THURSDAY, FEBRUARY 19, 1914.

THE PRACTICAL METALLURGY OF STEEL. *Liquid Steel, its Manufacture and Cost.* By David Carnegie, assisted by Sidney G. Gladwin. Pp. xxv + 520 + x plates. (London: Longmans, Green and Co., 1913.) Price 25*s.* net.

THE outstanding features of this valuable book are its most useful tables of the costs, both of plants and working expenses, which, as the authors point out, are approximate, being subject to the market fluctuations of material and labour. The first fifty pages of the book deal with the various materials used in steel manufacture, opening with a disconcerting table of the world's output of steel ingots. In 1910 the United States of America made about 26,000,000 tons, Germany 14,000,000, and the United Kingdom only 6,000,000 tons. The authors point out that Germany became easily the second steel-producing country of the world owing to the introduction of the basic process, a method worked out by British metallurgists. The authors, however, do not sufficiently emphasise the fact that Great Britain now holds her position in the steel world on the quality, and not upon the quantity, of her output. The materials dealt with by the authors in their opening section also include fuels, refractory materials, fluxes, and ferro-alloys.

Part i. of the book deals with the crucible process, and the authors very truly point out that for quality (in spite of various new and valuable methods of steel-making introduced from time to time) steel made by Huntsman's process has remained supreme so far as quality is concerned for more than 170 years. In a paragraph on p. 51 the authors state that for the killing of steel ingots by means of metallic aluminium "Mitis brought out his method." The reviewer suggests to the authors that the use of aluminium (originally employed for making very mild "mitis" steel castings) was discovered by Nordenfeldt and Oestberg in Sweden about 1885. Its use for killing crucible steel ingots was first elaborated in a research forming the subject of the presidential address inaugurating the formation of the Sheffield Metallurgical Society in 1891. The authors deal with the slight but important chemical changes taking place in the crucible process in a lucid and accurate manner, though the sulphur increase from 0·05 to 0·09 per cent., noted on p. 53, suggests the use of a coke very high (say 2 per cent.) in sulphur.

Part ii. deals with the Bessemer process, and here the authors do not appear to have fully realised the differences between the English Bessemer process and the Swedish Bessemer process, nor to have grasped the vital feature of Mushet's patent which made English Bessemer steel a marketable product. The essence of Mushet's contribution was to remove the dissolved FeO, which rendered Bessemer's blown metal hopelessly red-short, by the following reaction:—

$$\underset{\text{Soluble}}{FeO} + Mn = \underset{\text{Insoluble}}{MnO} + Fe.$$

Hence the insoluble MnO passed into the slag, and the de-oxidised steel forged readily. In Sweden, instead of adding metallic manganese at the end of the blow it is present to the extent of, say, 3 per cent. in the pig iron, and hence the formation and solution of FeO during the blow is prevented. With the above exceptions the acid and basic Bessemer methods and surface-blown modifications, such as those of Robert and of Tropenas and of Stock, are well described. A valuable chapter on blowing engines is included.

Pages 253 to 257 deal with the "physics" of Bessemer steel castings, an unfortunate term from a scientific point of view, since it has reference to the amounts of ferro-silicon, ferro-manganese, aluminium, &c., necessary for the production of sound steel castings. The term "additions" might well be substituted for that of "physics."

Part iii. deals with the open-hearth process, and gives a very valuable series of illustrations of the various types of furnaces employed. An equally admirable section deals with the various designs of gas producers. The consideration of the open-hearth process is concluded by a most useful set of examples of the charges, analyses, and uses of open-hearth steel, and a brief consideration of duplex methods.

Part iv. is devoted to electric steel-making by both the arc, induction, and combined methods, but it does not make a very clear differentiation between results which are obviously theoretical or estimated and those obtained in actual practice.

Part v., and last, is devoted entirely to costs, and will without doubt be of great use to works managers.

This book is written with a knowledge obviously the result of experience, and great care has been exercised in selecting information likely to be of practical importance. It may be unhesitatingly recommended as a work of standard rank.

J. O. ARNOLD.

POPULAR AND SPECIAL PHYSICS.

(1) *Wireless Telegraphy and Telephony without Wires.* By C. R. Gibson. Pp. 156. (London: Seeley, Service and Co., Ltd., 1914.) Price 2*s.* net.

(2) *A Text-book of Physics.* By Dr. R. S. Willows. Pp. viii+471. (London: Edward Arnold, n.d.) Price 7*s.* 6*d.* net.

(3) *Medizinische Physik.* By Prof. Otto Fischer. Pp. xx+1120. (Leipzig: S. Hirzel, 1913.) Price 36 marks.

(4) *Principles of Thermodynamics.* By Prof. G. A. Goodenough. Second edition, revised. Pp. xiv+327. (London: Constable and Co., Ltd., 1913.) Price 14*s.* net.

(1) MR. GIBSON'S book is a brightly written account of the development of wireless telegraphy, with just sufficient broadly popular explanations to give the ordinary reader the impression that he is understanding the nature of electricity and of electric waves. The historical sketch in chap. iv., in which the early suggestions and experiments of Steinheil, Morse (1844), Lindsay (1854), Trowbridge, and Preece (1882) find their due place, is very good reading, and the account of Lodge's syntonic jars and the improvements effected by Jackson, Righi, and Popoff brings out many points on which the ordinary man's memory has become somewhat hazy. Then comes Marconi's "antenna" and earthed apparatus, which increased the effectiveness of radiotelegraphy a hundredfold, and led to its most striking triumphs. From that time forward "wireless" and "Marconi" become almost synonymous among English speakers, but the German combination of the Braun-Siemens and Slaby-Arcs systems now known as the "Telefunken" system is allowed some space, and the American systems of de Forest and Fessenden, as also the Danish Poulsen system, are briefly described. A chapter on "telephoning without wires," a chronological table, and a short glossary of terms conclude a pleasing and eminently readable volume.

(2) Dr. Willows's "Text-book of Physics" treats the elementary phenomena rather more fully than do other works of a similar kind. One would suppose it to be intended mainly for self-tuition, to judge by the numerous examples (with answers) and the rather detailed style. The ground covered is the same as that already surveyed in countless physical works, and there is not much that is new, either in subject-matter or method of treatment, though one is pleased to see Callendar and Barnes's "J" apparatus, the hot-wire ammeter, and the moving-coil galvanometer duly explained. The illustrations are good, except Fig. 134 (erecting prism), which is incorrectly drawn. There are some minor shortcomings, such as the quite incredible explanation of osmotic pressure on p. 15, but on the whole it is a thoroughly useful and creditable work, which will no doubt be widely appreciated.

(3) A special work on "Medical Physics" is necessarily of a somewhat limited scope, but eclecticism has been carried almost to an extreme in Prof. Otto Fischer's substantial volume. It resolves itself into a collection of treatises on three or four chosen subjects. The first and most voluminous of these is the work on the kinematics and kinetics of linkages, with special reference to joints. It gives graphic methods for the kinematic analysis of the empirically determined motion of a point, and methods of compounding translational and rotational velocities, demonstrates the equivalence of the most general finite displacement of a body in space with a screw motion, and reduces the kinetics of manifold linkages to the kinetics of single, rigid bodies. Many examples are given, and the mathematical treatment is reduced to its simplest terms. One cannot help wishing that this portion of the book had been published separately, as it is self-contained, and the whole work, weighing more than 4 lb., makes an unwieldy handbook. The remainder of the volume gives certain chapters of acoustics and optics. The former comprise stationary and progressive waves, sound analysis, the physics of the ear, and the voice mechanism. The optical portion is a treatise on geometrical optics, the microscope, and the polarimeter. Only twelve pages are devoted to the human eye. If it were not for the many numerical problems and examples which form the most valuable feature of this work, one would scarcely see much prospect of it successfully competing with its many rivals. In a work on medical physics, one would have expected something on the motion of liquids in elastic and capillary tubes, on osmose and dialysis, on thermometry and hygrometry, on spectroscopy, on string galvanometers, nerve currents, and cardiograms. All this is conspicuous by its absence. It is a pity to see the utility of this otherwise admirable work curtailed by such faults of publication and presentation.

(4) Prof. Goodenough's "Thermodynamics" aims primarily at laying an adequate foundation for the advanced study of heat engines. The treatment of the fundamental laws is that of Bryan, which identifies the "second law" with the law of degradation of energy, and defines entropy in terms of unavailable energy. Chapters

x. and xi. give an account of the recent experiments on saturated and superheated vapours made in the Munich laboratory, and by Marks and Davis, and new equations for the specific heat, entropy, energy, and heat content of superheated steam are deduced and published for the first time. Throttling and "wire-drawing" are treated very fully, and a concise discussion of the various types of steam turbines and refrigerating apparatus using vapour media brings this useful and eminently practical volume to a close.

THREE BOOKS ON ENTOMOLOGY.

(1) *The Entomologist's Log-Book, and Dictionary of the Life Histories and Food Plants of the British Macro-Lepidoptera.* By A. G. Scorer. Pp. vii + 374. (London: George Routledge and Sons, Ltd., 1913.) Price 7*s.* 6*d.* net.

