are not yet proved to be Indian. We may point out that it was Kirby, the original discoverer of these insects, who proposed to make them a separate order (Strepsiptera), and Westwood merely followed him.

The two families of beetles dealt with in the latter half of this volume are specially interesting: the beautiful and active Cicindelidæ, or tiger beetles, and the Paussidæ, which are remarkable for the curious structure of their antennæ, and also for their habits, several species being found in ants' nests, and detonating like the well-known bombadier beetles (Brachinus).

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Clouds and Shadows.

IN NATURE of April 18 Mr. Charles Tilden Smith described a cloud-like appearance which he considered was no cloud, as it remained quite stationary while stratus and small lower clouds were driven quickly across the sky. I think I can throw some light on the subject, as I observed a similar appearance both on April 5 and on April 8, the date of Mr. Smith's observation.

On April 5 I was observing pilot balloons when my attention was directed to a cloud which formed in the east; it was a cloud with very soft edges, which were constantly changing their shape and were frequently ripple-marked. I enclose a photograph of the cloud taken about 6 p.m. What chiefly attracted my attention was the fact that the cloud remained stationary, though it was obvious from the motion

of the pilot balloons that there was a very strong wind in the upper air. The pilot balloon ascents at 5.27 p.m. and at 6.24 p.m. showed that at one kilometre above the surface the velocity was 20 metres per second or more, which is fairly high for such a low level; the velocity fell off a little at greater heights, but it was 15 metres per second or so at three kilometres.

As a north-west wind, which was the direction on this day, never seems to decrease very materially below the level of the stratosphere, it is obvious that the cloud in question was remaining stationary, though it was floating in a strong wind; presumably the particles of which it was composed were condensing on the windward side and evaporating on the leeward side of the cloud, as in cloud streamers seen round the peaks of mountains. That this was really the case I could not determine at the time, as I was taking observations of balloons, but on April 8 I noticed very similar clouds shortly before sunset, and by watching them carefully it was quite clear that in this case the above supposition was correct. There was a great development of these soft-edged clouds just before sunset; they were arranged more or less in parallel bands, with a vanishing point in the south-west; the particles of which they were composed were coming from the north-west. At one time I noticed that the edges of one cloud broke up into ripple clouds which moved rapidly from the north-west until they reached another cloud into which they merged.

If Dr. W. N. Shaw's supposition is correct that changes of pressure in the lower layers of the atmosphere are caused very largely by changes which occur in the level just below the stratosphere, it follows that a diminution of pressure at this level will cause a decrease of pressure through the whole of the underlying layers, and, as Dr. Shaw has pointed out, condensation and formation of cloud may take place wherever there happens to be a damp layer, and we get, what is so often seen, the simultaneous formation of sheets of cloud at widely different levels.

On April 5 there was a great development of cloud at different layers at sunset. If at any particular layer condensation is almost taking place, any uplift of air will hasten it, and any wave motion that may exist will become visible by condensation in the wave crests. On April 5 the strong wind passing over the irregularities of the surface, such as the South Downs in this neighbourhood, might have caused local uplifts of air which might have extended to considerable heights; thus at some particular layer condensation might take place, the cloud particles forming where the air was rising and evaporating further to leeward, where the air was descending. Soft-edged clouds, formed in a somewhat similar way, may sometimes be seen covering the tops of the Downs and closely following their contours, giving the hills a strange appearance of increased height, as recorded by Richard Jefferies in "Wild Life in a Southern County."

It is difficult to estimate the heights of the clouds seen on April 5 and 8, but I think, though I am not quite sure, that I saw a pilot balloon projected on one of them when it was at a height of about three kilometres; if this were so, the clouds must have been at a greater height.

CHARLES J. P. CAVE.

Ditcham Park, Petersfield, May 5.

Mammalian Remains at the Base of the Chalky Boulder Clay Formation in Suffolk.

MR. E. P. RIDLEY, Mr. Frank Woolnough, curator of Ipswich Museum, Mr. Fredk. Canton, and myself have to-day assisted in the removal of a large curved tusk which was found at the base of the chalky boulder clay formation, and on the top of the underlying middle glacial sand, at a depth of 11 ft. 3 in. from the present surface of the ground.

Numerous pieces of bone evidently belonging to the same animal have been found lying near the tusk, but were removed before we arrived. The spot where this discovery has been made is in a shallow valley at Charsfield, a village about eleven miles north of Ipswich, and it is owing to the kindness of Mr. W. H. Youngman that I was apprised of the find.

This shallow valley is a typical example of the dry valleys so often met with in Suffolk and elsewhere, and is not apparently connected with any present river system.

The section in the small pit, which is being worked for stone, shows 1 ft. of surface humus, 3 ft. of blackish gravel, 4 ft. of chalky boulder clay, developing into, and evidently a part of, a loamy gravel about 3 ft. in thickness.

At the bottom of the section the fine, stoneless middle glacial sand is exposed. The accompanying

photograph, taken by Mr. Frank Woolnough with the camera suspended over the pit, shows the tusk *in situ*, it being afterwards removed by my man Baxter and myself, who, finding it very friable, had to use great care in getting it up intact.

The remains have been sent away for identification, but it was obvious that they presented the same amount of mineralisation as was present in the human bones found by me at exactly the same horizon at Ipswich, in October of last year. As in this latter case the remains were found lying partly embedded in glacial sand and partly in the different overlying material, also in both cases the amount of iron staining is very slight.

This discovery appears to me to be of some importance, and affords an answer to those of my critics who were dissatisfied with my discovery of the human skeleton because I had not found any other mammalian bones at the same horizon at which this occurred.

It is also an additional piece of evidence that the top of the middle glacial sand was a land-surface in pre-chalky boulder clay times. J. REID MOIR.

12 St. Edmund's Road, Ipswich, May 5.

Les Éclipses d'Hiver et les Éclipses d'Été.

NOUS venons d'assister à un phénomène très curieux le 17 avril dernier. Au premier abord il paraît avoir été le résultat d'une faveur exceptionnelle d'Éole. Monsieur Angot, le savant Directeur du bureau central météorologique de France, a compulsé avec soin l'histoire de la science qu'il cultive si assidûment, il est arrivé à l'idée que les astronomes faisant d'immenses préparatifs pour observer l'éclipse à terre avaient très peu de chance de rencontrer un ciel serein permettant d'arriver à des mesures angulaires irréprochables; il leur en attribuait huit sur cent.

Monsieur Angot oubliait que l'éclipse qui a soulevé une si vive émotion se produisait dans les jours froids du printemps, que les vents soufflaient dans la direction de l'Est ou du Nord et que, par conséquent, le refroidissement produit par l'éclipse devait très difficilement déterminer la formation de nuées suffisamment épaisses pour empêcher d'observer le Soleil. D'après le compte rendu qui m'est communiqué des treize ascensions exécutées à Paris par Messieurs Bans et Barbotte, le refroidissement a été très énergique; à la hauteur de 2500 mètres où ils étaient parvenus ils ont constaté que leur thermomètre était descendu à plusieurs degrés centigrades au-dessous de zéro. Cependant grâce à la constitution atmosphérique qui est fréquente en pareille saison les observations terrestres ont été partout irréprochables. Si l'éclipse eut été réellement totale au lieu de l'être d'une façon hypothétique, on aurait vu les couronnes, les protubérances d'une façon merveilleuse sans avoir besoin comme l'ont fait si souvent Sir Norman Lockyer et J. Janssen de se transporter dans les Indes, dans l'Indo-Chine, en Égypte et dans les îles les plus isolées de l'Océan Pacifique.

Mais il existe une circonstance fort intéressante dont Mr. Angot n'a pas tenu compte et qui justifie parfaitement les efforts qu'a fait récemment le fils de Sir Norman pour suivre l'exemple de son illustre père.

En été dans le voisinage de la fin de juin, le disque du Soleil est réduit à son minimum parce que la terre arrive à son aphélie; alors notre satellite a beaucoup moins de peine à le recouvrir. Si par hasard à l'heure de l'éclipse la lune est voisine de son périgée le phénomène atteint son maximum; il peut durer plusieurs centaines de secondes, et on a tout le temps d'explorer le voisinage de l'astre qui malheureusement ne peut nous éclairer sans nous éblouir et nous cacher par conséquent tout ce qui se passe autour de lui.

Mais à cette époque, au moins dans notre hémisphère, l'air est saturé de vapeurs de sorte que les belles observations d'éclipse sont très rares; il est excessivement difficile d'en profiter pour résoudre les magnifiques problèmes dont on s'occupe si vivement depuis qu'Arago s'est immortalisé en les signalant lors de la grande éclipse totale visible à Perpignan en 1842. C'est ce qui fait qu'on a attaché tant de prix aux travaux de Sir Norman qui a imaginé et pratiqué avec tant d'habileté les recherches spectrographiques autour du Soleil sans se préoccuper des éclipses. Il est bon de faire remarquer que l'hémisphère austral se trouve à ce point de vue dans une situation beaucoup plus favorable que le nôtre et que les astronomes de Sydney ont beaucoup plus de chance que les nôtres d'observer de belles éclipses totales. En effet lorsqu'elles arrivent dans leur hiver qui correspond à notre été le Soleil est à son minimum.

Je ne peux terminer sans faire remarquer que l'éblouissement produit par le Soleil diminue rapidement par l'altitude à laquelle parvient l'aéronaute quoique la puissance calorifique du Soleil augmente. Il en résulte qu'on voit certaines étoiles plus voisines de l'astre que si l'on restait à terre. Par conséquent en s'élevant très haut lors du crépuscule ou de l'aurore on peut explorer d'assez près la banlieue du Soleil. C'est même cette circonstance qui faisait que Le Verrier avait désiré dans les dernières années de sa carrière faire exécuter des ascensions à l'observatoire de Paris pour découvrir la planète Vulcain à l'existence de laquelle il croyait fermement.

On peut voir du reste dans les comptes de ce grand établissement les dépenses qu'il a faites, lorsqu'il m'a chargé en 1875 de remettre en état le ballon de l'observatoire, malheureusement cet appareil avait été si maltraité par les aéronautes qui l'avaient eu

entre les mains pendant la durée du siège qu'il fut impossible de le réparer et que les intentions presque testamentaires de Le Verrier n'ont pu recevoir aucune exécution. W. DE FONVIELLE.

St. Broing, 23 avril.

The Ammonia Flame.

IT is generally recognised that Strutt's discovery of an active form of nitrogen is one of the most interesting results of recent investigations: it may be opportune, then, to direct attention to a phenomenon which seems to have some connection with active nitrogen. The colour of the flame of ammonia burning in oxygen is yellow, and of the same tint as the nitrogen glow in Strutt's experiment; the spectrum of the light emitted is similar. The structure of the flame is also exceptionally interesting; it consists of an inner bright yellow cone and an outer, almost non-luminous, flame. It would seem that the ammonia is first of all split up into nitrogen and hydrogen, and that the light of the inner cone is due to the combination of nitrogen atoms to nitrogen molecules, as is suggested in the case of the nitrogen glow, while in the outer flame hydrogen burns to water and some nitrogen combines with oxygen to give nitric oxide. An analysis of the products of combustion showed that nitrogen and water were the main resulting substances, but that nitrogen peroxide was also produced in considerable quantity.

There are one or two other points which support this view of the combustion. The shape of the flame is interesting; most flames which are due to the combination of substances have a pointed cone with more or less inflected sides, when the gases issue from a circular orifice; but in the ammonia flame the inner cone always asumes a rounded apex like a thimble, the outer flame being similar to the usual inflected pointed type of flame. The explanation of the difference in the structure of the flames appears to me to be plain, if in the inner cone a simple decomposition is occurring at a distance from the orifice depending on the velocity of the issuing stream of ammonia, while in the outer cone a combination is occurring with oxygen which is being drawn up along with the flame, as in an ordinary combustion.

Another point about the combustion which seems to support this view of the actions occurring in the flame is that it is difficult apparently to make oxygen burn in an atmosphere of ammonia or to get mixed oxygen and ammonia to burn, though such a mixture may explode if in correct proportions. I think, then, the above view of the cause of the luminosity is preferable to that which would ascribe it to the production of nitric oxide. ALFRED C. EGERTON.

R.M.A., Woolwich.

REPORT OF THE TUBERCULOSIS COMMITTEE.

IN a report just issued, the Departmental Committee on Tuberculosis, appointed in February by the Chancellor of the Exchequer "to report at an early date upon the considerations of general policy in respect of the problem of tuberculosis in the United Kingdom in its preventive, curative, and other aspects, which should guide the Government and local bodies in making or aiding provision for the treatment of tuberculosis in sanatoria or other institutions or otherwise," has made a pronouncement the importance of which will be realised only as the advice followed in that report comes to be followed and its suggested provisions put into force.

Up to a recent date the treatment of tuberculosis has been left, to a very large extent, to voluntary effort, and whilst excellent work has been done by the various associations that have undertaken this work, aided later by municipal and other health authorities, and eventually by Government and the Local Government Board, there has been a sad lack of coordination and want of organisation. This has militated seriously against the success of the campaign undertaken against the white plague. In the report now before us we have the "opinion" of a body of experts who have considered the question of the prevention and treatment of tuberculosis on what may be described as a national scale. These experts have already been engaged in some department or other of the crusade. Legislators, administrators, heads of institutions specially designed for the treatment of tuberculosis, medical officers of health, and other members of the medical profession, each in turn has brought some special knowledge and experience to bear, with the result that we have no pressing forward of incomplete or ill-considered schemes, no exaggerated claim for any special method of treatment, and no presentation of a panacea for all cases of tuberculosis.

The committee has taken its duties and responsibilities very seriously, and is evidently impressed with a sense of the importance of its functions. It has looked beyond those who are already in an advanced stage of tuberculosis, and has brought within its purview the measures that must be adopted to prevent the affection of those who are still sound or who suffer but slightly. Further than this, however, it is in full accord with the framers of the Act that much of what is now being contemplated is based on the knowledge that has been gained by research, in the ward to some extent, but primarily in the laboratory. It is impossible, of course, to affirm that in time we might not have reached our present viewpoint as regards the general treatment of tuberculosis in its various forms by a careful clinical study of the disease and a prolonged study, by rule-of-thumb methods, of the various drugs and certain of the modes of treatment; but it may be affirmed, and that most strongly, that this could not have been during the life of the present generation, and probably for several of those succeeding. Experimental investigations carried on by Villemin and Chauveau, by Burdon Sanderson, by Cohnheim and Salomonsen, and finally by Robert Koch, brought us, however, by a "short cut" to a point from which the rate of advance along the above and other lines has been phenomenally rapid; of this we have evidence in the report now before us.

The first aim under the Insurance Act is to find out tuberculous patients, and this, it is suggested by the Committee, is to be done through the "dispensary"; the second is to prevent the spread of the disease by the administrative work of our public health departments and our hospitals;

the third is to bring the patients to as high a state of physical health as possible through the agency of dispensaries, hospitals, sanatoria, open-air schools, and the like. Whilst all this is going on, however, the laboratory investigator is to be encouraged to contribute to that stock of knowledge on which most of the administrative preventive and curative methods of dealing with tuberculosis are based. The public health authority, both central and local, the tuberculosis expert, the general medical practitioner, the voluntary anti-tuberculosis organisation, and the laboratory worker are brought together in the scheme of the committee; funds are provided—whether in sufficient amount still remains to be seen, but they are a good beginning—and the scheme starts under the most favourable auspices. That an enormous amount of good will be effected no one can doubt; that a whole-hearted attempt is being made to get the best of the scheme is equally certain; and should modifications or alterations have to be made in the future, it will be only as more light is thrown upon, and a better view obtained of, a very difficult and complicated question.

SARDINES IN SCIENCE AND COMMERCE.

IT has been suggested to us by a correspondent that the publication of the full text of Alderman Sir George Woodman's judgment in the recent "sardine" case, referred to in NATURE of April 25 (p. 194), would be of interest. In our article Sir George was incorrectly stated to have said that the industry of packing the immature pilchard in tins was started in 1882; this date, as will be seen from the subjoined report with which he has kindly favoured us, should have been 1822.

"My decision is that the term 'sardine' is of French origin. It is the French name for the pilchard, the fish scientifically known as *Clupea pilchardus*. The industry of packing the immature pilchard in tins was started in France in 1822, and the fish so packed and imported into this country were universally known as 'sardines.' The word 'sardine' has now become Anglicised, and I hold that the meaning of the term is 'the immature pilchard prepared and packed in oil in tins.'

"This is not what the defendant sold. The 'Skipper sardines' sold by him were the Norwegian fish known as the 'brisling.' The 'brisling' is the *Clupea sprattus* of the same family but of a different species from the *Clupea pilchardus*, and is the same fish, allowing for differences caused by local environment, as the English sprat. There was a false trade description.

"The defendant has not proved that, prior to the passing of the Merchandise Marks Act, 1887, the description 'sardine' was generally applied to any small suitable fish prepared and packed in oil in tins, but I am satisfied that for the last twenty years at least the use of the term 'sardines' has been extended in commerce, especially amongst retail traders, to include any such small fish so packed and prepared. To the defendant, who started his own business in 1903, and was selling Norwegian sardines twenty years ago, the word had this extended meaning. He also knew that the Norwegian Government had formally adopted the word 'sardines' to describe the brisling packed in oil. He, in my opinion, believed that the description he applied was a true description, and, notwithstanding the very able legal arguments I have just listened to from Mr. Bodkin, I hold that he has proved that he acted innocently within the meaning of Section 2, Subsection 2 (*c*) of the Merchandise Marks Act of 1887. I therefore dismiss the summons."

We should like to have similar legal pronouncements upon several other commodities which are sold under misleading trade descriptions. For instance, the names under which furs are sold in shops often conceal from the public the nature of the animals from which the furs have been obtained. It is regarded as permissible by dealers and tradesmen to describe the fur of white rabbit, dyed, as "chinchilla coney," Australian opossum as "Adelaide chinchilla," American opossum as "Russian marten," and Belgian hare as "Baltic lynx." Such designations seem to us to be just as misleading as describing sprats as sardines when they are packed in oil. Again, quarry-owners and contractors for road-metal claim that any stone used for this purpose may be described as "granite," with the result that limestones or other inferior rocks for road-making are purchased by local highway authorities under the impression that they are obtaining true granite. We make no claim to impose specific scientific terms upon the common vocabulary or the labels of commerce, but we are sure that the trade custom of describing one thing as another of a superior class cannot be justified by any satisfactory standards of precision or ethics.

THE ROYAL SOCIETY CONVERSAZIONE.

THE first of this year's conversaziones of the Royal Society was held at Burlington House on May 8, and was, as usual, largely attended. Many objects and experiments relating to recent work in science were on view, and in the course of the evening short demonstration lectures were given by Mr. C. V. Boys on soap bubbles, the Hon. R. J. Strutt on active nitrogen, particularly as to the striking effects of pressure and temperature on active nitrogen, and Dr. J. S. Haldane on mountain sickness and acclimatisation to high altitudes.

We are unable to find space for a list of the numerous exhibits, but we extract from the official catalogue a few descriptions of some of the chief objects of interest.

ANTHROPOLOGY.—*Mr. W. Dale:* Palæolithic flint implements from the gravel beds of the River Test at Dunbridge, Hants, at about 100 to 150 ft. above Ordnance datum. The implements are diverse in form and in the character of their patination. A marked feature is the presence of pointed forms quite unwater-worn, which have acquired the white colour of the upper part of the gravel. These are taken as dating the gravel, and assigned to the St. Acheul period. The largest and most pointed is even considered to belong to a later and transitional period. In the same gravels are found older and water-

worn forms, which must have travelled from higher levels.

Sir Ray Lankester, K.C.B.: Flint implements from beneath the Red Crag of Suffolk. Many worked flints of a previously unknown shape, viz. that of an eagle's beak (rostro-carinate) and of other forms, have been discovered by Mr. Moir, of Ipswich, in the bone-bed of the Suffolk Crag. Several of these were exhibited, and also three rostro-carinate flint implements from the mid-glacial sands of Suffolk. Both the Red Crag sea and that of the mid-Glacial period swept these implements from an old Suffolk land surface. Those from below the Red Crag are of Pliocene, and possibly of Miocene, age.

NATURAL HISTORY.—*Dr. H. B. Fantham and Dr. Annie Porter: Nosema apis*, the parasite of Isle of Wight disease in bees. This pathogenic protozoon was discovered in 1906 by the exhibitors, and shown experimentally by them to be pathogenic, not only to hive bees, but also to wasps and mason bees. The parasite, which belongs to the Microsporidia, is allied to the organism causing pébrine in silkworms.

Mr. H. R. A. Mallock, F.R.S.: Apparatus for showing the disappearance of iridescent colouring under mechanical pressure. The coloured scales are placed between a flat plate and lens of quartz on the stage of a microscope and viewed during the process of compression with a low-power objective. The scales in the compressor were from Ornithoptera Poseidon. These are bright green by reflected light, but appear red when the light is transmitted. On applying pressure to a scale the colour first changes and then disappears, thus showing that its origin is due to the structure of the scale and not to colouring matter.

Dr. C. J. Patten: A selection of specimens and photographs illustrating some features in bird migration as observed during eight weeks' residence at the Tuskar Rock Lighthouse, Co. Wexford. The following points are noteworthy:—first, that in a comparatively short period, several rare birds—some new to Ireland—have been secured, which, had they reached the mainland, might never have been recorded; secondly, that birds supposed by some observers not to migrate, or at most to do so in a very desultory manner, have been found migrating in considerable numbers together; and thirdly, that remarkable variations in size and plumage may be seen in some species.

Prof. E. B. Poulton, F.R.S.: Butterfly mimicry and mutation. It has been argued, especially by Prof. Punnett, that the mimetic patterns of butterflies arose, ready-made and complete, by a sudden "mutation." The examples which he has specially mentioned are the mimetic females of the African *Papilio dardanus* and the two mimetic forms of *Euralia wahlbergi*. The exhibited series shows (1) the gradual origin of mimicry in the former, through the transitional form *trimeni* leading from the pattern of the non-mimetic females in Madagascar and Abyssinia to the mimetic *hippocoon* female; (2) the existence of a roughly mimetic representative of the two mimetic forms of the Euralia, in an allied species, *E. dinarcha*, and of intermediates which breed true, and are therefore not hybrids (heterozygotes), in a still more closely allied Euralia: all these bred by Mr. W. A. Lamborn in the Lagos district; (3) the four sharply separated mimetic patterns of a Pseudacræa, collected by Mr. C. A. Wiggins at Entebbe, connected by intermediates and running into one another on the islands in the Victoria Nyanza, where the Acræine models are relatively scarce. The latter collected by Mr. G. D. H. Carpenter.

ASTRONOMY.—*Dr. Percival Lowell (Lowell Observatory, U.S.A.):* (1) Spectroscopic discovery of the rotation period of Uranus. Two enlarged copies of two (out of seven measured) of the original spectrograms taken in September, 1911, by Dr. V. M. Slipher, one with the camera to the west, one with it to the east, of the telescope, thus reversing the direction of the tilt. The spectrum of Uranus appears in the middle flanked by the two comparison spectra. The slit was parallel to the satellite's orbital planes. Measurement of the original negatives gives a rotation spin of 10h. 45m. retrograde. (2) Autumnal morning hoar-frost on Mars. Enlarged positives from the original negatives of Mars, taken November 14, 1912, 39° of longitude apart, showing hoar-frost on sunrise edge of the disc 30° to right of topmost point. The hoar-frost was studied for two months, and a memoir is in course of publication. Theory shows that 60° latitude is exactly where it should first have appeared. (3) Halley's comet: last appearance. Photographs with the 40-in. Lowell reflector by Mr. C. O. Lampland, on May 23, 27, and 30, 1911; also positive showing the positions in which the comet was photographed by him up to June 1 inclusive. These are the last views got of the comet as it left. (4) Comet Brooks, 1911. Objective-prism spectrogram taken on October 28, 1911, and November 2, 1911, show monochromatic images of the comet, and register the fact that the tail was composed almost entirely of carbon monoxide, while the hydrocarbons and cyanogen were conspicuous in the head.

Prof. H. F. Newall, F.R.S.: Photographs of the spectrum of Nova Geminorum, taken at Cambridge Observatory. Nova Geminorum was discovered by Enebo on March 12, 1912. It was not recorded at Harvard College Observatory on plates taken on March 10, but appeared as a star of fifth magnitude on a plate taken on March 11. Since its first maximum brightness (magnitude about 3·0) the star has faded, with fluctuations, to magnitude 5·0 on March 18, magnitude 6·0 on April 1, 7·0 on April 15. The photographs of spectra exhibited have been prepared from negatives picked out of a series of forty plates secured by Mr. Stratton on thirty-six nights, between March 15 and April 29, with the two-prism spectrograph attached to the 25-in. equatorial, with exposures varying from twenty-five minutes to five hours. They illustrate the rapid changes in the nature of the light emitted, especially in the first ten days after the outburst of the star on March 11.

PHYSICS.—*The National Physical Laboratory:* Apparatus for measuring the visibility of point sources of light. (*Exhibited by Mr. C. C. Paterson and Mr. B. P. Dudding.*) The apparatus contains a pin-hole of known area with a flame of known intrinsic brightness behind it. The intensity of the transmitted light can be varied at will by calibrated absorption wedges placed in the beam to the observer's eye, the combination forming a variable standard point of light of known candle-power. The distant source of light is seen in the same field of view as the standard point source, and the latter is adjusted to be equal to it in brightness. There are arrangements for illuminating the background of the standard pin-hole when observations are being made on nights which are not quite dark. The lower limit of visibility is that of a point source of about one ten-millionth of a candle one metre from the eye of an observer.

Mr. C. T. R. Wilson: (1) Apparatus for making visible the tracks of ionising particles by vapour condensed upon the ions set free along the paths. (2) Cloud photographs showing the nature of the ionisation produced by different kinds of rays. By the sudden dropping of the floor of a cloud chamber,

the moist air within it is cooled sufficiently to make water condense on any ions which may be present, no appreciable stirring of the air resulting from the expansion. Ionising particles passing through the air leave visible trails, consisting of cloud particles condensed on the ions.

CHEMISTRY.—*Sir W. Crookes, O.M.:* Properties of pure fused boron, and the volatility of metals of the platinum group. Pure fused boron, prepared by Dr. Weintraub by decomposing a volatile boron compound in the electric arc, is deposited on water-cooled copper electrodes. The agglomerated boron condenses in a crystalline form. Pure boron can be fused in a mercury arc furnace. It is very hard, and easily scratches quartz and corundum. The most remarkable property of pure fused boron is the abnormal value of its temperature coefficient of resistance. Between ordinary room temperature and a dull red heat the resistance drops in the ratio of 2×10^6 to 1. A small piece of fused boron mounted in series with an electric lamp, at room temperature, obstructs nearly all the current. Warming the boron reduces the resistance, and the lamp lights. Platinum, in the form of very thin ribbon, heated for many hours to a temperature approaching its melting point, sublimes and deposits beautifully formed crystals on the surrounding vessel. Iridium is more volatile than platinum at a high temperature. A plate of pure iridium, after having been heated for twenty-two hours at 1300° C., has a beautiful "moirée" surface. A crucible of iridium, showing signs of crumbling after long heating, was exhibited.

Messrs. Carl Zeiss (London), Ltd.: Apparatus for demonstrating liquid crystals with polarised light (projection on screen). This instrument consists of an automatic feeding arc lamp of 5 amperes, condensing lenses, water cooler, mounted on optical bench, a microscope, with specially wide body tube situated on the end of optical bench in upright position, and provided with a blow-pipe arrangement and air blast for the purpose of heating chemical preparations to a temperature up to 800° C. Analyser and objectives are provided with cooling chambers, and the object stage is arranged with electric terminals for passing a current across the stage. A specially constructed polariser is fitted below the object stage possessing a large aperture as compared with its length.

ENGINEERING.—*Mr. J. Dewrance:* An adhesion pump. A viscous fluid enters by gravity a shallow spiral channel cut on a revolving surface that is held against the smooth surface of a corresponding chamber. The fluid adheres to both surfaces, and progresses along the channel and is delivered at the other end at considerable pressure.

Prof. E. G. Coker: Special polariscope for examining engineering models under stress. The polariscope is constructed for examining long transparent models of engineering structures by circularly polarised light. Plane polarised light, obtained by reflection from a black glass plate, is afterwards circularly polarised by large quarter-wave plates of mica. The object under stress is viewed through an analyser constructed of glass sheets, and a model, 40 in. by 10 in., can be viewed at one time without the aid of Nicol's prisms.

Dr. J. G. Gray and Mr. G. Burnside: (1) Continuous-current motor-gyrostats for the demonstration of the properties and practical applications of the gyrostat. The gyrostats, which are motors of the Gramme Ring type, are provided with accessories for demonstrating the properties and practical applications of the gyrostat. Experiments (both qualitative and quantitative) can be carried out with convenience and precision. (2) Walking and climbing gyrostats. Motor-gyrostats are mounted in various ways within wooden boxes. By operating the gyrostats by means of electromagnets, the boxes, which are provided with arms and legs, are caused to walk on the floor and to walk arm over arm along wires stretched horizontally.

NOTES.