(2) *The Fauna of British India, including Ceylon and Burma.* Edited by Dr. A. E. Shipley, assisted by Guy A. K. Marshall. *Diptera nematocera* (excluding Chironomidæ and Culicidæ). By E. Brunetti. Pp. xxix + 581 + xii plates. (London: Taylor and Francis; Calcutta: Thacker, Spink and Co., 1912.) Price 20*s.*

(3) *Handbuch der Entomologie.* Herausgegeben von Prof. Chr. Schröder. Lieferung 1–3. Pp. iv + 480. (Jena: Gustav Fischer, 1912–13.) Price 15 marks.

(1) "THE Entomologist's Log-Book," compiled by Mr. Scorer, should be extremely useful to all those who for any reason are interested in the natural history of our British butterflies and larger moths. Not only the ordinary collector, but also the worker in bionomic problems and the economic entomologist will find here information of value in easily accessible form. The arrangement of the book is alphabetical, the names of both insects and plants occurring in their proper order, so that reference to any item that may be wanted can be found at once. Under the name of each plant is given a full list of the Macrolepidoptera that feed upon it; while as to the insects themselves, it would be difficult to adduce any well-authenticated fact of their life-history which is not duly recorded in the appropriate place. We have tested the data in several particulars, and have found them accurate and trustworthy as representing existing knowledge. There are still gaps in our information as to life-histories; many of these, it is to be hoped, will be filled up by the help of Mr. Scorer's book, the usefulness of which is enhanced by interleaving with blank pages.

(2) The names of the editors and author of the recently published volume of the "Fauna of British India," dealing with the *Diptera nematocera*, are a sufficient guarantee that the work is worthy of the admirable series to which it belongs. The study of the two-winged flies, besides its intrinsic scientific interest, derives great importance from the influence exercised by members of the order upon agriculture and forestry, and their intimate connection with various forms of disease. Mr. Brunetti's work bears the impress of much minute and careful investigation; and the sections devoted to the external anatomy, the life-history of the early stages, and the classification of the Diptera are as valuable in their way as the more distinctively systematic portion. The plates of wing-venation and other details are well executed and clear.

(3) The first three parts of the elaborate "Handbuch der Entomologie," issued under the editorship of Prof. Schröder, contain chapters by Prof. Deegener, of Berlin, on the integuments and cutaneous organs, on the nervous system and organs of sense, the alimentary tract with its appendages, the organs of respiration and circulation, the body-cavity, the musculature and endoskeleton of insects. Dr. Prochnow adds a section on stridulating and other sound-producing organs. The portion at present published, which runs to nearly 500 pages, is less than a quarter of the work as it will ultimately appear. It will be seen, therefore, that the treatise has been planned on an extensive scale. The parts now before us constitute the fullest connected account as yet available of the departments of insect morphology with which they deal. The execution of the work is for the most part good, and the figures reach a high standard of merit. The bibliography, though in places not quite complete, has evidently been compiled with great care.

In a general work of this kind, however excellent, it usually happens that the student of special points finds something to criticise. There is no exception here; the section devoted to scent-glands contains several statements that are open to question, and a figure is borrowed from Illig which purports to represent a plume-scale from *Pieris napi*, but gives a very erroneous idea of that structure. Freiling, from whom several figures are taken, though cited in the text, appears to have no place in the bibliography. But slips of this kind are rare. It is worth noting that the remarkable conclusions on pupal assimilation announced by the Gräfin von Linden (see NATURE, vol. xc., 1913, p. 379) are considered by Prof. Deegener to be unwarranted by the existing evidence.

F. A. D.

OUR BOOKSHELF.

Die radioaktive Strahlung als Gegenstand wahrscheinlichkeitstheoretischer Untersuchungen. By Prof. L. v. Bortkiewicz. Pp. 84. (Berlin: Julius Springer, 1913.) Price 4 marks.

THIS mathematical work is a critical application of the theory of chance to the breaking down of radio-active atoms. Its discussion is mainly based on the experiments of Rutherford and Geiger. Scintillations were produced on a screen by polonium, and were counted over a succession of equal short intervals of time, and the intervals were classified by the number of them which showed either no scintillation or one or two or more. The experimenters found that their numbers agreed well with those predicted by the theory of pure chance, but they gave no criterion as to the closeness of agreement to be expected. The calculation of the "mean errors" is a simple matter, but in the comparison of such a series of numbers it is only likely that in a few of the cases the mean error should be considerably exceeded. Prof. Bortkiewicz therefore provides a single test for the whole experiment. He works out twelve cases, and concludes that the results are, on the whole, slightly closer to their most probable values than is predicted by theory. He suggests an experimental cause for this small discrepancy. He also discusses one of the experiments of Marsden and Barratt, who made their analysis by classifying the lengths of time between each two successive scintillations, and he concludes that the distribution is normal. In this case his test is not perfectly satisfactory, as it involves the use of quadrature and interpolation formulæ, processes which would seem to be very unsuitable for problems of chance. In both types of experiment distributions can be contrived which pass his tests, and yet are in reality very improbable, but no doubt there are great mathematical difficulties in the way of deriving the true probability test. From his work we may conclude that the search for regularity, other than the regularity of chance, in the disintegration of radio-active atoms is not a hopeful quest.

C. G. D.

A Pocket-Book for Miners and Metallurgists: Comprising Rules, Formulæ, Tables and Notes for use in Field and Office Work. Compiled by F. D. Power. Third edition, corrected. Pp. xiv + 371. (London: Crosby Lockwood and Son, 1914.) Price 6*s.* net.

MINING engineers are nowadays called upon for knowledge and powers in so many directions that to anticipate moderate success and escape serious blame, they must exhibit qualities for which Gilbert and Sullivan's heavy dragoon could not hope. To be ready to act at short notice as an explorer, a geologist, a civil and mechanical engineer, a chemist, a metallurgist, a doctor, and a lawyer, a man needs some little book in his pocket which he can consult as each new problem comes into view. Such a book Mr. Danvers Power set himself to construct many years ago, and the third edition, now issued, is not less successful than its forerunners. There is no trace of the amateur about the little volume. It is the work of a professional man who has set down the things he wanted to know himself. Like all pocket encyclopædias, it does not contain everything that could be wished for. There might have been included something about furnaces, refractory substances, and melting points, a few tips on mine-surveying problems, a little more about the strength of materials, and perhaps some information on first aid. But although there may be a few omissions, so much is included that the book deserves a trial by every prudent miner or metallurgist.

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.*]

The Constitution of the Interior of the Earth as Revealed by Earthquakes.

ON p. 45 of Dr. G. W. Walker's recently published book, "Modern Seismology," I find the following sentence:—"It has sometimes been asserted that S never reaches beyond a certain distance, and to explain this an impenetrable core of the earth has been assumed. We see that no such hypothesis is at all necessary to explain the observations." The reference here seems to be to a paper, by myself, "The Constitution of the Interior of the Earth as Revealed by Earthquakes," which was published in the Quarterly Journal of the Geological Society (vol. lxii., 1906), or, more probably, to the references to this paper contained in Prof. Wiechert's paper, "Ueber Erdbebenwellen," published in the *Nachrichten d. K. Gesellschaft d. Wissenschaften* (Göttingen, 1907), and as the summary dismissal of the subject indicates an imperfect appreciation of the problem, which is one of the important problems of the immediate future of seismological research, I trust you will afford me space to state the position.

In my paper, referred to above, I pointed out that the twofold character of the preliminary tremors, representing the arrival of two distinct forms of wave motion, can be traced continuously up to a distance of about 110° or 1200 km. from the origin, and that a comparison of the times of arrival of the waves at different distances shows a progressive and gradual increase of interval with distance, and affords no indication of any great change in the character of the material traversed by the wave paths. Beyond 12,000 km., however, the second phase can no longer be recognised with certainty, and has either entirely disappeared or is represented very feebly and with a considerable delay, as compared with the time of arrival which would be anticipated from the records of observations at lesser distances from the origin. From this I concluded that the wave paths to these more distant stations must have entered a central core of matter differing markedly in constitution from the outer portion of the earth, in that it was either quite incapable of transmitting the second-phase waves, or only transmitted them with a considerable diminution of energy and of rate of transmission.

Prof. Wiechert explains the facts in a different manner. From the laws of reflection, and assuming a tolerably homogeneous earth, he deduces the con-

clusion that waves incident on the earth's surface would suffer reflection accompanied by splitting up of the simple condensational or distortional waves into two sets, one of each kind, so that, at distant stations, the arrival of the direct waves would be complicated by the arrival of reflected waves, which had travelled one part of their course as condensational, and the other as distortional, waves. The critical point at which confusion from this cause would arise is at about 120° distant from the origin, and the disappearance of the second phase, as a recognisable feature in seismograms at greater distances, is attributed to this cause; the records, which I had accepted as possibly indicating a diminished and retarded appearance of this phase, being interpreted as the arrival of the reflected distortional waves.