AT a meeting of the London Section of the Deutsche Kolonial-Gesellschaft on May 11, Dr. A. Smith Woodward gave an address on the significance of the recent discoveries of Cretaceous Dinosauria in German East Africa. Since 1909 excavations have been in progress in the Tendaguru Hills, under the immediate supervision of Prof. W. Janensch and Dr. E. Hennig, and an appeal is now being made for funds to proceed with a fourth year's work. In describing the results, so far as he had seen them in the Berlin Museum, Dr. Woodward emphasised the importance of an exhaustive comparison of the sauropodous dinosaurs of Africa with those of North America, which would now soon be possible. He also alluded to the problems suggested by the gigantic size of some species, which much exceeded the extreme limit of growth calculated to be possible by the late Prof. Marsh when he first discovered the femur of Atlantosaurus. Prof. W. Branca sent for exhibition to the meeting a plaster cast of the humerus of Gigantosaurus, 2·10 metres in length, which is shortly to be placed in the British Museum (Natural History); while Prof. Janensch lent an important series of photographs which he had taken at different stages during the excavations. The German society is to be congratulated on its enlightened interest in purely scientific work undertaken in a colonial possession, and English science will appreciate the compliment paid to one of its exponents by his being invited to deliver the address in question.

PROF. FRÜHLING, who died at Brunswick on April 24, at seventy-one years of age, did much towards enabling young men engaged in practical sugar work to obtain a scientific training. After graduating in 1866 with a thesis on the nitric acid contents of agricultural crops during the various periods of their growth, he started, in 1870, a public analytical laboratory, and two years later added a department at which instruction in sugar work was given. This "Schule für Zucker-Industrie zu Braunschweig" has flourished ever since, and been attended by students from practically every sugar-producing country in the world, among them being fourteen Englishmen. His "Anleitung," or methods of analysis for all products connected with the sugar industry, has been translated into several foreign languages; in 1911 it reached its seventh edition. He also published an "Anleitung," or laboratory guide, for soil analysis, and edited Stammer's pocket calendar for sugar manufacturers since 1894. The majority of sugar factories in the north of Germany retained him as their official analyst. He also invented several useful pieces of apparatus, which have been adopted for sugar work in a large number of Continental sugar laboratories.

PROF. POYNTING being unable to deliver his lectures at the Royal Institution on May 30 and June 6, the lectures on those dates will be given by Prof. C. G. Barkla, F.R.S., upon the subject of "X-rays and Matter."

THE final meeting of the British subcommittee of the Anton Dohrn Memorial Fund Committee was held on Wednesday, May 8, in the University of London. The hon. treasurer, Prof S. J. Hickson, presented the accounts, and stated that after all expenses had been paid there was a balance in hand amounting to 163*l*. 18*s*. 9*d*. It was resolved that the account of the British subcommittee be closed, and the balance forwarded to the treasurer of the International Committee.

A CORRESPONDENT of *The Times* states that last week the Italian naval and military authorities, who have been carrying out experiments in wireless telephony, established communication between Monte Mario and the wireless station of Becco di Vela, on Maddalena Island, a distance of about 160 miles. A long extract from a newspaper was read in Rome and heard and repeated at Maddalena. The voices were perfectly distinct, so much so that the listener in Sardinia detected immediately the substitution of a different speaker half-way through the message.

WE are officially informed that the post of Inspector-General of Agriculture in India has been combined with that of the director of the Agricultural Research Institute and principal of the Agricultural College, Pusa, under the designation of Agricultural Adviser to the Government of India and Director of the Agricultural Research Institute, Pusa. All communications, publications, &c., intended for either of the two offices should therefore be addressed to the Agricultural Adviser to the Government of India and Director of the Agricultural Research Institute, Pusa. The designation of the post of Assistant Inspector-General of Agriculture in India has also been altered to the Assistant to the Agricultural Adviser to the Government of India.

THE London Institution (Transfer) Bill—or, to give the full title, "A Bill to provide for the transfer to the Commissioners of Works of certain property of the London Institution for the purposes of a School of Oriental Studies, and for the dissolution of the Institution, and for purposes in connection therewith"—has now been circulated. It is proposed that the property and funds of the institution shall be transferred to the commissioners, and that certain books and manuscripts will be retained by the institution. There will be paid to the institution, in consideration for the vesting of the property in the commissioners, 12,000*l*. out of moneys provided by Parliament. The books and manuscripts retained by the institution are to be transferred to such public institutions as may be determined by the committee of management. The institution will eventually be dissolved, and the charter of the institution revoked. The sums of money to be paid to the proprietors of the institution to discharge their shares are specified in a schedule to the Bill.

THE Colonial Office has issued a memorandum announcing that from July 1 the Sleeping Sickness Bureau will be known as the Tropical Diseases Bureau. The Sleeping Sickness Bureau had its origin in the International Conference on Sleeping Sickness held in London in 1907 and 1908, to concert measures for the control of that disease, which was spreading rapidly in tropical Africa. After its establishment it soon became evident that what the Bureau was doing for sleeping sickness could be done in the same way for tropical diseases generally. Lord Crewe, during his term of office as Secretary of State for the Colonies, and Mr. Lewis Harcourt have interested themselves in the expansion of the Bureau, and the arrangements are now completed. The expansion entails increased expenditure, and the annual available sum is now approximately 5000*l*. The Bureau, having outgrown the accommodation provided by the Royal Society, will have its quarters at the Imperial Institute. The new Bureau will deal with all exotic diseases which are prevalent in tropical and subtropical regions, and will publish at frequent intervals a *Tropical Diseases Bulletin*, which will take the place of the present *Sleeping Sickness Bulletin*. The director will have the help of an assistant director and a number of experts, who will be responsible for the different subjects, and will furnish authoritative reviews and summaries of published papers, to appear in the *Bulletin*. Thus the results of the most recent researches on every tropical disease in every country, new methods of treatment, improved means of prevention, will quickly become available for the remote worker in the tropics. The tropical diseases of animals will be treated in a separate publication.

MANY ethnologists are probably unaware of the important collections possessed by Marischal College, Aberdeen. These have now been rearranged and described in an admirable and well-illustrated catalogue, the work of the curator, Dr. R. W. Reid. At the present time, when proposals for the establishment of a folk museum are under consideration, it may be remarked that this class of objects is very fully represented at Aberdeen. Besides a fine collection of prehistoric objects, the museum is particularly rich in specimens of those domestic and rural implements and appliances which are rapidly passing into disuse and will soon be unprocurable. Thus there are numerous examples illustrating the arts of spinning and weaving, rude agricultural implements, household utensils, such as crusie lamps, the "puirman" for holding pine splinters used for illumination, and many others of equal interest. Of special importance is the marshal staff of Scotland, presented in 1760 by George, tenth and last Earl Marischal, great-great-grandson of George, fifth Earl Marischal, who founded the college in 1593.

THE Report of the Bacteriologist and Bulletins Nos. 8, 9, and 10 of the State Board of Agriculture, Michigan, dealing with various bacteriological subjects, which have been sent us, indicate how actively agricultural biology is being applied in the United States to the elucidation of practical problems, *e.g.* diseases of stock, the treatment of hog-cholera with a serum, soil and dairy bacteriology, and so on.

WE have received a report to the London School of Tropical Medicine on dysentery in Fiji during the year 1910, by Dr. P. H. Bahr, who was sent out specially to investigate the disease by funds generously provided by Lord Sheffield and Mr. E. W. Blessig. The disease in Fiji is of bacillary origin, and a number of varieties of the dysentery bacillus were isolated. Evidence is adduced that the housefly is the principal agent in its spread. Treatment with a polyvalent anti-dysentery serum seemed to give the best results. The report is a very valuable one, and is well illustrated.

EVER since 1857 British coleopterists have been on the look-out for *Claviger longicornis*, a species not uncommon in ants' nests on the Continent. Certain beetles taken in Oxfordshire in 1906 prove, according to Mr. J. J. Walker, in the May *Entomologists' Monthly Magazine*, to belong to the missing species.

THE migratory British species of Salmo—in other words, salmon and trout—form the subject of a very fully illustrated article by Mr. Boulenger in *The Field* of May 4. Figures are given of the age-phases and the adults of the two sexes of both species at different seasons, and likewise of some of the supposed local species of the trout.

ACCORDING to the third part of the *Bergens Museum Aarbok* for 1911, Norway experienced fourteen shocks of earthquake during 1910. The most severe was that of July 26, which was felt from Gildeskaal to Mo in Rauen. Four occurred in the earthquake district in Nordre Bergenhus Amt, on the west coast, another four in the disturbed district between southern Søndre Bergenhus Amt and Ryfylke in Stavanger Amt, two in the northernmost seismic area, and the remainder, which were all local, in districts usually free from disturbance.

IN *The Field* of May 4 is recorded the birth of an Indian elephant calf at Copenhagen on April 6th, this being the offspring of the same parents which produced a calf in 1907. It is the third recorded instance of such an event in Europe. In the case of the first Copenhagen calf the gestation period was twenty-three and in the second twenty-one months. Both calves showed black bristles on the back, but not apparently the coat of fine hair which was present in the calf born in London in 1903, the skin of which is mounted in the Natural History Museum.

DR. MARK JANSEN has published, in a brochure entitled "Achondroplasia: its Nature and its Cause" (Leyden: E. J. Brill, Ltd., 1912), the results of his studies on the phenomena exhibited by human dwarfs. He suggests that these phenomena may be due in part to abnormally high amnion pressure during certain stages of development, which may disturb the nutrition and growth of part of the fœtus without interfering with the normal development of other parts of the body. He also discusses the influence of the pituitary body and the phenomena of acromegaly.

THE April number of the *Quarterly Journal of Microscopical Science* (vol. lvii., part iv.) contains important additions to our knowledge of two of the smallest and at the same time most interesting groups of the animal kingdom. Mr. E. S. Goodrich gives a full account of the anatomy of the worm *Nerilla antennata*, hitherto regarded as a small Polychæte, and shows that it is really an Archiannelid. It occupies a central position amongst the somewhat heterogeneous members of that group, which it thus serves to bind together, and at the same time it in some measure bridges over the gap which separates the Archiannelida from the more highly organised Polychæta. Mr. C. L. Boulenger describes a new species of fresh-water medusa, *Limnocnida rhodesiae*, from Rhodesia. This form, which is very closely related to the well-known *Limnocnida tanganicae*, of Lake Tanganyika, was discovered by Mr. R. H. Thomas, in a tributary of the Hunyani River, which itself flows into the Middle Zambesi.

AN important contribution towards a complete flora of the Chinese Empire has been published in the *Kew Bulletin*, Additional Series, No. 10, by E. T. Dunn and W. J. Tutcher, the former and present superintendents of the Botanical and Forestry Department at Hongkong. This consists of an account of the flowering plants, ferns, and fern-allies of Kwangtung, the southernmost province of China, and of Hongkong itself. The short introduction to the flora deals with the climate, geology, and ecology of the area. This is followed by a key to the natural orders, which is skilfully worked out, and will prove of great use to students of general systematic botany apart from its special purpose—that of enabling collectors in China to determine their plants. Keys are also given to the genera of each order and to the species of each genus, and the bulk of the work is occupied by an enumeration of the species. The price of this Flora, which contains 370 pages, is 4*s*. 6*d*.

DR. C. E. MOSS, curator of the Cambridge University Herbarium, who some time ago published a critical account of the British oaks, has just contributed to *The Gardeners' Chronicle* (Nos. 3718–3720) a much-needed revision of the British elms. After a critical discussion of the various species, varieties, and hybrids of the genus as represented in Britain, the author gives a concise key and conspectus of these forms. Of the five species noted, the Wych Elm (*Ulmus glabra*), the Smooth-leaved Elm (*U. nitens*), and the Small-leaved Elm (*U. sativa*) are regarded as being indigenous, while the English Elm (*U. campestris*) and the Cornish Elm (*U. stricta*) are not indigenous. Of the two *U. glabra* × *U. nitens* hybrids, the Dutch Elm (×*hollandica*) and the Huntingdon Elm (×*vegeta*), the former appears to be native in some localities. The Jersey Elm is described as a new variety (*U. stricta*, var. *sarniensis*, Moss). The articles are illustrated by photographs of herbarium specimens, and will undoubtedly be of great assistance to field botanists in the determination of the British elms, which have for so long remained in almost hopeless confusion.

WE have received, by the courtesy of the director, an advance copy of No. 1 of the new issue of the Bulletin of the Imperial Institute, the publication of which has been undertaken by Mr. John Murray. The

great activity in tropical planting enterprise in recent years has resulted in a large demand for this quarterly bulletin, which is now considerably enlarged, and will be the means of publishing the results of investigations of new raw materials from the Colonies and India carried out at the institute, and recent information regarding developments in tropical agriculture generally. This number (vol. x., No. 1) contains a concise introductory article on the history and activities of the institute, followed by articles dealing with the rubber resources of Uganda, the cultivation of cotton in Nyasaland and Uganda, the large deposits of diatom earth in East Africa, hemp and hemp seed, cultivation and preparation of ginger, and the first part of a long and detailed account of the cocoanut and its commercial uses—to mention only a few of the interesting papers in this issue of nearly 190 pages. A large number of reports on investigations of new Colonial products are included, and a special section of the bulletin is devoted to giving an account of recent developments of tropical agriculture throughout the world.

THE pupils of Ferdinand von Richthofen have agreed to publish annually a collection of geographical memoirs under the title of "Mitteilungen des Ferdinand von Richthofen-tages," to commemorate their master, who passed away in 1905. The first part, issued by Teubner, of Leipzig, for 1911, appropriately contains three papers on China, that by M. Groll dealing with the progress that can now be made in the production of a general map of the country. The greatest difficulty still lies in the absence of details as to the relief. It seems unfortunate that these papers cannot be published as special contributions to one of the recognised geographical journals.

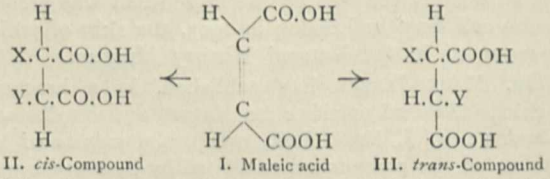
FROM the issue of December last of the *Monthly Weather Review* of the Department of Marine and Fisheries, Canada, some interesting details are given of the highest and lowest temperatures in each province of Canada during that month. The highest temperature recorded was 65° at Alix, Alberta, on December 3, and the lowest was −59° on December 28, at Fort William, in the same province. Other low temperatures recorded during the month were −51° at the Pas, Saskatchewan, on December 29, −50° at Swan River, Manitoba, on the same day, when −40° was recorded at Fort St. James, British Columbia.