With regard to this explanation, I may say that the reality of the reflected waves, though accepted by many seismologists, and practically universally by the Germans and the whole school dominated by the influence of their work, still seems to me far from being established. The theory is based on the assumption of a globe of uniform constitution bounded by a reflecting surface, but this does not exist in nature, for the outer crust of the earth is composed of material which was long ago shown, I believe first by Prof. Rudzki in 1899, to be composed of material which cannot transmit simple condensational and distortional waves, but transforms them into more complex forms of wave motion. Nor have we reason to suppose that the lower surface of this outer crust presents a definite surface of contact between two media of different character, from which reflection could take place; rather it is to be expected that the transition is gradual and that the simple forms of wave motion, which can be propagated through the central portion of the earth, would be gradually converted into more complex forms, and become extinguished, in the surface layers. On the observational side, too, the case is not conclusive, for though the presence of reflected waves in the record has been claimed, more particularly in the case of earthquakes originating in the Malay Archipelago and beyond, their presence does not seem to be constant, nor by any means so conclusively established as the reality and distinctness of the first- and second-phase waves.

Accepting, however, the reality of reflected waves and the interpretation, offered by Prof. Wiechert, of the records accepted by me, with considerable hesitation, as possibly representing the arrival of the second-phase waves, it does not afford a sufficient explanation of the absence of the record of the arrival of the second-phase waves, travelling along the direct course from the origin, in seismograms from stations at and beyond 12,000 km. from the origin. This phase is well represented, and usually conspicuous, especially in the records of horizontal pendula with a moderate rate of travel of the recording surface, and up to the limiting distance, at which it disappears, forms a feature in the seismogram which should be recognisable even if superimposed on the record of reflected waves; for, apart from the hypothesis of a central core of material less capable of transmitting these waves, there is no reason for anticipating a diminution in the amplitude of the record at greater distances, but rather the reverse.

The length of wave path of the waves emerging at the antipodes of the origin is certainly greater, about 12,750 km., as against about 9500 km. for waves emerging at 10,000 km. from the origin, but, on the other hand, two wave paths starting directly downwards with a divergence of 1° will issue on the surface at a distance of about 222 km. apart, and two wave paths starting at an inclination of about 70° to 74° downwards from the horizontal and a divergence of 1° will reach the surface at some 10,000 to 12,000 km. from the origin, and at a distance of about 500 km. apart. Setting these two against each other, we have, on one side, the increased energy due to a more than twofold concentration of wave paths, and, on the other, the greater absorption due to about 30 per cent. greater length of wave path, the former of which should more than counterbalance the latter, so that the record of the direct waves ought to be more conspicuous at greater distances than between 10,000 and 12,000 km., up to which it is easily recognisable. I have examined most of the records obtained at greater distances previous to 1906, and some of later date, but have failed to discover the second phase, and it seems reasonable to suppose that this may be explained by the wave paths to these greater distances having encountered a different form of matter which is less capable of transmitting the second-phase waves from that traversed by the wave paths which do not descend so deeply into the interior of the earth.

Though this letter has run to a considerable length, I hope you will allow me space to refer to another passage in Dr. Walker's book, on p. x. of the introduction, where he refers to a paper by me (published in *Phil Trans.*, 1900) as the first application of the well-known theory of longitudinal and transversal waves to Milne seismograms. Had Dr. Walker verified his reference he would have found that the paper has nothing to do with Milne seismograms, and that it was the first published demonstration of the *three-fold* character of the wave motion recorded at a distance from the origin, and incidentally an explanation of the failure of earlier attempts to interpret the records in terms of the two forms only, of longitudinal and transversal waves. R. D. OLDHAM.

The Evidence for Spontaneous Generation.

IN reference to the letter of Profs. Farmer and Blackman in NATURE of February 12, it seems needful to state that only two of my tubes were opened in their presence. One of them showed, as I had predicted, bodies very closely resembling Torulæ, in large numbers. They were not, however, typical Torulæ, such as are represented in Figs. 1, 3, and 5, of my communication published in NATURE of January 22, and I am prepared to admit some doubt as to their nature. The other tube showed, as others of the same series had done, peculiar spores, which when shown together with their mycelium (as in Fig. 2) to an eminent fungologist, were said by him to belong to a mould allied to the genus Oospora. He had no doubt as to its nature; and I am certain that these moulds must have grown within the tubes after their sterilisation, in one case to the extent of producing, after sixteen months, two tufts plainly visible to the naked eye.

I am glad to learn that one of the colleagues of Profs. Farmer and Blackman is repeating my experiments, and trust he will, after a time, be able to solve their doubts. H. CHARLTON BASTIAN.

The Athenæum, February 13.

The Wearing of Birds' Plumage—A Woman's Protest.

IT is very gratifying to find how earnestly the best papers are now taking up the cause of the various beautiful birds hitherto so cruelly and callously slaughtered for the sake of their plumage. The dealers in feathers seem to think that because they have embarked in that particular trade it must never

be abolished, no matter if the most exquisite birds become extinct.

It is known that many trades have suffered severely from the advent of the motor-car. Whip-makers have scarcely anything to do. Harness-makers have also suffered, yet these trades could scarcely demand that motors should not be used because such might suffer thereby. And as the world becomes more thoughtful and humane, surely if birds are to be safe the plumassiers must go to the wall, and no great harm. There are other callings in which they must by degrees embark.

It is very strange that men do not more definitely show how very much they dislike seeing ospreys and humming-birds in women's hair or headgear. Men who are most feeling and know all about it, and keenly detest the cruelty that these ornaments involve, will sit by women at dinners and operas and not show in the slightest degree what they feel about these barbarous ornaments. After all, women only adorn themselves to please men, and if these had the courage to show how intensely they disliked, and were distressed, by these things, they would decidedly not be worn. To their intimates they could say, "How much more charming you would look with anything on your head or hat than that."

Of course, there is no denying the fact that woman is the sinner, and it seems very sad and shocking that all the trouble and misery brought upon birds with beautiful plumage is owing to the ignorance or cruelty of woman—*cherchez la femme*. Yes, alas! woman—and woman alone—is the sinner. She will not listen to the voice of her sisters who *do* know, and who so gladly would, and could, put her in the right way of looking at the matter. As she adorns herself chiefly to please men, well, let them educate her, with scorn and strong words if her vanity or stupidity leave her cold to information kindly given.

There is no supply without demand. This holds good of every commodity; and let the demand once cease, and all the endeavours of the kind-hearted lovers of the beautiful to preserve birds now so ruthlessly destroyed for no purpose but the adornment of vain and stupid women will be needless.

There is such an abundance of lovely ornaments to be had. Natural or artificial flowers, exquisite ribbons, laces, &c., and if there must be feathers, then take some which require no cruelty to procure, and which the deft fingers of most clever workers can dye and trim into things of weird beauty, almost as pretty as the real thing, for glint and twist can be added to ducks' and fowls' feathers enough to satisfy a savage. These would not only save the birds, but their feathers, being no longer required, would come into ever-increasing demand, and give work to thousands of women who are always complaining that there is nothing much left for them to do. This makes so many of them force themselves into positions which males could occupy. Every woman who takes a position a man could fill prevents one man marrying. This is an aspect of the case seldom considered by women, and would be well for them to ponder on. One is glad of *any* argument to induce women to think and to act in such a way that the horrible cruelties associated with their feathered heads may in time be a thing of the past. There is no doubt if they *knew* the shocking cruelties perpetrated to obtain such an unsuitable adornment to any kind-hearted woman's head, they would certainly not wish the *real* ospreys and humming-birds' feathers to be procured for them.

Of course, imitation feathers would be cheap—to some women an unpardonable fault. Well, when the adornment *must* be expensive, there are jewels and laces.

O. L.

Specific Heats and the Periodic Law—An Analogy from Sound.

I AM much interested in Dr. H. Lewkowitsch's letter on specific heats and the periodic law, which appeared in NATURE of February 12. His suggestion, based on Guldberg and Wage's "mass law," of a reconciliation between Sir James Dewar's recent low-temperature experiments and Dulong and Petit's earlier experiments on specific heats, seems to me most valuable.

I am well aware that analogies are apt to be dangerous, especially when pushed very far. Nevertheless, I am proposing to put forward the analogy from acoustics which may interest some of your readers.

The experiments on which my analogy depends are performed on an ordinary pianoforte, and as they may be repeated by anyone, I will state the directions thus:—Very gently strike a high note (say C in alt) with "loud" pedal down and the finger soon removed; change to soft pedal and notice how long the note is audible as you sit at the piano. Repeat in all particulars with a lower note (say C, two or three octaves below). It will be found that the lower note persists very much longer than does the higher note. Next repeat everything in the same way, but strike powerfully instead of gently. Notice the time during which each loud note remains loud (or audible to a friend in the next room). It will be found that there is very little difference in the duration of the two loud notes.

I think the analogy to be deduced is fairly obvious, but I will state it nevertheless.

Very soft notes arise from wires when vibrating with small amplitudes; these wires correspond to atoms at very low temperatures, for atoms under such conditions vibrate also with small amplitudes.