THE separately issued appendix No. 3 to the report for 1911 of the U.S. Coast and Geodetic Survey gives particulars of the magnetic observations made during the year ending at midsummer, 1911. Of the 351 land stations occupied during the year, seventy-one were old or "repeat" stations, and particulars are given of the values derived for the secular change of declination at these. Table I. summarises the results of the observations at the land stations, including nearly sixty stations along the Alaskan boundary, seven in Hawaii and one in British Columbia. Table II. gives particulars of observations made at sea, in both the Atlantic and Pacific Oceans, by three vessels attached to the Survey. The last fifty-nine pages are occupied with a description of the land stations and their exact positions.

THE March number of the Journal of the Institution of Electrical Engineers contains a summary of the theory of the production of electric oscillations by Mr. A. S. M. Sorensen. After two short paragraphs dealing with oscillations in a single circuit having capacity and inductance, and in coupled circuits, he points out that in actual practice the capacities and inductances are not concentrated at particular points of the circuits nor are resistances and damping constant. In the case of an arc in circuit he shows how by the aid of the "characteristic curve" of the arc the main features of the oscillations produced in the three most important cases can be traced without the necessity of appeal to the differential equation of the circuit.

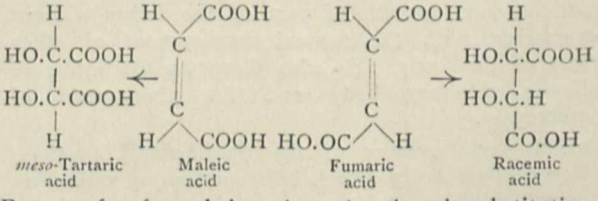
A YEAR ago Dr. K. Fredenhagen, of the University of Leipzig, described in the *Physikalische Zeitschrift* some measurements he had made of the currents produced by the electrons emitted by metals at high temperatures. At the time he believed his results were free from secondary effects, but more recent work on the alkali metals distilled and tested in high vacua has, according to a short communication to the German Physical Society published in the *Verhandlungen* for April 15, convinced him that the whole of the current observed in such cases may be due to the reactions taking place between the metal and the trace of gas still present even in the highest vacua. Since the velocities of such reactions would follow exponential laws as the temperature increased, the currents obtained would be expressed by Prof. Richardson's formula.

IN his presidential address to the Chemical Society, reprinted in the April number of the Journal, Prof. Frankland has directed attention to the extreme frequency with which the rupture of a "double bond" is accompanied by "*trans*-substitution." It has usually been thought that the addition of a substance XY to a compound such as maleic acid must result in the production of the *cis*-compound II., in which the radicals X and Y occupy the same positions as the ends of the broken bond.



II. *cis*-Compound I. Maleic acid III. *trans*-Compound

This view was confirmed by the oxidation of maleic acid to *meso*-tartaric acid and of fumaric acid to racemic acid.



meso-Tartaric acid Maleic acid Fumaric acid Racemic acid

But, so far from being the rule, the *cis*-substitution shown above appears to be entirely exceptional, since

it rarely (if ever) occurs except in the special case of oxidation. These facts are of considerable importance, as they throw doubt on the assumption, which is almost universally made, that a substituent group normally enters the same position as the atom or linkage which it displaces.

THE seventy-eighth annual report of the Natural History, Literary, and Polytechnic Society of Bootham School, York, for 1912, is noteworthy as providing evidence of the enthusiasm for scientific work which can be developed among schoolboys when qualified masters of a boarding-school are willing to devote part of their leisure hours to what is nearly always entirely a labour of love. The Natural History Society has some eleven sections, each devoted to a separate science, and excellent practical work was done in them all during the year under review.

A CONVENIENT card for hanging in offices, entitled "Standard Metric Equivalent Tables, comprising Weights, Measures, and Prices in Francs and Marks," has been published by the Central Translations Institute, Eastcheap, London. The equivalent prices in francs and marks per foot, yard, square yard, cubic foot, gallon, and similar British units will be very handy for merchants. The price of the card is 1*s.* 2*d.* post free.

A NEW and cheaper edition of "The Grouse in Health and in Disease" is in the press, and will be published in July next by Messrs. Smith, Elder and Co. In the absence of Dr. E. A. Wilson in the Antarctic, the book has been edited by Mr. A. S. Leslie and Dr. E. A. Shipley, and Lord Lovat has contributed an introduction.

OUR ASTRONOMICAL COLUMN.

REPORTED DISCOVERY OF A NEW COMET.—We learn, from *The Daily Mail* of May 14, that the following telegram has been received at the Greenwich Observatory:—"A comet-like object with a tail has been observed by Mr. Hansen at Praestoe, Denmark. It is of intense magnitude, and its position, given on May 10 at two o'clock, was R.A. 20h. 53m. 20s.; decl. 31° 24′ N."

Probably the first statement of the second sentence should read, "It is of *the tenth* magnitude," for we are told that it is not visible to the naked eye. The position given lies about half-way between ζ and ϵ Cygni, and is on the meridian at about 5 a.m.; that is to say, it is above our horizon during all the hours of darkness.

The origin of the above telegram is not stated, and, so far, we have received no intimation of the discovery from the Kiel Centralstelle.

THE ROTATION OF URANUS.—When the axis about which a planet revolves makes a considerable angle with the observer's line of sight, the rotational motion can be detected, or even measured, spectroscopically, because as the planet rotates some regions of its limb must be travelling towards the observer, while others are travelling away from him. At the present epoch the orientation of Uranus is favourable to such an investigation, and spectrograms giving a measure of the planet's rotational velocity, secured at the Lowell Observatory, were exhibited and explained by Prof. Lowell at the recent meeting of the Royal Astronomical Society. On these spectrograms the lines are inclined because the slit was so placed that at the top was the approaching limb, while at the bottom was the receding limb. Thus, in accordance with Doppler's principle, the extremities of the lines were displaced towards the violet and the red respectively, that is to say, they are inclined to the normal lines of the comparison spectrum photographed on the same plate. Measures of the inclination of a number of these lines, on different photographs, indicate that the planet makes one complete rotation in about 10h. 45m.

THE RECENT SOLAR ECLIPSE.—A large number of communications describing the observations made during the solar eclipse of April 17 are published in No. 4571 of the *Astronomische Nachrichten*.

Observations of the bright-line spectrum were made by Drs. Eberhard and Ludendorff at Berlin, and, like Prof. Fowler at South Kensington, and Prof. Iñiguez, Prof. Eberhard found that he was able to study the bright lines for quite half an hour. Dr. Kempf found that the first and last contacts took place 0·4m. earlier than predicted by the *Berliner Jahrbuch*, while at Lemberg, Dr. Grabowski found they were, respectively, 0·3m. and 0·6m. earlier. Quite a number of observers remark on the unexpected darkness of the eclipse and its observed effect on various flowers (especially tulips), beasts, and birds.

M. Felix de Roy gives a very interesting account of the observations made by the mission organised by the Antwerp Astronomical Society, and located at Silenrieux (Hainaut, Belgium), where a true annular eclipse was seen. The inner corona was seen by one observer only, and the chromosphere and prominences were looked for in vain. Among the observers of contacts at the Kiel Observatory was Prince Henry of Prussia.

THE ORIGINS OF THE BRIGHT LINES IN NOVÆ SPECTRA.—At the meeting of the Royal Astronomical Society, reported in the current number of *The Observatory* (No. 448), a number of spectra of Nova Geminorum were exhibited on the screen and afterwards discussed. Prof. Fowler, after remarking on the unfavourable weather experienced at South Kensington, exhibited two small-dispersion spectra obtained on March 15 and 29 respectively, and stated that as regards the origins of the lines, those assigned by Sir Norman Lockyer to the lines observed in the spectrum of Nova Persei (1901) would probably serve. The bright lines appearing in novæ also appear in the chromosphere and solar prominences, and are mainly those of the enhanced iron spectrum. Prof. Newall also agreed that many of the bright lines may be identified as enhanced lines of iron.

Dr. R. H. Curtiss describes the early spectra secured at the Ann Arbor (Mich.) Observatory, in No. 3, vol. xxxv., of *The Astrophysical Journal*. Five photographs taken on March 13 show a continuous spectrum similar in general appearance to that of Altair, but differing in the positions of the lines. Few narrow dark lines were seen, and all the prominent lines of the F5 type, *e.g.* λ4481 and λ4549, appear to be absent. Hδ, Hγ, and Hβ are all strong lines and very complex, both absorption and emission being represented; lines at λ5016, λ4922, and λ4472, and the H and K lines of calcium have similar characteristics, the sharp reversals in the latter indicating a velocity of +5 km. ±3 km. On a photograph taken on March 22 many of the maxima of emission on March 13 were maxima of absorption, and *vice versa*, and no certain trace of the nebula lines was to be seen.

THE IRON AND STEEL INSTITUTE.

THE annual spring meeting of the Iron and Steel Institute was held at the Institution of Civil Engineers on Thursday and Friday of last week. Besides the presidential address, and the ceremonies of presenting the Bessemer medal to Mr. Darby and the Carnegie medal to Prof. Goerens, of Aachen, the meeting had to consider an exceptionally long and interesting list of papers covering a very wide range of subjects, and therefore likely to appeal to both the practical and the scientific members of the institute. The complaint is sometimes heard among the practical members of the institute that there are too many papers of a scientific character, and that discussions on scientific metallurgy, and more especially on metallography, are out of place at the institute. Such a view is surely unduly narrow, since the ultimate benefit of the steel industry must go hand-in-hand with the development of those branches of science which are more intimately connected with steel. It is true, of course, that a discussion on the constitution of hardened steel may not be of immediate and direct interest to the manager of a rolling-mill, but even for him the time will come when he must ask for scientific guidance in some new difficulty, and the value of the aid which can be given him will depend upon the accuracy and completeness of our theories on the constitution and transformations of steel.

Even the obvious fact that "professors" disagree need not alarm the practical man—the "professors" only discuss the few outstanding points upon which divergences of opinion exist—upon the main body of their scientific knowledge they are so completely in agreement that they would no more discuss it than the multiplication table. Where men are working to advance the outposts of our knowledge, divergent views are bound to arise, and vigorous discussion is needed to sift out the truth, but the practical man will make a great mistake if he interprets these discussions as implying uncertainty as to the main body of the science.

These considerations have been raised at the recent meeting because the entire afternoon of Thursday was occupied by the discussion—at times of a vigorous character—of scientific subjects, the constitution of steel and the nature and mechanism of corrosion being the two principal questions. On the former, Prof. Arnold, of Sheffield, contributed two short papers, which formed the subject of strong criticism by both Dr. J. E. Stead and Dr. W. Rosenhain. Prof. Arnold cannot yet reconcile himself to the equilibrium diagram of the iron-carbon system and to the attached nomenclature which has found general acceptance by the great majority of metallurgists; he points out, with obvious correctness, that the diagram in question does not explain the difference between the same steel when quenched from a moderate and correct hardening temperature, and when quenched from an excessively high temperature, which still lies in the same "field" of the diagram. That, however, is a criticism on the value of such diagrams in general, and not on the correctness of the particular example, and similar points could be raised concerning most of the well-established diagrams. The conclusion is evident that equilibrium diagrams, although they possess a very considerable value in their own special direction, cannot tell us everything about the behaviour of metals and alloys. Stable equilibria, which can alone be properly indicated on these diagrams, are comparatively rarely met with in metals as used in practical work, and the equilibrium diagram must therefore be regarded as a basis for the study of those more complex conditions which arise when meta-stable and labile conditions have to be considered.

The subject of corrosion was dealt with in three papers, one—on the influence of carbon on the corrodibility of iron—by Mr. C. Chappell and two, on the mechanism of corrosion and on the corrosion of nickel, chromium, and nickel-chromium steels, by Messrs. J. Newton Friend, J. Lloyd Bentley, and Walter West. The results obtained by the first-named author indicate that an increasing proportion of pearlite in rolled, annealed, and "normalised" steels causes increasing corrosion up to that concentration at which the steel consists entirely of pearlite, while an increase of carbon beyond that point appears to cause a reduction of corrosion, but only one hyper-eutectoid steel has been studied in the paper. In quenched steels, on the other hand, a continuous increase of corrosion appears to accompany increasing carbon-content.

The paper on the mechanism of corrosion by Dr. Friend and his collaborators is particularly interesting, as some rather unexpected sources of error in corrosion tests carried out in tanks of still water in the laboratory are indicated. These errors arise from the fact that there appears to be a "corrosion zone" around any piece of corrodible metal immersed in water, and throughout this zone there is an oxygen concentration gradient; if now the specimen under test is placed close enough to the walls of the vessel to allow these walls to lie within the "corrosion zone," then the rate of corrosion will be apparently diminished. In the case of bright surfaces of pure iron, the radius of the corrosion zone appears to be approximately equal to the linear dimensions of the specimen, so far as small laboratory specimens are concerned. In their study of the corrosion of nickel and chromium steels, the same authors suggest that the corrodibility of such steels is affected by two opposite factors; the galvanic action between such substances as cementite in ordinary carbon steels and the complexes containing nickel and chromium in the alloy steels on the one hand, and the more corrodible ferrite on the other, tends to increase with the addition of such metals as nickel or chromium, but this tendency to increased corrosion is counteracted by the fact that the presence of these incorrodible substances themselves affords a considerable mechanical protection against corrosion. These two factors are differently affected when acceleration tests are made in acids, so that these become untrustworthy for alloy steels. The most striking positive result obtained is the resistance of chromium steels to sea-water corrosion, and the authors consider that the "application of chromium steels in the construction of ships would be justified on this ground alone."

A particularly interesting and somewhat novel feature at the present meeting was formed by a group of four papers dealing with the ancient metallurgy of iron, both in the East and in England. Prof. T. Turner describes the "ham bones" found in the neighbourhood of Walsall, in Staffordshire, and discusses their probable mode of origin, while Sir Hugh Bell presents an account of a bloom of Roman iron found at Corstopitum (Corbridge), the investigation of this material by Prof. Louis and Dr. Stead being described. The conclusion appears to be established that this mass of iron is built up of small blooms obtained by a "direct" process from the local ore. The purposes ascribed to the object as found vary from a stake anvil to a battering-ram. Mr. H. G. Graves contributes an interesting note on the early use of iron in India, describing some of the large masses of iron utilised in the construction of certain

ancient temples. Finally, Sir Robert Hadfield's account of "Sinhalese Iron and Steel of Ancient Origin" throws an interesting light on the materials and methods in Ceylon many centuries ago, particularaly in the production of steel tools and implements. We hope to give a separate abstract of this paper in a later issue.

The exceptionally full and interesting programme of the meeting is completed by a series of valuable papers dealing more directly with steel manufacture, including an historical survey of forty years' progress of the industry by the president (Mr. Arthur Cooper) in his address, an interesting paper on steam engines for driving rolling-mills by Mr. J. W. Hall, and an account of the Nathusius electric steel furnace by its originator, with several other contributions of a similar character. Altogether the institute is to be congratulated upon a singularly successful meeting, which revives the traditions of the best days of its history.

M. POINCARÉ'S LECTURES AT THE UNIVERSITY OF LONDON.

I.—May 3.—*The Logic of the Infinite.*—Some years ago, M. Poincaré said, he had published a certain number of articles upon the subject, which had involved him in a veritable polemic. He would not attempt to renew the arguments that had been used on either side, or to bring forward any fresh arguments, as he believed that the divergence of the two schools was irreducible. It arose from an essential difference of mentality; he would therefore accept it as an experimental fact, and would endeavour to account for this divergence. For the first school, whom, for the sake of convenience, he would call Pragmatists, the infinite was derived from the finite; for the second, the Cantorians, the infinite pre-existed, and the finite was only a small piece of the infinite. From another point of view, to use the language of the scholastics, the Pragmatists were *extensionists*, while the Cantorians were *comprehensionists*. This appeared in the nature of the definitions used by the two schools. For the first a definition consisted in the addition of one new object, expressed in terms of the aggregate of known objects; for the second a definition was a fresh subdivision of the aggregate of all objects known and unknown. The Pragmatists were idealists, and for them an object did not exist until it had been *thought*. The Cantorians were realists for whom the existence of objects was independent of a thinking subject. For them the infinite was independent of man or any thinking being; it was pre-existent and was discovered by man.

II.—May 4.—*Time and Space.*—The conception of space arose from our muscular sense. When we saw an object we knew the movements necessary to attain it. The idea of space, then, was the association between certain sensations and certain movements. To the whole of space the principle of relativity applied, that is to say, we had no means of perceiving a transportation, a magnification, or a deformation of the universe, provided that in the transformation all objects were subject to the same law. Space, in fact, was "soft and without rigidity." We appreciated the relations between objects in space by means of our instruments of measurement, of which our body was one, and the science of geometry was a study of these instruments. But the instruments were not perfect, and therefore we replaced them by a series of ideal instruments for the purposes of our geometry, which thus depended upon an aggregate of conventions approximating to the actual laws, but simpler. The principle of relativity also applied to time; if all actions were retarded uniformly we had no means of perceiving it.

A revolution had recently been brought about by the researches of modern physicists, especially those of Lorenz. Formerly the action of one body upon another was supposed to be instantaneous. But if we supposed that such an action was transmitted through the intervening space at a finite speed, the question of priority of action became very difficult. Formerly we had considered an action α to be anterior to a dependent action β, when α could be regarded as the cause of β. But in the new mechanics, if β occurred too soon it might happen that α could not be regarded as the cause of β, nor β as the cause of α. It might be necessary at this stage to abandon our former mechanical conventions and to adopt new ones.

III.—May 10.—*Arithmetical Invariants.*—If an algebraic form, in two variables, say, $F(x, y)$, was subjected to the transformation

$$x \to \alpha x + \beta y,\ y \to \gamma x + \delta y, \text{ where } \alpha\delta - \beta\gamma = 1 \quad . \quad (1)$$

there were certain functions of the coefficients of F which remained unchanged. These were algebraic invariants. Suppose now that α, β, γ, δ, and also the coefficients of $F(x, y)$ were restricted to be whole numbers, positive or negative, $F(x, y)$ would possess the same invariants as before, but it would also possess others which were termed *arithmetical invariants.*

The simplest form was $F(x, y) = ax + by$. This form possessed no algebraic invariants. Some arithmetical invariants, however, could be obtained which were related to the Weierstrassian elliptic functions, the thetafuchsian functions, and the functions of Jacobi.

In the case of quadratic forms it was necessary to distinguish between the definite and the indefinite. The definite quadratic form might be reduced for this purpose to a pair of linear forms, but for an indefinite form invariants could only be found if we took certain subgroups of the group of transformations considered instead of the group itself.

IV.—May 11.—*The Theory of Radiation.*—Planck had enunciated some ideas, which, if they were accepted, would bring about in the science of physics the most profound revolution that had occurred since the time of Newton. We owed to Newton the principle that the laws of nature could be expressed in the form of differential equations. According to Planck, phenomena satisfy not differential, but finite difference equations.

By the method of statistics applied to a very great number of separate molecules we arrived at one of the fundamental theorems of thermodynamics, that of Maxwell on the equipartition of mean kinetic energy. Upon the same basis we arrived at Wien's law of radiation and Rayleigh's law. The last was consistent with the theorem of Maxwell, but it was not justified by experiment.

Planck supposed that there existed in incandescent bodies a very great number of *resonators*, each corresponding to a certain wave-length of light; these resonators could only acquire or emit energy by a definite increment: a *quantum* or atom of energy. Planck obtained in this way a law of radiation, which was justified by experiment, but which was not consistent with Maxwell's theorem. M. Poincaré found that if, instead of considering the action of light upon a molecule, we applied the ideas of Planck to the action of a molecule upon light, we should be forced to conclude that diffusion took place with a certain retardation, and this was certainly not true. Thus the hypothesis of Planck was unsatisfactory, and no solution to the problem was at present in sight.

FOOD AND THE CHILD.

TWO conferences held in London since our last issue show that increasing attention is being given to questions relating to the physical and mental development of children from a national point of view. At one conference, held at the Guildhall, the subjects considered related to diet at public and private secondary schools; and at the other, held at the University of London, the health of the child in relation to its mental and physical development formed the general basis of discussion.

Of all that mankind has attempted since the world began, there is nothing which it has practised so regularly, so persistently, and on the whole so successfully as eating and drinking. It is therefore somewhat disquieting to find the great civilised nations suddenly smitten with misgivings as to whether the rising generation is being suitably nourished. It is admitted that the provender provided for the better-class school children of to-day is more abundant in quantity, better in quality, and better served than that supplied to their immediate ancestors; that it is, indeed, exceptional for the fare to be actually deficient in amount, while, whatever its form, it certainly comprises those essential elements of proteids, fats, and carbohydrates upon which previous generations achieved a national pre-eminence. Yet, evidence accumulates to the effect that all is not well with the school child in relation to his diet; and, this being so, the impression arises that the fault lies with the eater .at least as much as with the food supplied to him. This also appeared to be the opinion of most of those who spoke with authority and from experience at the recent conference on school diets.

The healthy normal child will eat with avidity of plain wholesome fare, and may even be trusted to eat of it to repletion without risk of injury, it was stated. But, by the healthy normal child was clearly meant one whose teeth were sound, who used them effectively for complete mastication, and whose natural appetite had not been vitiated by a too promiscuous feeding on more highly seasoned viands at home. Now only a small proportion of school children possess quite sound teeth. The rest have mouths more or less septic, and, consequently, infected digestive tracts. Practically none masticate their food completely, and their digestion is by so much the further hampered; while many of those belonging to the upper social classes, when at home, share the more delicately prepared and attractively flavoured foods which are needed to stimulate the faded appetites of their parents, and consequently come to regard simpler fare as insipid and unappetising.

The situation is one of national importance. It calls for a reform of the home dietary and upbringing —beginning in the earliest nursery days—quite as much as for a reform of school diets. The latter may, indeed, be here and there modified with advantage, both in matter and in method; these details, important enough in themselves, were more or less clearly hinted at, but a single-day conference did not provide the time for their adequate consideration. The conference, so far as it went, was as a useful and most suggestive troubling of the waters. Its repetition on a more complete and more comprehensive scale would serve to bring out with greater clearness the need for some effective collaboration between the home and the school in relation to one of the most important factors in determining the future of the race.

At the conference of child-study societies existing in various parts of the kingdom, held on May 9–11 in the University of London, an address was delivered by Sir James Crichton-Browne, the president of the central society. He took for his subject the need for proper classification and education of feeble-minded children, with especial reference to the discrimination of those who presented mentally abnormal qualities not amounting to feeble-mindedness, and those whose mental defects might by suitable education under medical guidance be removed and their minds strengthened. At the meeting on May 10, papers were read by Dr. Kerr Love, on the influence of defects of hearing in relation to the mental and physical development of the child, and by Mr. Bishop Harman, on the influence of defects of vision in relation to the mental and physical development of the child. Mr. B. P. Jones, as a teacher of the deaf, gave a successful demonstration with two ex-scholars of what may be done for the hard of hearing. Dr. Jane Walker read a paper on the tuberculous child. In the afternoon, a visit was paid to Sir Francis Campbell's normal college for the blind, where an excellent musical performance was given by members of the college. In the evening Dr. Saleeby lectured on eugenics and child-study. At the meeting on May 11, Dr. Hyslop read a paper on mental hygiene in relation to the development of the child, and a discussion ensued in which Dr. Percy Nunn and Mr. Kirkpatrick, of the Normal College, Fitchbury, Mass., took part. A discussion followed on the instruction of the young in sexual hygiene, in the course of which admirable addresses were delivered by several ladies. In the evening the delegates were entertained by Sir Richard and Lady Martin at their house in Hill Street. The next conference will be held at Liverpool.

THE REFORM MOVEMENT AT CAMBRIDGE.

THE progressive party in Cambridge has lost heart about reforming the University from the inside, and a memorial asking for a Royal Commission, which has been signed by six professors and some twenty-two other members of the University, is being generally circulated for signatures. The signatories hope that power may be given to the commission to make statutes in regard to such matters as financial and other relations between the University and the colleges, and the administration of funds devoted to fellowships, scholarships, and exhibitions. A certain number of those usually associated with reform movements in the University have withheld their signatures, partly, apparently, because they mistrust the sort of commission they anticipate the present Government would nominate, and partly because they feel that the resident members have by no means made up their minds on what lines they would wish reform to be initiated; but some at least hold the view that it is not desirable that the commission should have power to frame statutes.

The petition is as follows:—

To the Right Hon. H. H. Asquith, Prime Minister.

We, the undersigned resident members of the Senate of the University of Cambridge, desire to lay before you a request that a commission may be appointed to inquire into the constitution of the University of Cambridge, the financial and other relations which exist between the University and the colleges, and the administration of funds devoted to fellowships, scholarships, and exhibitions; and that power may be given to the commission to make statutes in regard to these matters.

We venture to remind you that on July 24, 1907, in the House of Lords, the Marquess of Crewe, speaking on behalf of the Government, stated that the

Government were unwilling to appoint any commission for the Universities of Oxford or Cambridge until full opportunity had been given to these Universities to make necessary reform for themselves. In the five years that have since elapsed various proposals for constitutional reform have been brought before the Senate of the University of Cambridge by the council of the Senate, but they have been, without exception, rejected by the Senate; and it is clear to us that no further attempt of the kind is likely to be successful. We therefore make our present appeal for the appointment of a commission.

ELECTRICITY SUPPLY: PAST, PRESENT, AND FUTURE.[1]

IT was in 1882 that Parliament passed the first of the Electric Lighting Acts. This Act was in part based upon recommendations made by a Select Committee on Lighting by Electricity that sat in 1879, and as an instance of the want of proportion in the ideas that then prevailed it may be mentioned that before that committee Mr. Joseph Rayner, the Town Clerk of Liverpool, explained that one of the reasons why the Corporation of Liverpool were seeking for Parliamentary powers to supply electricity within their borough was because they were in a specially advantageous position to do this, as they had an engine which was used during the daytime for working a fountain, and might well be used for supplying electricity during the night, that engine having a capacity of 20 horse-power. At the end of last year the electric supply plant of the Corporation of Liverpool amounted to about 50,000 horse-power, which, when compared with this 20 horse-power engine, affords a commentary on the parochial character of the ideas in accordance with which the first of the Electric Lighting Acts was framed.

In the year 1882, also, the first electric supply station for supplying incandescent lamps on a public scale in London was established by the Edison Company on Holborn Viaduct. The Holborn station was equipped with two Edison dynamo machines, and it is interesting, as giving an inkling of the notions then prevailing, that these machines were described by the then editor of one of our chief engineering papers as "enormous," it being added, evidently as a matter of wonder, that "no less than 1000 full size or 16-candle incandescent electric lamps were maintained constantly in operation from one machine." It may be mentioned that each of these dynamos was driven by a high-pressure Porter engine of 130 horse-power, which shows that even in 1882 ideas had not progressed very far beyond those to which I have already alluded in connection with Liverpool three years earlier. The design of these early Edison machines, with their multiple-magnet limbs each with its separate winding, is also illustrative of the ignorance then prevailing on electromagnetic subjects, it being obvious in the light of modern knowledge that the arrangement was altogether inefficient and absurd. It was the late Dr. John Hopkinson who first put the design of continuous-current dynamos and their magnetic circuits on a sure foundation.

So far from assisting electricity supply, the Electric Lighting Act of 1882 had the immediate effect of crushing enterprise in that direction, the period of seven years for which licences, or the twenty-one years for which provisional orders, were granted to promoters of electric supply undertakings being found quite inadequate to enable money to be raised for such purposes. Between 1883 and 1888, when the Act was amended, only ten licences were applied for, all of which afterwards expired or were revoked, and though in the first year there were a considerable number of applications for provisional orders, not one of these was carried into effect, capitalists refusing to find money for undertakings which had only a tenure of twenty-one years. No doubt, also, this unsatisfactory result was assisted by the severe reaction that had set in from the speculative mania in electric lighting affairs of a few years earlier.

It was not until 1885 that Sir Coutts Lindsay laid down an installation in Bond Street to light the Grosvenor Picture Gallery and the premises of some of the neighbouring tradesmen, which installation in its subsequent development had probably more influence than anything else on the fortunes of electricity supply, not only in London, but in the country generally. Quite a novel system of distribution was employed, the current being alternating and distributed at high pressure by means of overhead wires, and transformers (or secondary generators, as they were called) on the Goulard and Gibbs system being used to reduce the pressure to suit that of the lamps.

To begin with, the system did not work well, and, on the advice of Lord Kelvin, Mr. S. Z. de Ferranti was called in to assist. The station was immediately reorganised and fitted with machinery of much greater capacity, and so successful was the outlook that, early in 1888, the London Electric Supply Corporation, Ltd., was formed with a capital of 1,000,000*l.* sterling, and what were then considered as immense works were started upon as far away as Deptford, six miles from the centre of London, the scheme being to transmit the electricity from where land, coal, labour, and water for condensing could be cheaply obtained, at a pressure of no less than 10,000 volts, with suitable substations where it could be transformed and thence distributed at lower pressures. The great courage shown by those responsible for the venture was deserving of a better fate—but alas for the uncertainty of human endeavours! While the working of the station at Deptford was still in its inception, the plant at the Grosvenor Gallery became ignited by a short circuit and was burnt out; while the London Electric Supply Corporation soon afterwards went into the hands of a receiver, leaving unfinished, and never to be finished, the 10,000 horse-power sets of dynamo and engine which Mr. Ferranti's genius had dared to devise.