On the piano a definite amount of damping (produced by pedal action) curtails the amplitudes of the compared vibrating wires in a ratio which approximately is *inversely proportional* to their respective masses—*i.e.* equal damping (equal resistance to motion) has the *smaller* effect on the *more* massive wire. The results of Sir James Dewar's experiments at low temperatures are echoed *pianissimo* by these vibrating wires.

Louder notes correspond to higher temperatures; the amplitudes both of wires and of atoms are wider. In these circumstances of higher excitement, it is found on the piano that about the same amount of energy is wanted to reduce equally the loudness of light and heavy wires, while in the calorimeter it was shown by Dulong and Petit that about the same amount of energy is degraded in reducing equally the temperatures of light and heavy atoms.

REGINALD G. DURRANT.

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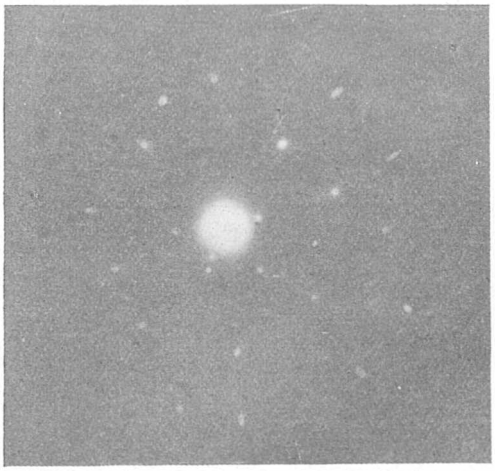
X-Rays and Metallic Crystals.

IN NATURE (August 14, 1913), and later in the *Philosophical Magazine* (October, 1913), Keene gave an account of some interesting experiments on the transmission of X-rays through rolled metal sheets. In connection with his investigation it may be of interest to record some results we have obtained in recent work on metallic crystals.

Some preliminary experiments were carried out with annealed specimens. A lump of copper, for instance, was cut in two, and one of the pieces heated up to a high temperature and then allowed to cool gradually, whilst the other piece was left untreated. Beams of X-rays were allowed to fall at almost grazing incidence on the two newly cut surfaces, and the reflected

beam was examined on a photographic plate. It was found that the untreated specimen gave no definite reflection. In the case of the annealed specimen, however, spots were observed on the plate indicating that there were now present in the metal, crystals big enough to reflect quite an appreciable portion of the beam in definite directions. The same results were observed whether the surfaces were highly polished or badly tarnished.

On passing beams of X-rays through various metallic crystals, *e.g.* antimony, zinc, aluminium alloy (50 per cent. Al and 50 per cent. Cu), Laue spots were observed on the photographic plates. The spots



obtained on transmission through an antimony crystal are shown in the adjoining photograph. Owing, however, to the difficulty of procuring individual crystals of the metals, symmetrical Laue patterns have not yet been obtained. The experiments, however, show that this method of investigating metallic crystals may prove very helpful to the metallurgist.

E. A. OWEN.
G. G. BLAKE.

Teddington, February 9.

The Magneton and Planck's Constant.

THE relation between the magneton and Planck's constant is even more intimate than Dr. Allen's remarks (NATURE February 5), and his numerical illustration would suggest.

Using the notation employed by Dr. Allen, an electron (charge e, mass m) moving in a circular orbit (radius a) with angular velocity ω would have angular momentum $ma^2\omega$, and magnetic moment $\frac{1}{2}ea^2\omega$. On Dr. Bohr's hypothesis the angular momentum is related to Planck's constant h by the relation $ma^2\omega = h/2\pi$, and the magnetic moment becomes $e/m\ h/4\pi$, as Dr. Allen indicates.

The value of the magnetic moment per atom gram is $n\frac{e}{m}\frac{h}{4\pi}\frac{R}{k}$, where n is the number of such electrons per atom, and R and k the constants of the gas theory, so that R/k is the ratio of the atom gram to the atom.

Taking $\frac{e}{m} = 1{\cdot}772\ _{10}{}^{7}$

$\frac{ch}{k} = 1{\cdot}437$ (from radiation measurements)

$R = 8{\cdot}316\ _{10}{}^{7}$,

we have the magnetic moment per atom gram $= n\ 5617{\cdot}1$. But the magnetic moment per atom gram, as given by Weiss ("Idées Modernes sur la Constitution de la Matière," p. 334), is 1123·5, so that the number of such electrons in five atoms is equal to the number of magnetons per atom, as defined by Weiss, with the accuracy of Weiss's measurements and that of the constants above.

If instead of Bohr's hypothesis, the alternate one, that the angular momentum is equal to h/π, be employed, the five is replaced by ten. This seems to indicate that, in the magnetic materials, there is a unit of five (or ten) atoms, which has a constant number of magnetons.

The above results were stated by the writer in the discussion on radiation at the British Association, Birmingham, 1913. S. D. CHALMERS.

The Northampton Institute, Clerkenwell, E.C.,
February 7.

Zonal Structure in Colloids.

IF Mr. George Abbott (NATURE, January 29, p. 607) will refer to the paper by Prof. J. W. Gregory and myself on eozoonal structure in the ejected blocks of metamorphosed limestones of Monte Sommá and Vesuvius he will find that twenty years ago I explained the mechanism of zonal structure, and showed it to be of osmotic origin in that and other cases. This has been amply confirmed by further investigation into illustrations of my "osmotic theory" of metamorphism, and, although paid little attention to by my own countrymen, is amply credited by the recent publications of Liesegang and Kurd Endell.

Amongst several of my papers will be found references to concentric laminated structure in such objects as spherulites, oolites, pisolites, calculi, &c. This I would attribute to zones of chemical exhaustion or surplus, which, in the end, is very nearly related to chemical exhaustion or surplus in osmotic interchange.

H. J. JOHNSTON-LAVIS.

Beaulieu-sur-Mer (A.M.), France,
February 1.

DR. JOHNSTON-LAVIS'S letter is indeed welcome; it confirms my own impression that English geologists have neglected concretionary processes. During my fifteen years of observation of the Fulwell beds no one ever suggested osmosis to me before Prof. S. Leduc. Even the authorities of the British Museum, South Kensington, whilst accepting a large number of my best specimens—some of them I cannot replace—have since repeatedly refused to give them the benefit of a modern classification, because none could be "recognised."

Few persons realise the great "experiment" made by nature at Sunderland, where there are two square miles of limestone, 130 ft. thick, associated with 70 ft. of the so-called marl beds. All the limestone shows magnificently the unique concretionary structure such as is unknown elsewhere in England, and, possibly, in the world.

The osmotic influence, or "osmotic interchange," as Prof. Johnson-Lavis calls it (Prof. Küster, of Bonn, in a recent letter to me says, "rhythmical precipitation, not osmosis") has operated in, and through, all the 130 ft. of rock, whilst the forces of crystallisation must have been subsequent and partial.

The change apparently took place after the strata had become solid enough for the formation of ordinary joints, the structure being conspicuous in starting from joints and bedding planes, whilst the pattern is very seldom seen to cross them. Pisolites and spherulites are, of course, common.

GEORGE ABBOTT.

Rusthall Park, Tunbridge Wells, February 9.

THREE BOOKS ABOUT BIRDS.

(1) THE prefatorial note of Mr. Lowe's book, apparently emanating from the publishers, tells us that this is the first of two volumes, of which the object is to help those who wish to know something about the birds they see at the seaside. It does not claim to be a scientific work in the strict sense; but the author, Mr. Lowe, is a man of science and a traveller far and wide, and knows how to appeal equally to the specialist and the general reader. Though heavy in the hand and somewhat trying to the eyes, the book is undoubtedly a beautiful one, and will be most welcome to all who wish to learn something about birds of the shore. Happily, the photographs with which it abounds are all good, and far more useful and striking than those of most inland birds, of which we have long been getting rather weary. Both the birds of the sea and their haunts suit photography wonderfully well, and some of these pictures, notably the frontispiece, a flying gannet, are quite superb. There are, of course, too many of them, and the distinction between a picture-book and a book of natural history is not consistently maintained; for instance, in the excellent introductory chapter, where Mr. Lowe emphasises the fact that all our sea birds, the auks, petrels, and the kittiwake excepted, rarely wander far from the shore, the eye of the youthful reader will be distracted from the letterpress to photographs which have no direct bearing on the question. Yet it is most important, as a foundation of his knowledge, that he should learn this fact soundly, and be able to let his mind work on the hydrographical map opposite page 2.

On p. 22 we have two fragments of letterpress dealing with the general distribution of the gulls and their kind, interrupted by a picture of black-headed gulls coming to rest, and opposite it is one (occupying the whole page) of a herring-gull in a state of "suspicion." Turning over the page we find two whole pages occupied with photos, and Mr. Lowe's last unfinished sentence on p. 22 is only re-discovered, like one of his own ringed birds, on p. 26. Surely it would have been better, less distracting for old eyes as well as young minds, to print this chapter so that it might run consecutively, uninterrupted by illustrations which do not belong to it. Later in the book it becomes a positive relief to be able to read a page or two of letterpress almost free from photos; this is so in the very interesting description of the skuas, birds which do not allow even the most ardent photographer to deal with them very freely. Perhaps in the second volume it may be found possible to keep more consistently to the principle that illustrations should illustrate.

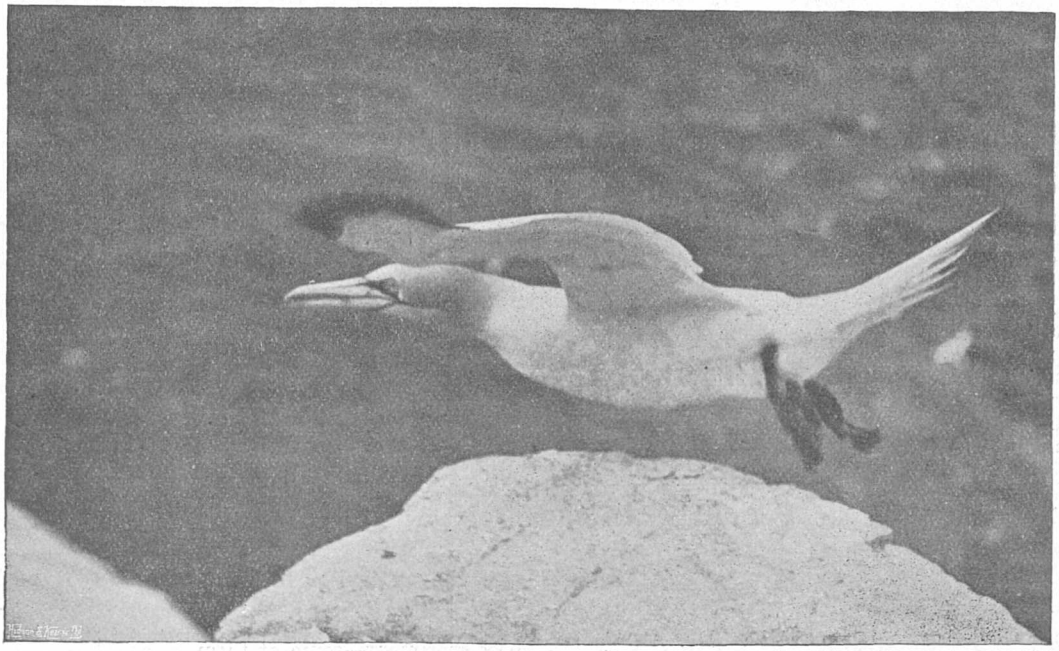


FIG. 1.—Gannet—commencement of flight. From "Our Common Sea-birds."

But we gladly allow that a great number of the photographs may be found scientifically valuable as well as artistically beautiful; for example, there is much matter here for the student of the flight of birds, especially of the gannet. And those who simply turn over the book to look at the pictures will learn much of "the life and conversation" of some thirty species, which they never could have realised (or as we say now, *visualised*) before the days of bird-photography. Lastly, as photography has brought all the writers—for there are others beside Mr. Lowe—into immediate contact with the birds they have studied for

1 (1) "Our Common Sea-birds." By Percy R. Lowe. Pp. xvi+310. (London: *Country Life*, Ltd., n.d.) Price 15*s*. net.
(2) "Bird Life Throughout the Year." By Dr. J. H. Salter. Pp. 256+ plates. (London: Headley Brothers, n.d.) Price 7*s*. 6*d*. net.
(3) "Wild Life on the Wing." By M. D. Haviland. Pp. iv+244+plates. (London: A. and C. Black, 1913.) Price 5*s*. net.

long, solitary hours in all manner of wild places, we often find vivid descriptions of their ways and movements far exceeding in interest those of pre-photographic days.

Some of the best work in the book will be found near the end, where the auks are treated of, and photos are fewer. We may specially notice Mr. Lowe's attempt to account for the "wreck" of countless little auks in February, 1912, and on other occasions, by reference to the nature of the bird's oceanic food, which might be sunk too deep for them by sudden currents of cold air reducing the temperature of the surface water; they would thus be driven before the storm in search of their usual supplies. My Pycraft a few pages further on tries to solve the mystery of the guillemot's egg, but confesses that there is no certain explanation.

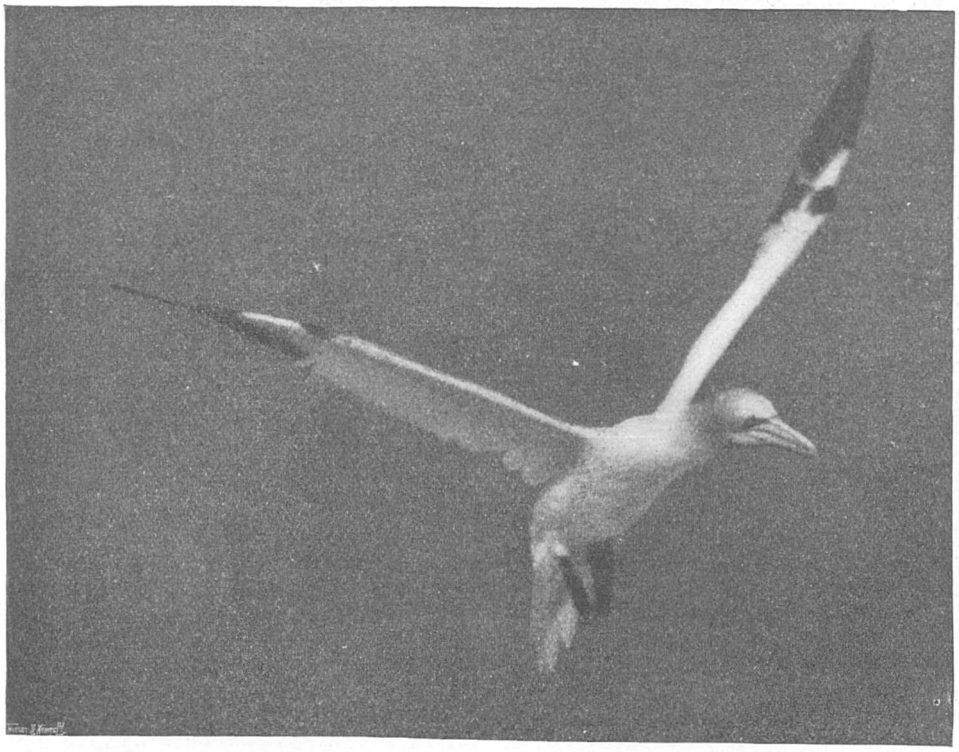


FIG. 2.—Putting on the brake. From "Our Common Sea-birds."

(2) "Bird-Life throughout the Year," by Dr. J. H. Salter, is a pleasant collection of notes, some of them unusually interesting, *e.g.*, that on the nesting of the dotterel (p. 170). Dr. Salter is a real naturalist, to whom we are mainly indebted for the interest aroused in the preservation of the kite in South Wales, and his book will be a safe and stimulating guide for the young beginner. There are some good photographs in it, but the coloured ones are not always successful.

(3) "Wild Life on the Wing," by M. D. Haviland, is a collection of stories about teal, woodcock, &c., by one who is not deficient in woodcraft. Whether she is equally an adept in the art of telling a tale may be doubted; but the book is a pleasant one, and well adapted for a gift.

THE RADIATION PROBLEM.

THE radiation discussion, which was one of the most notable features of the Birmingham meeting of the British Association, appears to have created a general impression that some radical revision of our ideas as to the nature of radiation must now be regarded as unavoidable. It may therefore be of interest to give a brief summary of the present state of the problem.

Its acute phase has been brought about by the remarkable successes achieved by some forms of what is known as the "theory of quanta." This theory, or rather hypothesis, assumes that not only matter, but energy itself, has an atomistic or discontinuous structure, particularly when it is flung out into space in the form of radiant energy or radiation.

Are we, then, drifting back to a corpuscular emission theory of light, destined to replace the now generally accepted wave theory? Such a return to older views would not be altogether without precedent. History has witnessed similar fluctuations of view as regards the shape and motion of the earth, and as regards the structure of electricity. And the triumphs of atomistic conceptions in other fields, achieved with the aid of radioactivity and of Brownian motions, make the propaganda for a further extension of the atomistic principle easy. R. A. Millikan[1] maintains that the number of atoms and molecules in a given mass of matter may now be counted with as much certainty and precision as we can attain in counting the inhabitants of a city. With the characteristics of these inhabitants we can deal by means of the science of statistics, and the adherents of the new atomistic theory of radiation would have us apply statistical methods to an immense range of physical investigations.

But the hypothesis of "quanta" or irreducible and indivisible elements of energy is not merely atomism gone mad. There are certain undeniable and undoubted facts which find their simplest

[1] *Science*, vol. xxxvii., p. 119, January 24, 1913.

explanation in the hypothesis of a discrete structure of radiant energy.

Chief of these is the observed mode of transfer of energy from kathode-rays to X-rays, and *vice versâ*. Kathode rays are electrons projected with enormous velocities. The stoppage of an electron by the target in the Röntgen tube generates an X-ray pulse. All electrons are stopped within a time, which is the shorter the greater their energy of motion. Hence the X-ray pulse generated is "thin" in proportion as its energy is great. The more rapid the kathode rays, the thinner, "harder," and more penetrating are the X-rays.