Though so very unsuccessful financially at its first start off, there can be no question as to the enormous influence that the Deptford undertaking had on the history of electricity supply, not only in London or in this country, but throughout the world. Here, at length, was an electricity supply proposition on a scale similar to those of the great undertakings that furnish gas to the Metropolis, with generating plant and means of distribution designed for the sale of electricity over a large portion of London. The more cautious procedure adopted by other concerns which sprang up about the same time and later was no doubt more successful from a business point of view, but the impulse given by this ambitious scheme became manifest from the great competition that was shown for provisional orders for different parts of London, leading to the public inquiry that was held by the Board of Trade immediately after the passing of the amended Electric Lighting Act of 1888, in which the period of twenty-one years, after which the undertaking was subject to purchase without any allowance for goodwill, was extended to forty-two years.

[1] From a discourse delivered at the Royal Institution on Friday, April 19, by Alan A. Campbell Swinton.

It is worthy of note that the London Electric Supply Corporation has now some time ago successfully emerged from its period of financial distress, while Mr. Ferranti, though, as has been shown, he was one of the pioneers of electricity supply, still remains with us as one of the most vigorous intellects in the electrical industry, and one who, as president of the Institution of Electrical Engineers, is even now dreaming fresh dreams of higher things and lower costs so far as electricity supply is concerned.

During the period with which we have been dealing, so far as the public were then aware, the chief improvements that had been effected in connection with machinery for electricity supply had reference to the dynamos which generated the current, the batteries that stored it, the cables and switches and other apparatus that distributed it and regulated its performances. True, to some extent, special designs of steam engines had been got out to suit the requirements of driving the fast-running dynamos, as, for instance, the well-known Willan's engine. As yet, however, there had been no departure from the reciprocating engine.

Early in the year 1885 the present speaker had the privilege, for the first time, of seeing running in the works of Messrs. Clark, Chapman and Parsons, Gateshead-on-Tyne, the first true rotary engine that ever gave useful results. The invention had been patented by Sir Charles Parsons in April, 1884, and in the interval this first practical steam turbine had been constructed. I am able to show you the actual machine, which the South Kensington Museum authorities have kindly sent here, withdrawing it for the evening from the congenial company of Watt's beam engine and Stephenson's "Rocket," amongst which it now has its appropriate abode.

As will be seen, it is a very small machine directly coupled to a dynamo giving about six electrical horse-power when running at the great speed of 18,000 revolutions per minute, and it is interesting to compare its parts, as, for instance, its blading, with that of the very large steam turbines on exactly the same principle that have been constructed in recent years, as, for instance, portions of blading such as is used in the turbines of the *Mauretania*, which, through the courtesy of Messrs. C. A. Parsons and Co., I am also able to bring to your notice.

The steam turbine has now come into very general use, being employed to the almost complete exclusion of other heat engines where very large electrical powers are wanted. At its inception, however, its inventor had many difficulties to encounter, together with much prejudice. Since the days of James Watt inventors up to that time had been continually trying to produce a successful rotary engine, and all had failed. It was natural, therefore, for engineers to ask why this new inventor should succeed any more than those who had gone before. They did not realise that the advances that had been made in thermodynamics, and more especially in machine tools and workshop methods, had rendered things practicable which, up till that time, had not been so; nor did they understand that here at last the subject was being tackled on really scientific principles by one exceptionally endowed by nature to grapple with it. Another difficulty that Sir Charles Parsons had to contend with was that, in the nature of things, experiments must usually be conducted, in the first instance, on a small scale. Moreover, at that period, when the steam turbine was only employed for driving dynamos, there was no demand for machines of any but what at the present day would be considered of very small size. Now it is one of the peculiarities of steam turbines that they are much easier to make in large sizes than in small sizes to give reasonable economy. Thus it was by reason of the very small powers that were wanted that in these earlier days turbines earned the opprobrious epithet of "steam-eaters."

The Parsons steam turbine was first chiefly employed for the electric lighting of ships, but in 1887 the whole of the electricity for lighting the Mining, Engineering, and Industrial Exhibition that was held in Newcastle-upon-Tyne was generated by a number of Parsons machines; while a little later the Newcastle and District Electric Lighting Company was formed, the works of which on the banks of the Tyne were the first in which steam turbines were employed to afford a public supply of electricity for general lighting and other purposes. The first machines employed in this station were only of about 100 horse-power, while others of an improved type, which were first employed at Cambridge and at Scarborough, were of about double this power, and were considered as very large. The first steam turbines to be employed in London were used for the lighting of Lincoln's Inn Hall, where they worked for many years, to be followed not long after, in 1891, by three others, each of 50 horse-power, at New Scotland Yard, which still exist, and to-day are providing electricity for lighting, printing, and other purposes, for the Metropolitan Police.

Some fifteen years ago, in evidence that he gave before the Judicial Committee of the Privy Council in connection with Sir Charles Parsons's application for a prolongation of his patent, Lord Kelvin characterised the Parsons turbine as the most important development in steam engines since the days of James Watt. At the time this seemed a somewhat bold assertion, but in the light of experience it has proved to be a fact.

I mentioned just now that it was on the banks of the Tyne that the steam turbine was first applied to the public supply of electricity, and it has also been on the banks of the Tyne, and in the adjacent areas of Northumberland and Durham, that the greatest existing development in this country of electricity supply for industrial purposes has taken place. Not the least of the causes that have led to this is the fact that, apart from London, where the circumstance are very special, in Newcastle-upon-Tyne alone among the great manufacturing cities of Great Britain has electricity supply remained in the hands of private enterprise, and not become municipalised.

The district covered by this vast power-supply undertaking extends as far north as Morpeth, as far west as Consett, is bounded on the east by the sea, and extends right away down through the county of Durham to Stockton-on-Tees, Middlesbrough, and Cleveland. There are seventeen generating stations, of which six are coal-fired stations, and the remainder most interesting waste-heat stations, where steam for making the electricity is obtained either from exhaust steam that has already done work in blowing or other engines, or by steam raised by blast-furnace gas or from the waste heat and gas from coke ovens.

Excepting in the old original power station at Neptune Bank, where power supply was inaugurated by Lord Kelvin in June, 1901, and where there are still some reciprocating engines, the whole of the works are equipped with alternators driven by steam turbines, mostly of the Parsons type, supplying 3-phase 40-cycle current at voltages varying from 3000 to 12,000. The power is supplied to all the leading manufacturers for every kind of purpose, and also to the railway from Newcastle to the sea, which has

been electrified. The total horse-power connected amounts to nearly 200,000.

It is obvious that an undertaking of these vast dimensions, covering as it does large portions of two counties and several large towns and industrial centres, could never have been undertaken by a single municipality. It is equally obvious that it could never have succeeded as well as it has had Newcastle itself, which has been from the first the nucleus of the undertaking, been cut out of the area of supply. This explains why other electric power schemes, such as those being worked on the Clyde and in the area round Glasgow, in Yorkshire and in Lancashire, have failed to go ahead anything like so rapidly as the one of which I have just been speaking. Parliament in its wisdom, at the instance of municipal parochialism, cut nearly all the large towns out of the areas supplied by these schemes, with the result that progress has been impeded with real benefit to no one.

As to the future, we have seen from the lessons of the past how very dangerous it is to prophesy, it being frequently the entirely unexpected that turns up. So far as the immediate future of electricity generation on a large scale is concerned, the steam turbine appears likely to hold the field, though in regard to the smaller stations, where units up to 500 or 1000 kilowatts are what are wanted, the internal-combustion engine is undoubtedly gaining ground. Will it, however, ever catch up the steam turbine in the case of the really large power stations? Turbine units up to 25,000 kilowatts are now in actual use or in contemplation, and as electricity becomes more and more employed, not only for power, but for electrochemical and metallurgical purposes and for domestic heating, we may expect units of plant of still larger dimensions. At present about 2000 horse-power, or about 1500 kilowatts, seems to be about the maximum that it is considered can be safely obtained per cylinder from the internal-combustion engine, so that increased powers can only be obtained by a process of multiplication, which leads, in the case of very large units of plant, to great complication. Then again, as the steam turbine, particularly with the employment of superheated steam, tends to increase in fuel economy as the dimensions of the unit of plant are increased at a much greater ratio than does the internal-combustion engine, a point must be reached when, as we enlarge the units of plant, taking all things, such as first cost, lubricating oil, attendance, and upkeep, into account, the steam turbine will be as cheap as, or even cheaper than, its rival.

So far, the internal-combustion or gas turbine has not been alluded to, but some of the difficulties in the way of its successful realisation may be mentioned. All turbines essentially consist of machines by means of which power is obtained by the passage of fluids or hot gases through narrow apertures, and by their impingement on blades, in such a manner that the fluids or gases are in intimate contact with large surfaces of metal. Now, as all engineers are aware, the law which limits the efficiency obtainable in any heat engine is expressed by the formula $(T'-T)\div T'$, where T' is the absolute temperature of the working gas and T the absolute temperature of the condenser or the exhaust. From this it is clear that if we are to get maximum efficiencies, the temperature of the working fluid must be as high as possible, and the sole reason for the extra good efficiency of an internal-combustion engine is because in this machine the temperatures that can be successfully dealt with are very high. In the cylinder the combustion takes place when the gas is in considerable mass, and though those portions of it which are in contact with the walls of the cylinder become cooled, still, the interior of the mass keeps very hot, indeed at temperatures which could not possibly be employed in turbines unless we could find the materials of which to construct the blades which would maintain their tenacity while running at a red heat. It is conceivable that the science of metallurgy may be able to provide new metals or alloys with the necessary properties for doing this in the future, but at present no such material exists, and the only way in which the internal-combustion turbine can for the moment be worked is by reducing the temperatures of the gases by the introduction of water, steam, or air to a reasonable amount; indeed, in practice the temperature has to be reduced to that usual with superheated steam, when, of course, according to the formula I have quoted, the maximum efficiencies theoretically obtainable with the internal-combustion engine and the steam turbine become equal. Even then, if other things were equal, the internal-combustion turbine might have some advantage by doing away with boilers; but, unfortunately, there are other difficulties —such as the bad economy of all methods of compressing the gaseous mixture as is necessary to obtain the full advantage of its combustion.

No doubt the future of electricity supply lies with very large stations employing very big units of plant, and combining the generation of electricity with chemical manufacture, the electricity on the one hand and the chemicals on the other being by-products each of the other's manufacture. So far as this country is concerned, for electricity supply at all events, we are not likely to depart from the use of coal so long as that source of energy holds out. For the propulsion of ships oil may present advantages, but on land in Great Britain coal must remain the cheaper. In all probability, however, in the future the coal will not be simply burnt. It will be turned into gas, and the sulphate of ammonia and the tar, with all its interesting constituents, saved. Whether the gas will be burnt under boilers for the raising of steam to supply steam turbines, or whether it will be used in internal-combustion engines, will depend on the progress made by the latter in regard to attaining larger dimensions, and also as regards improvements in the gas firing of boilers, in respect of which, as has recently been shown by Prof. Bone in his interesting lecture on surface combustion, there is still much to be done.

When the coal and oil and also the peat are exhausted, what then? The date may be distant, but come it must, and that within a period short in comparison with our past civilisation.

The water-power existing on the earth, when all harnessed, would only supply a very small percentage of the demand for power, light, and heat. The utilisation of the tides does not appear a very hopeful project, any more than does the utilisation of the internal heat of the earth. There remain the energy dependent on atomic transformation, the availability of which the highest authorities appear to regard as probably impracticable, and the radiant energy that reaches this planet from the sun. The latter, as calculated by Sir J. J. Thomson, amounts on a clear day to no less than 7000 horse-power per acre, or about 4,500,000 horse-power per square mile of the earth's surface.

Here is obviously an ample supply of energy sufficient for all purposes provided it can be converted into work by some reasonably efficient process. This should not prove impossible, and we have therefore here a problem for the physicist of the utmost importance to the race.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—At a meeting held on May 7, Convocation received a report from the standing committee, in which is reprinted the statement presented to the Royal Commission on behalf of Convocation. The statement deals exhaustively with the origin of the commission as having reference specifically to the question of the future relations of the Imperial College to the University. Other questions involved in the commission's terms of reference are not mentioned in this statement; but Dr. Senter, one of the witnesses, put in a statement regarding the work of the University on its external side. As a record of the events leading to the establishment of the Imperial College the statement is valuable. Lord Rosebery's letter, dated June 27, 1903, to Lord Monkswell, then chairman of the London County Council, is reprinted, and a detailed account of the proceedings in the Senate in relation to the question is given. It is urged that the only changes necessary in the constitution of the University for the incorporation of the Imperial College are such as were offered by the Senate in December, 1908.

Presentation Day at the University was on May 8, the Vice-Chancellor (Sir William Collins) presiding. The report of the Principal (Sir Henry Miers) showed a decrease in candidates for all examinations as compared with 1910–11 of 12,681 to 12,263, due mainly to a decrease of entries at the matriculation examination. The number of degrees or diplomas granted was 1342, and the number of internal students is 4578. The record of endowments and benefactions given or offered during the year for university purposes amounts to a capital sum of 650,000*l*. Reference was made to the resignation of Sir William Ramsay. Finally, the Principal asserted that the activities of the University had not been checked by the general feeling of uncertainty due to the existence of the Royal Commission. The chief subject for anxiety was the decline of matriculation entries and its financial effect.

A letter from Lord Haldane to Sir Francis Mowatt, dated May 7, has been published, containing an account of the actual position of matters in regard to the proposed new university buildings. The sum of 375,000*l*. asked for the proposed site behind the British Museum was not a settled price. It is stated that the site was regarded as most suitable, because it was ascertained that additional land adjoining might be available for subsequent development. There is a risk, Lord Haldane suggests, that in consequence of the action taken by certain persons connected with the University the offers originally made may not now be available, and in the circumstances it would be idle to take steps to complete the formation of the proposed trust. "If there is to be a hostile attitude within the University itself, the task of those who wish to help in every way they can becomes a very hard one."

IN addition to a studentship in pathology and bacteriology which they endowed some time ago, the Misses Riddell, of Belfast, have now placed 25,000*l*. at the disposal of trustees to provide a hall of residence at Queen's University, Belfast, for young Protestant girl students at the University.

EXETER COLLEGE, Oxford, has appointed Mr. A. M. Hocart, late open scholar of the college, to a senior studentship, tenable for two years, in order that he may conduct anthropological research in Fiji and the adjoining parts of the Pacific region. Mr. Hocart has already had experience of field work under Dr. Rivers in the Solomon Islands, and has since had an opportunity as a teacher of natives in Fiji of mastering the local dialect.

PROF. FILIBERT ROTH, who recently resigned his chair of forestry at the University of Michigan to accept a similar post at Cornell, has reconsidered his decision, and will remain at Ann Arbor. The Michigan regents have agreed to provide the facilities required for the extension of their forestry department. A thousand-acre "school forest" is to be purchased, which, together with the present eighty-acre forest farm, will give ample opportunity for the field work of the students.

MR. GOLDSWORTHY L. DICKINSON, fellow and tutor of King's College, Cambridge, and Mr. Percy M. Roxby, lecturer in the University of Liverpool, have been elected to Albert Kahn Travelling Fellowships. These fellowships, each of the value of 660*l*., were established to enable the persons appointed to them to travel round the world. The founder's object is to enable men of proved intellectual attainments to enter into personal contact with men and countries they might never have known. The trust is administered at the University of London, and Sir Henry Miers, F.R.S., is the honorary secretary to the trustees, as well as a trustee himself.

THE detailed programme of papers and discussions at the Congress of the Universities of the Empire, to be held in July next, as already announced, is now complete. The congress meets for discussion on six half-days, beginning on July 2 and concluding on July 5. Among numerous other papers, the following may be mentioned:—Sir Alfred Hopkinson, Vice-Chancellor of Manchester University, on the question of the division of work and specialisation among universities; Principal Peterson, McGill University, on inter-university arrangements for post-graduate and research students; Prof. A. Smithells, F.R.S., the relation of universities to technical and professional education and to education for the Public Services; Mr. H. A. Roberts and Miss M. G. Spencer, on the action of universities in relation to the after-careers of their students; and Sir James Donaldson, Vice-Chancellor and Principal of the University of St. Andrews, on the representation of teachers and graduates on the governing body of a university. Many varied entertainments have been arranged for members of the congress. These include a luncheon to delegates by invitation of the Government at the Hotel Cecil, dinners given by several city companies, and many "At Homes."

THE Viceroy of India attended the recent Convocation of the Calcutta University, and in his capacity of chancellor of the University delivered an address. Dealing with the need for further progress in the provision of facilities for higher education, Lord Hardinge said the Government of India has decided to make a solid advance in the direction of teaching and residential universities. A recurring grant of 3 lakhs of rupees a year has been allotted, of which the Calcutta University will receive 65,000 rupees a year for the appointment of University professors and lecturers in special subjects, and for the encouragement in other ways of higher studies and research. Non-recurring grants amounting to 16 lakhs, of which the Calcutta University will receive 4 lakhs, have been allotted for the provision of University buildings, libraries, and equipment. In addition, a special grant of 10 lakhs has been reserved for hostel accommodation in Calcutta, which will be non-collegiate in character. Another sum of 10 lakhs has been

allotted for the development of accommodation in Dacca and the buildings required for the new university in that place. Lord Hardinge hopes that the liberality of the Government will be supplemented by private liberality, and that before many years have passed efficient teaching universities will take the place of the examining and federal universities which India has to-day.

THE attendance at German universities forms the subject of an article by Mr. R. Tombo, jun., in the issue of *Science* for April 26. Mr. Tombo analyses the statistics given in the Deutscher Universitäts-Kalendar for the summer semester of the present year. There are 57,398 students in German universities, as contrasted with 57,200 for the preceding summer semester. This is, however, exclusive of 5563 auditors, who, if added, would run the grand total to 62,961, as against 61,274 during the summer semester. The University of Berlin continues to lead the list with an enrolment of 9829 matriculated students. The University of Berlin is followed by the University of Munich, with an enrolment of 6797 matriculated students and 782 auditors. The University of Leipzig ranks third with 5170 matriculated students and 925 auditors. Of the remaining universities, Bonn, Breslau, and Halle each have more than 3000 students; Göttingen, Freiburg, Heidelberg, Münster, Strassburg, and Marburg each have more than 2000, and all the other universities, except Rostock with 955, have each more than 1000 students. Of the total number of students in German universities, 52,435 are from Germany, and of the remainder 160 only are from the British Isles.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 9.—Sir Archibald Geikie, K.C.B., president, in the chair.—A. Vernon **Harcourt**: The variation with temperature of the rate of a chemical change. In an inquiry into the connection between the conditions of a chemical change and its amount, one of the conditions varied was that of the temperature of the solution in which the change took place (Phil. Trans., vol. clxxxvi., 1895, A, pp. 817–95). A relation was found to exist between this condition and the rate of change, expressed by the equation

$$a_T/a_{T_0}=(T/T_0)^m,$$

where a is the rate of change, or the number of minutes in which a definite portion of chemical change is accomplished, T_0 the absolute temperature 273°, and T any other absolute temperature. Not only do the numbers found from this equation agree very closely with the observed numbers, but the equation expresses a natural law which is nearly related to that upon which all calculations of gaseous volumes have long been based. Several later measurements of the rate of change at different temperatures have been published and compared with numbers calculated from other formulæ. In an appendix to the present paper it is shown, by one of the authors of the previous paper, that the numbers thus calculated are in less close agreement with the actual measurements than numbers calculated from his formula given above, while also the formulæ have no physical interpretation.—Dr. C. **Chree**: Some phenomena of sun-spots and of terrestrial magnetism at Kew Observatory. An investigation made some years ago by the author indicated the probability that a relation existed between the amplitude of the daily range of the magnetic elements and the sun-spot area, not on the same day, but several days previously. The object of the present research was to inquire into the reality of this connection. It was found that there is a well-marked period of about 27·3 days in magnetic phenomena, in this sense, that if a certain day exhibits magnetic disturbance attaining the international standard "2," as interpreted at Kew, a day which follows either 27 or 28 days after has nearly double the chance of attaining standard "2" that the ordinary day has. This 27-28-day period was not so clearly shown in the years of maximum sun-spot frequency of the epoch considered as in the years of minimum frequency, and was most clearly shown in certain intermediate years characterised by the number rather than by the magnitude of magnetic disturbances. The conclusion that a period of about 27·3 days exists in "magnetic storms" had been reached some years ago by Mr. Arthur Harvey and Mr. E. W. Maunder, independently, considering respectively data from Toronto and Greenwich, but their conclusions have not been universally accepted. The present investigation shows that the phenomenon is not confined to the large disturbances usually termed "magnetic storms," but is exhibited in the daily range of the average day.—Sir Walter Noel **Hartley** and H. W. **Moss**: The ultimate lines and the quantities of the elements producing those lines in spectra of the oxyhydrogen flame and spark. In a recent paper by one of the authors (Proc. Roy. Soc., 1911, vol. lxxxv., p. 271, Hartley) on some mineral constituents of a dusty atmosphere as determined both by flame and spark spectra, a brief reference was made to the method employed for ascertaining the weights of matter necessary to give calcium and copper lines in the spark. This work has been extended to about twenty elements. The quantities of the elements which render the ultimate lines in the oxyhydrogen flame spectra had previously been carefully determined. With the alkali metals it is found to vary between 0·0008 milligram in the case of potassium, 0·01 mgrm. rubidium and cæsium, and 0·1 mgrm. lithium. In the alkaline earth group, 0·01 mgrm. strontium, 0·1 mgrm. calcium, and barium 1·0 mgrm. Silver 0·1 mgrm., copper 1·0 mgrm., and gold 50 mgrms. Gallium, iridium, and thallium 0·01 mgrm., manganese 0·001 mgrm., lead 0·1, and tin 100 mgrms. The gold spectrum shows the heads of very strong bands which correspond with lines in the spark spectrum. Tin shows no lines, but the edges of bands or flutings which are enfeebled until scarcely visible.—E. **Marsden** and C. G. **Darwin**: The transformations of the active deposit of thorium. The present paper is concerned with a series of experiments undertaken with the view of discovering the genetic arrangement of the various products in the active deposit of thorium, and more particularly the transformations occurring in the product or products included in thorium C. The results give strong reason for supposing that, of the atoms of thorium C, 35 per cent. emit α particles of range 4·8 cm., and become converted into atoms of thorium D, while the remaining 65 per cent. emit β particles and disintegrate into atoms of a very short-lived α-ray product, thorium C. The experiments also show that although the β rays of thorium C are extremely penetrating ($\mu=13{\cdot}5$ cm.$^{-1}$ Al), yet they are practically unaccompanied by γ rays, while the relatively soft β rays of thorium D are accompanied by a very intense penetrating γ radiation containing more than six times the amount of energy of the β rays.—W. **Wilson**: The β particles reflected by sheets of matter of different thicknesses. (1) The radiation reflected when the β particles from uranium (*loc. cit.*) strike a screen can be split up into two parts, one with a very large coefficient of absorption, and the other with absorption coefficient of the same order as that of the

primary beam. (2) The absorption coefficient of the more penetrating part of the reflected beam decreases with increasing thickness of the reflector. (3) The final absorption coefficient of the rays reflected from thick sheets of aluminium, copper, and lead are 33·7, 26·6, and 20·2 cm.$^{-1}$ respectively. (4) The coefficient of absorption of the easily absorbed part of the radiation reflected by aluminium is about 235 cm.$^{-1}$. The absorption coefficients of the corresponding rays reflected from copper, lead, and air have not been determined with any degree of accuracy, but are of the same order of magnitude as that of the rays reflected by aluminium. (5) An expression has been obtained for the variation of the amount of reflected radiation with the thickness of the reflector, and has been shown to be in good agreement with the results obtained experimentally by Schmidt.

Geological Society, May 1.—Dr. Aubrey Strahan, F.R.S., president, in the chair.—P. **Lake** and Prof. S. H. **Reynolds**: The geology of Mynydd Gader, Dolgelly; with an account of the petrology of the area between Dolgelly and Cader Idris. Mynydd Gader lies immediately south of the area described by the authors in a previous paper (Q.J.G.S., vol. lii., 1896, pp. 511–21). The Tremadoc beds are here succeeded by a group of rocks which are, for the most part, of volcanic origin. These may be divided into a rhyolitic series below and an ashy series above. The rhyolitic series is formed chiefly of lava-flows; the ashy series consists mainly of volcanic ashes and slates, the ashes predominating below and the slates above. *Didymograptus bifidus* occurs near the base of the ashy series, *D. murchisoni* in the upper part. The rhyolitic series appears to be older than the main mass of volcanic rocks in the Arenig area, but it may be contemporaneous with the Calymene ashes of that district. It is probably of approximately the same age as the volcanic series of Skomer Island, and the fact that in both places the rhyolitic rocks are soda-rhyolites is of considerable interest. H. **Bolton**: Insect-remains from the midland and south-eastern coalfields. The writer describes a series of three insect-wings obtained by Dr. L. Moysey from the Shipley clay-pit near Ilkeston (Derbyshire), and a blattoid wing, and three fragments from the borings of the Kent Coal Concessions Company, Ltd., in East Kent. The first series of insect-wings occur in greyish-brown ironstone nodules, which lie in bands in a yellow clay about 30 or 40 ft. below the top hard coal. The East Kent insect-remains occur in core shales, the horizon of which is not yet determined. The East Kent insect-remains contain one wing, referable to the genus *Soomylacris* (*Ettoblattina*), a species of which is already known from the Forest of Dean coalfield. The finding of two species of the same genus in coalfields so widely separated as those of the Forest of Dean and East Kent is not without interest, in view of the generally-accepted belief in the former continuity of the Coal Measures across the south of England.

Linnean Society, May 2.—Dr. D. H. Scott, F.R.S., president, in the chair.—Miss T. L. **Prankerd**: The structure of the Palæozoic seed *Lagenostoma ovoides*, Will.—Dr. Karel **Domin**: Additions to the flora of western and north-western Australia. The account was drawn up from undescribed material in the herbarium of the Royal Botanic Gardens, Kew, consisting chiefly of collections by Dr. E. Clement and Captain A. A. Dorrien-Smith. Beside many new varieties, the author characterises fourteen new plants, one being *Casuarina dorrieni*, eight grasses, three being species of Panicum, and five other Monocotyledons.—G. H. **Wailes**: Fresh-water Rhizopoda from the States of New York, New Jersey, and Georgia, with a supplementary account of some species from the Seychelles. The gatherings forming the basis of the present paper were collected in the autumn of 1911; the Rhizopod fauna is summed up as being rich in species and individuals, about 80 per cent. being similar to those found in Europe. The remainder of the paper was devoted to a systematic account of the species found, including three new species of Nebela, one of Euglypha, and many varieties.

Physical Society, April 26.—Mr. A. Campbell, vice-president, in the chair.—The adjourned discussion on Mr. H. Donaldson's paper on the coefficients of expansion of fused silica and mercury was resumed. Prof. H. L. **Callendar** opened the discussion by communicating a paper on the expansion of vitreous silica. The expansion of vitreous silica at ordinary temperatures had acquired special interest recently in connection with mercurial thermometry and standards of length and expansion. The majority of observers had used the Fizeau method with specimens 10 mm. to 15 mm. long. Somewhat different values had been found for different specimens with different standards of comparison. For a cylindrical specimen on a platinum-iridium tripod Chappuis found 50×10^{-6} for the expansion from 0° C. to 100° C., and $0{\cdot}385\times10^{-6}$ for the coefficient at 0° C. Scheel, for a similar specimen, tested against a quartz-crystal ring, found $45{\cdot}5\times10^{-6}$ from 0° C. to 100° C., and $0{\cdot}217\times10^{-6}$ at 0° C. For a ring specimen tested in a vacuum by the absolute method he found values almost identical with Chappuis; but Randall, employing a similar ring specimen, also made by Zeiss, found the mean coefficient from 16° C. to 80° C. (which is nearly the same as that from 0° C. to 100° C.) to be only $0{\cdot}424\times10^{-6}$. Such differences might be due to accidental errors, or to differences in form and treatment of the specimens employed, or to differences in the standards of comparison. But since the whole expansion of 1 cm. of fused silica between 0° C. and 100° C. was only of the order of one wave-length of light, it was also possible that small constant errors might arise in so delicate an experiment from gas-films or other surface effects variable with temperature. It seemed, therefore, desirable to measure the expansion of the long silica rods at low temperatures by a direct interference method in which such sources of error were excluded. The method used gave a smaller and more rapidly diminishing value for the expansion of the silica rods than that obtained by other observers employing the orthodox Fizeau method with short specimens. With the assistance of Mr. A. Eagle, the author had made some observations on the difference between the radial and axial expansion of a silica tube similar to that from which the bulbs of the mercury weight thermometers employed by Harlow and Eumorfopoulos had been constructed. Three sets of determinations had been made by Mr. Eagle on three different days with closely concordant results. The mean of these showed that the axial coefficient of expansion of the specimen tested exceeded the radial coefficient by $0{\cdot}20\times10^{-6}$ over the range 18° C. to 90° C. This result agreed as closely as could be expected with the values of the cubical coefficient deduced from the weight thermometer observations of Harlow and Eumorfopoulos when the values of Callendar and Moss for the absolute expansion of mercury were assumed.—R. **Appleyard**: The solution of network problems by determinants. The paper is a practical application of the method described before the Physical Society in 1885 by Dr. J. A. Fleming. Let it be supposed that cyclic currents have been assigned to all the meshes of a given network, and that all capacities (K, in farads), inductances (L, in henries),

and leakances (S, in mhos) have been converted into resistances in ohms

$$\left(\frac{1}{Kip}, Lip, \frac{1}{S}, \text{where } p=4\pi\sim\right).$$

The general network problem then is to find the current, in amperes, in any given branch, corresponding to the application of an E.M.F. of sine form, between any two fixed points in the network.