Now the beautiful recent work on the reflection and interference of X-rays, often referred to in NATURE, has proved that these rays are covered by the wave-theory of light. The X-ray waves are some 10,000 times shorter than the shortest ultra-violet light waves known. They have, like ordinary light, a wave-length, or rather a range of wave-lengths, and the energy of every X-ray wave is *proportional to its frequency*, since the thinner and "harder" pulses have the smaller wave-lengths.

But this is not all. When X-rays impinge on a target, electrons are projected from it; they in turn constitute kathode rays. The velocity of these electrons is independent of the intensity of the X-ray beam. It only depends upon its "hardness," *i.e.*, its frequency, or the reciprocal of its wave-length. To put it in the language of visible light, the velocity with which an electron is expelled from the target depends, not upon the "brightness" of the X-rays, but solely upon their "colour," and is the greater the more that colour tends towards the "blue" end of the spectrum.

Moreover, those electrons which are not expelled from the material exposed to the X-rays appear to be quite unaffected, and they form the vast majority of the electrons present, unless a particular "characteristic frequency" is used for the existing rays, whereupon the electrons come out in enormous numbers.

The handing on of a quantity of energy intact from X-ray to kathode-ray and back to X-ray was used to support an atomistic view of the X-rays themselves, until it was found that the same rules apply to the liberation of electrons by ultra-violet light. Here arose a dilemma: either ultra-violet light itself (and probably all radiation) is atomic, or there is some mechanism by which radiant energy can be absorbed until a definite quantity (proportional to the frequency) is accumulated, whereupon an electron is expelled. The remarkable thing is that this energy of the electron is actually derived from the light, so that the latter does not simply liberate internal energy by some sort of "trigger" action.

All this might not have ensured a hearing for an atomistic hypothesis of energy had not Prof. Max Planck (now rector of Berlin University) put forward a theory of radiation based upon quite other considerations, which also involved an atomic structure of energy, at least when radiated.[2] He was endeavouring to explain the experimental fact that the total heat of all wave-lengths radiated by a black body (not a blackened body, but the "ideal" black represented, say, by the mouth of a deep cave) is proportional to the fourth power of its absolute temperature, and found that no formula completely representing the relation between the frequency and the amount of energy associated with it could be written down unless the energy was flung out by each molecular radiator in definite amounts or "quanta" proportional to the frequency, *i.e.*, inversely proportional to the "wave-length." This immediately accounted for the fact that, as a body gets hotter, it passes from "red" heat to "white" heat (*i.e.*, towards higher frequencies) until, when we reach the temperature of the sun, the maximum energy is well within the visible spectrum.

The actual magnitude of the supposed quanta is excessively small. For a frequency of 1 vibration per second, it would only amount to 6×10^{-27} erg, a quantity known as the "action constant." For frequencies like that of green light (600 billion per second) it would still only amount to some billionths of an erg, but such is the marvellous sensitiveness of the eye, that it can detect light (say, from a star of the sixth magnitude) when the amount of energy passing through the pupil is only some 300 or 400 quanta per second.

What, then, is the mechanism of this radiation by quanta? Are we to suppose that it resembles the sound waves proceeding from the incessant but irregular rifle fire of a large army, in which each soldier gradually accumulates sufficient powder to fire his shot? Or is it atomistic, like the bullets? Or must we fall back upon Sir J. J. Thomson's bold but rather appalling conception of a gigantic web of countless threads pervading the universe, in which each thread connects a positive and a negative electric atom, and bears its trembling message along with the speed of light in a single direction?

Whichever view may be finally adopted, we may be sure that the investigation of this fascinating problem will teach us a great deal about the interstellar æther which conveys the messages. The recent German attempt to explain away the æther, known as the electromagnetic "Principle of Relativity," has failed in its main object. Gehrcke, in his preface to Drude's "Lehrbuch der Optik," describes that principle and its temporary sway as "the most notable case of mob suggestion since the days of the N-rays." The hypothesis of quanta is saved from a similar failure by keeping in close touch with experiment. In the hands of Nernst and Lindemann and Debye it has been used with brilliant success for investigating and explaining the fall in the specific heat of all bodies as we approach the absolute zero of temperature. The specific heat probably begins by being proportional to the cube of the absolute temperature, so that the heat energy of the body is proportional to the fourth power, thus recalling the Stefan-

[2] "Vorlesungen über Wärmestrahlung," 2nd edition. (Leipzig, Barth.)

Boltzmann law of total radiation already mentioned.

Planck's "action constant" has turned out a most useful quantity in all sorts of investigations, and although its actual nature is somewhat doubtful,[3] it may yet turn out to be, like the velocity of light, one of the fundamental constants of nature.

But before any quantum theory of radiant energy can be accepted, it must make its peace with those phenomena (chiefly diffraction and interference) which overthrew Newton's emission theory, and established the wave theory of light. That has not yet been done, or even attempted, so there is but little prospect as yet of a decisive battle. E. E. FOURNIER D'ALBE.

TRANSPARENCE OR TRANSLUCENCE OF THE SURFACE FILM PRODUCED IN POLISHING METALS.[1]

IN a communication to the British Association (B.A. Report, 1901, p. 604) it was suggested that all smooth metal surfaces are covered with an enamel-like transparent layer. In a subsequent communication to the Royal Society (vol. lxxii A, p. 218) the actual formation of a surface layer or skin by polishing was demonstrated. Two of the photo-micrographs in the latter paper, Figs. 5 and 6, plate 9, showed that minute pits on a polished surface of antimony had been covered over by a film of this description. It was suggested that the diminished reflecting power of the film covering the pits probably indicated that it had become translucent, but no direct evidence of this translucence was afforded by these particular observations. It was also suggested that the film might have been carried across the pits on a support provided by small granules or flakes which had filled up the pit to the level of the general surface. The purpose of the present communication is to record and illustrate certain recent observations which show:—

(1) That the film which covers the pits is transparent, or at any rate highly translucent, and

(2) That in the case of the smaller pits the mobile film has been carried across the empty pit without any support from below.

In the casting and working of copper, unless certain precautions are taken, the metal is always more or less spongy owing to the presence of gas bubbles. When the surface of this metal is ground and polished some of the gas bubbles are laid open and appear on the surface as tiny pits. If the cast metal has been subjected to cold working, by rolling or otherwise, the larger bubbles are distorted and take elongated and other varied forms.

By any method of polishing which will give a fair surface the pits are flowed over and obliterated, but by lightly etching the surface with a solvent the surface skin can be removed, and the pits are again disclosed. By careful regulation of the action of the solvent it is possible to remove the surface layer step by step, and the film covering the pits can be reduced to extreme thinness. Through this thin film one seems to be looking right into the pit. In polishing metal surfaces the amount of the metal which is removed by the polishing agent can be varied through wide limits under conditions which need not be specified here. It is sufficient for the present purpose to state that by suitable methods the skin developed on the surface may be raised to a maximum thickness or reduced to a minimum. For the present inquiry it was desirable that the film produced should be as thin as possible. The copper used in these experiments received its final polishing on fine linen stretched over a hard, flat surface, and moistened with one of the ordinary commercial brass polishing liquids. On the copper surface prepared in this way the pits, as seen under high magnification, appear as blue spots on the pale rose-coloured ground of the solid metal. While some of the film-covered pits appear uniformly blue, others show patches of red at various parts of their surface. When these red patches were first noticed it was supposed that they indicated a thickening of the film at these points to the extent necessary for normal reflection. More careful study has shown that the red patches are due to reflections from the inner concave surface of the pit. The beam of light from the vertical illuminator behind the back lens of the object glass of the microscope passes through the film covering the pit, strikes the concave metallic surface, and is reflected back through the film to the object glass and thence to the eyepiece. The reflecting surface of the pits is evidently far from optical perfection, and the reflected beam is therefore more or less broken up by irregularities of the reflecting surface.

By the use of autochrome plates it has been possible to obtain high power photo-micrographs in natural colours of pits on a copper surface. Four of these transparencies have been reproduced by the three colour process, and are shown on the plate issued as a supplement to this week's NATURE. Figs. 1 and 2 are at a magnification of 800 diameters, and 3 and 4 at 1800 diameters. In Figs. 1 and 3, the pits are covered by a blue film, but show patches of red on the blue. Figs. 2 and 4 show the same pits after the film has been dissolved and removed by a 10 per cent. solution of ammonium persulphate acting for 20 to 30 seconds. On comparing the members of each pair, 1 with 2, and 3 with 4, it is seen that the red patches in 1 and 3 correspond with the spots of light reflected from the concave surfaces of the uncovered pits as shown in 2 and 4.

It is clear that the pits which show these reflections from the under surface must have been practically empty when they were covered by the film, so that the film during its flow was quite unsupported from below.

The thickness of the films covering the pits is probably of the order of 10 to 20 micro-millimetres.

[3] It is an energy divided by a frequency, but has also been regarded as an angular momentum.