MANCHESTER.

Literary and Philosophical Society, April 23.—Prof. F. E. Weiss, president, in the chair.—R. L. **Taylor**: The action of bleaching agents on the colouring matter of linen. The author showed that the colouring matter of unbleached linen is quite abnormal with regard to the action of the ordinary bleaching agents upon it, and differs from every other colouring matter with which he is acquainted. Whereas colouring matters, such as indigo, Turkey-red, and the colouring matter of cotton, are bleached much more rapidly by free chlorine or hypochlorous acid than by a hypochlorite, with the colouring matter of linen the exact opposite is the case, this being bleached more rapidly by a solution of a hypochlorite. Apparently the maximum bleaching effect on unbleached linen is produced by a solution of a hypochlorite which contains no free alkali, but rather some free chlorine or hypochlorous acid. Excess of alkali retards the bleaching action, just as it does in the case of other colouring matters. The addition of a chloride to the solution sometimes accelerates and sometimes retards the bleaching action (this depending upon the amount of alkali in the solution), instead of, as is the case with other colouring matters, always accelerating it.

CAPE TOWN.

Royal Society of South Africa, March 20.—Mr. S. S. Hough, F.R.S., president, in the chair.—L. **Peringuey**: Bushman sticks decorated on intaglio and poker-work, a note on the decorative skill of the Bush people and other aborigines. Specimens of sticks, decorated with drawings and carvings, also bust models, &c., were exhibited. On the sticks the intaglios were extremely fine, and represented hunting scenes, in which men in police uniform and on horseback were depicted with most consummate skill; other sticks were ornamented with poker-work and line drawings of very great artistic merit, but representing modern subjects, a railway train among them. Poker-work was, in his opinion, probably of Kafir origin, and it was quite possible that the Bush people had obtained it from the latter, but improved on it through their natural artistic disposition. He had at one time doubted the authorship of rock-graving in connection with the Bush people, but he exhibited a Bush painting in which the back of the animals had been graved. The Bushman thus combined the two arts, graving and painting.—J. R. **Sutton**: Some meteorological conditions controlling nocturnal radiation. According to the results obtained, it appears that after allowance has been made for the state of the sky and the movement of the air, the only factor of real importance determining the radiation temperature gradient is the relative humidity.—T. **Muir**: The resultant of a set of homogeneous lineo-linear equations. Three different methods are given for obtaining the resultant, but the main interest is concentrated on one of them, because of two or three somewhat obscure references made to it by Sylvester when studying the problem in 1863.—W. A. Douglas **Rudge**: The variation in the value of the atmospheric electrical potential with the altitude. This paper gives some account of observations taken at various places in South Africa in order to find the relation which exists between the atmospheric potential gradient and the altitude of the places of observation. Observations were taken between Lourenco Marques and Durban, *via* Johannesburg, passing thus from sea-level to sea-level over a considerable stretch of country in which the altitudes rose to nearly 7000 ft. The general result is that there is a great change in the value of the potential gradient with the altitude, the extreme value at the highest point (6500 ft.) being not more than one-eighth of that at sea-level. Similar differences having been observed on previous occasions at other places, led to the investigations being conducted. The maximum values were about 500 volts per metre at Lourenco Marques and Durban, and 58 volts at Belfast, 6500 ft. above sea-level, and at places in between values were obtained which showed that the greater the altitude the smaller the potential gradient. An exception to this rule was seen at Johannesburg, where the potential gradient was very variable and changed signs at different points in the neighbourhood. These variations were traced to the clouds of steam, and especially of dust, proceeding from the mine heaps. Steam has the effect of increasing the positive gradient, while dust lowers it.—H. A. **Wager**: Respiration and cell energy.

BOOKS RECEIVED.

The Mechanics of the Aëroplane. By Captain Duchêne. Translated by J. H. Ledeboer and T. O'B. Hubbard. Pp. x+231. (London: Longmans and Co.) 7*s.* 6*d.* net.

Richtlinien des Entwicklungs- und Vererbungsproblems. By Prof. A. Greil. Erster Teil. Pp. iii+352. (Jena: G. Fischer.) 10 marks.

Building Stones and Clays: their Origin, Characters, and Examination. By E. C. Eckel. Pp. xv+264. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd.) 12*s.* 6*d.* net.

German Varnish-making. By Prof. M. Bottler. Authorised translation, with Notes on American Varnish and Paint Manufacture, by A. H. Sabin. Pp. vii+363. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd.) 15*s.* net.

Canada. Department of Mines. Mines Branch: an Investigation of the Coals of Canada with reference to their Economic Qualities, as conducted at McGill University, Montreal, under the Authority of the Government of the Dominion. By Drs. J. B. Porter and R. J. Durley and others. Vol. i. Pp. xxiii+243+maps+plates. (Ottawa: Government Printing Bureau.) 1 dollar.

The Elements of Statistical Method. By W. I. King. Pp. xvi+250. (London: Macmillan and Co., Ltd.) 6*s.* 6*d.* net.

Zoology. By Prof. J. G. Kerr. Pp. vii+99. (London: J. M. Dent and Sons, Ltd.) 1*s.* net.

A Class Book of Physical Geography. By A. T. Simmons and E. Stenhouse. Pp. viii+436. (London: Macmillan and Co., Ltd.) 4*s.* 6*d.*

An Outline of the Russo-Japanese War, 1904–1905. By Colonel C. Ross. Vol. i. Pp. xxv+490+maps. (London: Macmillan and Co., Ltd.) 10*s.* 6*d.* net.

Studies in Seeds and Fruits: an Investigation with the Balance. By H. B. Guppy. Pp. xii+528. (London: Williams and Norgate.) 15*s.* net.

Scientific Papers. By John William Strutt, Baron Rayleigh. Vol v., 1902–1910. Pp. xiii+624. (Cambridge University Press.) 15*s.* net.

Petrographisches Praktikum. By Dr. R. Reinisch. Zweiter Teil, Gesteine. Zweite Auflage. Pp. vii+217. (Berlin: Gebrüder Borntraeger.) 7.60 marks.

Fertilisers and Crops, or the Science and Practice of Plant-Feeding. By Dr. L. L. Van Slyke. Pp. xiv+734. (New York: Orange Judd Co.; London: Kegan Paul and Co., Ltd.) 2.50 dollars.

Handwörterbuch der Naturwissenschaften. Edited by E. Korschelt and others. Achte Lief. Pp. 321–480. Neunte Lief. Pp. 545–960. (Jena: G. Fischer.) each 2.50 marks.

Das Tierreich. Edited by F. E. Schulze. 32 Lief. Tunicata, Salpæ I., Desmomyaria. By Dr. J. E. W. Ihle. Pp. xi+67. (Berlin: R. Friedländer & Sohn.)

Allen's Commercial Organic Analysis. Edited by W. A. Davis and S. S. Sadtler. Fourth edition. Vol. vi. Pp. ix+726. (London: J. and A. Churchill.) 21*s.* net.

A Catalogue of the Vertebrate Fauna of Dumfriesshire. By H. S. Gladstone. Pp. xiv+80+map. (Dumfries: J. Maxwell and Son.)

Tables of Logarithms, Anti-logarithms, and Reciprocals. Pp. 7. (London: C. and E. Layton.) 1*s.*

Bush Days. By Amy E. Mack. Pp. xii+132. (Sydney: Angus and Robertson, Ltd.; London: Australian Book Co.) 3*s.* 6*d.* net.

A Manual of Practical Bio-Chemistry for the use of Students during Introductory Courses. By Dr. H. L. Kesteven. Pp. 64. (Sydney: Angus and Robertson, Ltd.; London: Australian Book Co.) 2*s.* 6*d.* net.

Søren Hjorth, Inventor of the Dynamo-Electric Principle. By S. Smith. Pp. v+29. (København: J. Jørgensen and Co.)

Die Entdeckung des Radiums. By Mme. P. Curie. Pp. 28. (Leipzig: Akademische Verlagsgesellschaft m.b.H.) 1.50 marks.

Ueber neuere thermodynamische Theorien. By Prof. Max Planck. Pp. 34. (Leipzig: Akademische Verlagsgesellschaft m.b.H.) 1.50 marks.

Views and Reviews from the Outlook of an Anthropologist. By Sir H. Johnston. Pp. 314. (London: Williams and Norgate.) 3*s.* 6*d.* net.

The Essentials of Morbid Pathology. By Prof. A. S. Grünbaum. Pp. xvi+219. (London: Longmans and Co.) 7*s.* 6*d.* net.

The Marlborough Country. By H. C. Brentnall and C. C. Carter. Pp. 171. (Oxford University Press.) 2*s.* 6*d.* net.

Inorganic Chemistry for Beginners. By the Right Hon. Sir Hy. Roscoe, assisted by Dr. J. Lunt. Second edition. Pp. x+256. (London: Macmillan and Co., Ltd.) 2*s.* 6*d.*

Examples in Arithmetic. Part ii. By H. S. Hall and F. H. Stevens. Pp. 117–281+xxiii–xxxix (Answers). (London: Macmillan and Co., Ltd.) 2*s.*

Heat Engines. By H. A. Garratt. Pp. xi+332. (London: E. Arnold.) 6*s.*

Contre la Métaphysique: Questions de Méthode. by F. Le Dantec. Pp. 255. (Paris: F. Alcan.) 3.75 francs.

DIARY OF SOCIETIES.

THURSDAY, MAY 16.

ROYAL SOCIETY, at 4.30.—(1) The General Theory of Colloidal Solutions; (2) The Tension of Composite Fluid Surfaces and the Mechanical Stability of Films of Fluid; (3) On the Formation of a Heat-reversible Gel: W. B. Hardy.—(1) Studies on Enzyme Action. XVI. The Enzymes of Emulsin. II. Prunase, the correlate of Prunasin; (2) Studies on Enzyme Action. XVII. Enzymes of the Emulsin Type. II. The Distribution of β-enzymes in Plants: Prof. H. E. Armstrong, E. F. Armstrong, and E. Horton.—Studies on Enzyme Action. XVIII. Enzymes of the Emulsin Type. III. Linase and other Enzymes in Linaceæ: Prof. H. E. Armstrong and J. V. Eyre.—Reflex Rhythm Induced by Concurrent Excitation and Inhibition: Dr. Alexander Forbes.—The Factors in Rhythmic Activity of the Nervous System: T. Graham Brown.

ROYAL INSTITUTION, at 3.—Ice Formation in Canada. I. The Physical Aspect: Prof. H. T. Barnes, F.R.S.

INSTITUTION OF MINING AND METALLURGY, at 8.—Illogical Precision in Mine Reports: F. Percy Rolfe.—The Law of the Pay-streak in Placer Deposits: J. B. Tyrrell.—Gold and Platinum Alluvial Deposits in Russia: Leon Perret.—A Plant for the Enrichment of Pyritic Blende Concentrates: E. C. Hugon.

INSTITUTION OF ELECTRICAL ENGINEERS, at 7.45.—Annual General Meeting.—At 8.30.—Condensers in Series with Metal Filament Lamps: A. W. Ashton.

ROYAL SOCIETY OF ARTS, at 4.30.—Indian Railways: Neville Priestley.

FRIDAY, MAY 17.

ROYAL INSTITUTION, at 9.—High Frequency Currents: W. Duddell, F.R.S.

MONDAY, MAY 20.

ROYAL GEOGRAPHICAL SOCIETY, at 3.—Anniversary Meeting.

ROYAL SOCIETY OF ARTS, at 8.—Heavy Oil Engines: Captain H. R. Sankey, R.E.

TUESDAY, MAY 21.

ZOOLOGICAL SOCIETY, at 8.30.—Lantern Exhibition of Game Animals from British East Africa: A. Blayney Percival.—The Local Races of Burchell's Zebra: Major J. Stevenson Hamilton.—On Two New Larval Trematodes from the Striped Snake: Dr. W. Nicoll.—On *Dipteropeltis*, a New Genus of the Crustacean Order Branchiura: Dr. W. T. Calman.—Second Contribution to our Knowledge of the Varieties of the Wall-Lizard (*Lacerta muralis*). G. A. Boulenger.—A Note on the Rare British Nudibranch *Hancockia eudactylota*, Gosse: Sir Charles Eliot, K.C.M.G.

ROYAL INSTITUTION, at 3.—The Study of Genetics: Prof. W. Bateson, F.R.S.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Demonstration of Maor Skulls: Dr. R. J. Gladstone.

ROYAL SOCIETY OF ARTS, at 4.30.—Australian Railways: Hon. J. G. Jenkins.

ROYAL STATISTICAL SOCIETY, at 5.—Railway Accounts and Statistics: W. M. Ackworth and George Paish.

WEDNESDAY, MAY 22.

ROYAL METEOROLOGICAL SOCIETY, at 4.30.—The Thunderstorm of March 11, 1912, in Hampshire and Sussex: C. J. P. Cave.—The Automatic Release of Self-Recording Instruments from Ballons-Sondes: Eric S. Bruce.

THURSDAY, MAY 23.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* Theory of a New Mechanism for Varying the Volume of Discharge in the Rotating Slider Crank Form in the Chamber Crank Chain of Rouleaux: H. S. Hele-Shaw.—A New Treatment of Optical Aberrations: Prof. R. A. Sampson.—On the Extinction of Light by an Illaminated Retina: Sir W. de W. Abney, K.C.B.—Optical Measurements at High Pressures: Walter Wahl.—The Changes in Certain Absorption Spectra in Different Solvents: T. R. Merton.—Changes in Absorption Spectra of "Didymium" Salts: W. C. Ball.—The Viscosity of Carbon Dioxide: Dr. P. Phillips.

ROYAL INSTITUTION, at 3.—Ice Formation in Canada: The Economic Aspect: Prof. H. T. Barnes, F.R.S.

FRIDAY, MAY 24.

ROYAL INSTITUTION, at 9.—Recent Advances in Agricultural Science: The Fertility of the Soil: A. D. Hall, F.R.S.

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