[1] Paper read before the Royal Society on February 12 by Dr G. T. Beilby, F.R.S.

H. B. WOODWARD F.R.S.

BY the death of Mr. Horace B. Woodward we have lost a geologist with an unrivalled experience of the stratigraphy of the British Isles. His father, Dr. S. P. Woodward, was engaged in the British Museum; and Horace, who was born in 1848, began his geological career at the age of fifteen in the employment of the Geological Society of London, as assistant in the Library and Museum. In 1867 he obtained an appointment on the Geological Survey under Sir Roderick Murchison, and continued in that department until the end of 1908. During the last seven-and-a-half years of his service he occupied the post of assistant director, and was in charge of the work in England and Wales.

In the course of this period of forty-one years Woodward did much towards developing the work of the Survey, in the direction of both precision and utility. The early surveying was carried out for the greater part of England and for all Wales on the Old Series 1-in. map. By no one were the difficulties of precise mapping on so small a scale and so obsolete a basis more successfully met than by Woodward, and it was not until his career as a member of the field-staff was drawing to a close that 6-in. ordnance maps became available. His duties lay at first in adding detail to the mapping of the Rhaetic and other secondary strata in the south-west, but later on he spent many years in Norfolk and the adjoining counties in mapping superficial deposits and the underlying Tertiary and Cretaceous strata.

Woodward was author of many valuable memoirs. The results of his early field-work are incorporated in the Geological Survey Memoirs on the East Somerset and Bristol Coalfields, on the Geology of Norwich, and the Geology of Fakenham. But the most important of his official publications were the three volumes on the Jurassic Rocks of Britain, which appeared in 1892–5. This work was the outcome of a project to bring together all that is known of each British formation. Yorkshire was otherwise provided for; but as regards the rest of the country, the heavy task of gathering all that was worth preserving from copious literature, of examining the principal sections throughout the country, and of presenting the whole in an intelligible form, was carried out single-handed by Woodward.

At this period of his official career he was temporarily engaged in Scotland in applying his knowledge of the Jurassic rocks of England to the elucidation of the occurrences in Raasay and Skye. The commercial development of the iron-ores of Raasay was due in the first place to his suggestion that there occurred there iron-ores of economic value on the same horizon as the Cleveland ores.

His more statistical memoirs, such as those on the water-supply of Lincolnshire, and of Bedfordshire with Northamptonshire, are valued as works of reference; but he showed, too, a happy facility for putting geological information into a form that was agreeable to the general reader in his account of Soils and Subsoils, and of the Geology of the London district.

Outside his official work his most important publication was the "Geology of England and Wales," first published in 1876, but revised and enlarged in 1887. An untiring industry and a wide experience of the subjects on which he was writing enabled the author to produce a work that is indispensable both to the student of the science and to those who are interested in its practical applications. No less useful in their respective subjects are his "Geology of Water-Supply," of "Soils, and Substrata," and his contributions to the Victoria County Histories.

In 1904, when the Geological Society was preparing for its centenary celebration in 1907, it was decided to prepare a volume in which the birth, development, and influence of the Society might be traced. It was felt that the writing of the historical part of such a volume could be safely entrusted to one who claimed close connection with the Society and its work for half a century.

Woodward was elected to the Geological Society in 1868, and was the recipient of the Murchison Fund in 1885, the Murchison Medal in 1897, and the Wollaston Medal in 1909. He was also one of the most active members of the Geologists' Association, and served as president in 1893–4. He was elected to the Royal Society in 1896.

His health had begun to fail at the time of his retirement from the Geological Survey, but he worked on with untiring industry until within a few hours of his death, on February 6, 1914.

COL. A. R. CLARKE, C.B., F.R.S.

IT is with more than usual regret that we record the death, on February 11, at eighty-five years of age, of Colonel Alexander Ross Clarke, one of the foremost geodesists of our time. Born in 1828, he was commissioned second lieutenant in the Corps of Royal Engineers in 1847, and was appointed to the Ordnance Survey in 1850. From this date onwards to his retirement in 1881 his energies were devoted to the work of the Survey with the exception of a three-year tour of service in Canada (1851–4). Throughout this period the work of the Ordnance Survey was in a most interesting stage, and it was fortunate that he was available to assist in the development of its scientific labours.

In 1856 Clarke took charge of the trigonometrical and levelling departments. The work of the Principal Triangulation was complete in the field, and in 1858 Clarke published the final results. The reduction of the observations by the method of least squares was in itself a laborious task, but in this volume is published in addition his first investigation into the figure of the earth.

In 1861 appeared, in two volumes, the abstracts

of spirit-levelling in England and Wales, and in Scotland, for which Clarke was mainly responsible. During this year he was appointed, with two others, to meet certain French officers and draw up a scheme for connecting the triangulations of England and France. In 1862 he observed at several of the English stations of the connection, and in 1863 published the account of the completed work.

In 1860 the Russian Government invited the co-operation of the Governments of Prussia, Belgium, France, and England to cooperate in the measurement of the European longitudinal arc from Orsk to Valencia. A necessary preliminary was the intercomparison of the standards of length of the various countries affected. At the instigation of the English Government these standards were sent to Southampton, where they were compared by Clarke in a specially designed and built bar room. The result of this undertaking was published in 1866, and included in the series were 10-ft. bars for India and Australia. At the end of this volume is the second investigation which Clarke made as to the shape of the earth. In 1867 he published a pamphlet on the positions of the Feaghmain and Haverfordwest observatories, also in connection with the longitudinal arc.

In 1874 two standard yards were made for the United States of America by Messrs. Troughton and Simms, and at the express desire of the United States Government, Clarke carried out the determination of their lengths. In 1880 appeared his "Geodesy," a subject on which he had already contributed an article for the "Encyclopædia Britannica." This work has been translated into several languages.

In 1881 he retired as Lieut.-Colonel, after thirty-four years' service. Clarke's retirement was brought about by a sudden and unexpected order from the War Office to hold himself in readiness to proceed at short notice to Mauritius, and sever his connection with the Ordnance Survey. The national survey never suffered a severer loss. It took many years to recover.

The extent of the work done during those thirty-four years can only be appreciated by a study of the books he published, for they contain a mass of calculation which evidence great mathematical ability as well as great energy.

In 1883 Colonel Clarke was appointed delegate to the International Geodetic Congress in Rome in conjunction with the Astronomer Royal. In 1870 he was made a Companion of the Order of the Bath, and in 1887 he received the Royal Medal of the Royal Society, of which he was a Fellow. He was also a Fellow of the Royal Society of Edinburgh, of the Royal Astronomical Society, honorary member of the Cambridge Philosophical Society, and corresponding member of the Imperial Academy of Sciences of St. Petersburg.

Although he had for many years ceased to take an active part in the prosecution of his favourite subject, his name still remains, and will remain, a constant stimulus to a younger generation.

H. S. L. WINTERBOTHAM.

NOTES.

WE regret to announce the death on February 13, in the sixty-first year of his age, of M. Alphonse Bertillon, director of the anthropological department of the Prefecture of Police in Paris. M. Bertillon, following the custom of his family, devoted himself to the study of human races. At the beginning of his career he paid particular attention to those characters of the body which might be used for the purposes of identification. In 1885, when he was in his thirty-second year, he published the first draft of his famous system of identification and registration of criminals under the name of "Instructions signalétiques." The principle on which his system rests is that no two individuals are alike in all their bodily measurements and proportions. In 1893 Bertillon's system was introduced to British prisons. The system which, in the hands of Bertillon himself and of his pupils, worked satisfactorily, proved to be untrustworthy when applied by a heterogeneous body of observers. Even in the hands of experts, exact measurement of the living body is difficult of attainment. Hence in 1901 Bertillon's system was replaced in this country by one founded on finger imprints, a method which had been developed in India by Sir Edward Henry. It is popularly supposed that M. Bertillon invented the system of identification by finger-prints, but this is an error. Dr. Henry Faulds, in NATURE of October 28, 1880, indicated how finger-prints might be applied to ethnological classification; and his was the first printed communication upon the subject, though public and official use of finger-prints had been made by Sir William Herschel in India some years before. M. Bertillon added the finger-print method to his own about 1891, after its advantages had been urged by Sir Francis Galton. Although Bertillon's system has proved defective in practice, still the merit of realising that a scientific system of measurements and observations could be elaborated to serve the purposes of the State will always stand to his credit. Under his system an enormous number of observations of the utmost scientific value have been accumulated and placed at the disposal of anthropological students.

THE first Guthrie Lecture of the Physical Society will be delivered by Prof. R. W. Wood, of Johns Hopkins University, Baltimore, at the Imperial College of Science, on Friday, February 27. The subject of the lecture will be "Radiation of Gas Molecules Excited by Light."

WE understand from Messrs. Gurney and Jackson that Major Barrett-Hamilton's lamented death, referred to last week (p. 667), will not cause any break in the publication of his valuable work on "British Mammals," as Mr. Martin C. Hinton has agreed to continue and complete the work.

ON Saturday, February 28, Sir J. J. Thomson will begin a course of six lectures at the Royal Institution on recent discoveries in physical science. On Tuesday, March 3, Sir J. H. Biles will deliver the first of three lectures on modern ships: (1) "Smooth-water Sailing," (2) "Ocean Travel," (3) "The War

Navy"; and on Thursday, March 5, Prof. C. F. Jenkin will begin a course of three lectures on heat and cold. The Friday evening discourse on February 27 will be delivered by Prof. W. A. Bone on surface combustion.

THE sea-fish hatching season at the Port Erin Biological Station has commenced earlier than usual this year, and seems to promise well. The first few hundreds of plaice eggs were found on the surface of the pond on January 28, and on February 3 embryos at least a week old were obtained. The pond was systematically skimmed for the first time on February 5, and a haul resulted of more than 200,000 fertilised plaice eggs, which are now in the hatching boxes. In recent years the first fertilised eggs have generally been obtained on some date between the middle of February and the first week of March, so the present season seems to be at least a fortnight earlier than usual.

AT the anniversary meeting of the Royal Astronomical Society, held on February 13, the following officers and council were elected for the current year:—*President,* Major E. H. Hills; *Vice-Presidents,* Dr. F. W. Dyson, Dr. J. W. L. Glaisher, Prof. H. F. Newall, and Prof. H. H. Turner; *Treasurer,* Mr. E. B. Knobel; *Secretaries,* Prof. A. S. Eddington and Prof. A. Fowler; *Foreign Secretary,* Prof. Arthur Schuster; *Council,* Dr. S. Chapman, Sir W. H. M. Christie, Rev. A. L. Cortie, S.J., Dr. A. C. D. Crommelin, Mr. W. Heath, Mr. J. H. Jeans, Dr. W. H. Maw, Prof J. W. Nicholson, Rev. T. E. R. Phillips, Dr. A. A. Rambaut, Prof. R. A. Sampson, and Mr. F. J. M. Stratton.

THE tenth annual meeting of the Association of American Geographers was held at Princeton at the beginning of last month. Mr. A. P. Brigham was elected president for 1914. One of the most important features of the meeting was the adoption by the association of the plan of cooperation proposed by the American Geographical Society. The plan provides for (1) a joint research committee of the two organisations to administer a joint research fund; (2) a joint meeting in New York each spring; (3) the publication by the association in collaboration with the American Geographical Society of the annals of the association; (4) an interchange of the publications of the two societies.

FROM numerous cuttings from the issues of the Manila Press for December 19 last which have reached us, we learn that the Bill introduced into the local Assembly, and intended to reduce the expenses of the Philippine Weather Bureau, has not been favourably received. Father Algué, the director of the bureau, who has presided over its activities for many years with conspicuous success, was given the opportunity on December 18 of laying before the Upper House, or Commission, as it is called, particulars as to the work of the bureau, and the small cost at which it is conducted. Commenting on Father Algué's statement the next day, the *Manila Daily Bulletin,* instead of supporting the suggested retrenchment, said "to the average man it should appear strange that no attempt is being made to increase the salaries of Father Algué and his entire staff at least 100 per cent."

WE recently announced the issue by Messrs. Macmillan of a new publication, *Ancient Egypt.* We have since received the first number of *The Journal of Egyptian Archaeology,* issued by the Egypt Exploration Fund. The two publications, though devoted to similar subjects, are so different in matter and *format* that there is ample room for both. In the latter the article of most general interest is that by Prof. Sayce on the date of Stonehenge. He directs attention to certain beads, now in the museum at Devizes, which he identifies as Egyptian, of the period 1450–1250 B.C. Mr. H. R. Hall points out that the same identification had already been made by him in the third volume of "The Eleventh Dynasty Temple at Deir-el-Bahari" (thirty-second memoir of the Egyptian Exploration Fund). This identification is not, of course, conclusive as to the exact date of the barrow. But it corresponds fairly closely with Prof. Gowland's conclusions derived from his excavations in the course of the re-erection of a fallen pillar. The evidence would thus assign the erection of Stonehenge to the fourteenth century before our era.

WE regret to announce the death on February 7, in her fifty-fourth year, of Dr. Julia Cock, consulting surgeon to the New Hospital for Women and Dean of the London (Royal Free Hospital) School of Medicine for Women. As a girl, Miss Julia Cock joined the small band of pioneer women who opened the medical profession to women. She had a distinguished career as a student, and obtained honours in her final examination. In 1887, Dr. Cock was appointed a member of the out-patient staff of the New Hospital for Women, and, in 1892, she became full physician to the hospital, round which her professional interests henceforth centred. To the end of her life she was a student, humble and eager to learn, a constant reader, untiring in her enthusiasm and devotion, an accurate observer, a magnificent clinical teacher. Dr. Cock did not value popularity, and never sought for personal recognition. She believed that "so long as good work is done, it does not matter who does it." For thirteen years she was joint lecturer in medicine at the London School of Medicine for Women. For eleven years she was dean of the school, and the high position taken by it in recent years is largely due to her administrative ability and statesmanship. She contributed valuable articles on various subjects to the literature of medical science.

THE death of Prof. H. F. Rosenbusch, on January 20, 1914, at the advanced age of seventy-eight years, removes one of the most influential authors from the field of mineralogy and petrology. It is remarkable that when Zirkel published his great work on petrography in 1866, the study of thin slices of rocks under the microscope was not appreciated as an aid to research. Seven years later, Rosenbusch had no difficulty in persuading geologists of the importance of "microscopic physiography," and a band of pupils gathered at Strassburg, and later at Heidelberg, who

rivalled those of Werner in carrying their master's views throughout the world. The stimulating publications of Lévy and Lacroix, working on absolutely independent lines on the other side of the Rhine, established the new methods with equal firmness; and for a time the enthusiastic study of rock-structure threatened to remove geologists from observation in the field. While Rosenbusch issued successive editions of his great work, "Die mikroskopische Physiographie der Mineralien und Gesteine," the latest being in conjunction with Dr. Wülfing in 1905–7, he also summarised admirably the characters of rocks in his "Elemente der Gesteinslehre," published in 1900. He was responsible for many changes and redefinitions in nomenclature, which have been promulgated by the weight of authority rather than by the light of reason; but the exactitude of thought and method brought by him into a subject that, since 1825, had fallen from its high estate, has earned the gratitude of petrologists in every land.

In the Transactions of the East Riding Antiquarian Society for 1912, which has recently been published, Mr. T. Sheppard contributes a valuable paper on East Yorkshire history in plan and chart. Between Bridlington and Spurn Point, a distance of some thirty miles, the land is being worn away at a rate varying from a few feet to more than 20 ft. per annum. The continuous changes in the coast-line are well illustrated by reproductions of a number of maps and charts, beginning with those of Leland and Lord Burleigh, in the time of Henry VIII., down to that by the late Mr. J. R. Boyle in 1889, showing the sites of the lost towns on the Humber.

A pamphlet by Prof. Ernst Schwalbe, entitled "Die Entstehung des Lebendigen," has just been published by Mr. Gustav Fischer, Jena. After a summary of the writings on the subject from Aristotle onwards, the author expresses the opinion that we are completely ignorant as to the origin of life, but he inclines to the view that it is supernatural.

In Lieferung 40 (pp. 1–37) of Dr. Schulze's "Das Tierreich" (Friedländer und Sohn, Berlin), Dr. G. Neumann, of Dresden, treats in considerable detail and in masterly style of the second division of the salpoid tunicates, constituting the groups Cyclomyaria and Pyrosomida. The diagrams illustrating the complex structure of these organisms seem all that could be desired, as are likewise the definitions of the various groups.

We have received a copy of *The Canadian Entomological Record* for 1912, published in the report of the Entomological Society of Ontario for that year, in which Mr. Arthur Gibson, chief assistant entomologist to the Department of Agriculture, records the most notable species of insects captured in the Dominion during the period under review, inclusive of those described as new. Another paper contributed by the entomological division of the Department of Agriculture, Ottawa—in this instance to vol. vi. of the Annals of the Entomological Society of America—records observations made by J. D. Tothill on variation in flies of the genus Lucilia. This variation embraces size, colour, and the mode of arrangement and number of the cephalic bristles. As the result of this study, it appears "that all the new characters used by Mr. Townsend for the erection of the ten supposedly distinct species are shown to come within the limits of variation of the North American species of Lucilia as recognised by Hough."

In January, 1912, Mr. C. W. Gilmore described, under the new generic and specific name of *Globidens alabamaënsis*, the remains of a mosasaurian reptile from the Upper Cretaceous of Alabama, characterised by the globular form of the cheek-teeth, that type of dentition having been previously unknown to exist in that group of lizard. By a curious coincidence, Prof. L. Dollo, of the Brussels Museum, received the imperfect remains of a lower jaw of a mosasaurian from the Maestricht Cretaceous, carrying three teeth of the same general type as those of the American specimen, but somewhat laterally compressed. He has described the Belgian specimen in *Archiv Biol.*, vol. xxviii., pp. 609–26) as a new species of the American genus under the name of *G. fraasi*. M. Dollo concludes that while the typical mosasaures (Mosasaurus) were surface swimmers, and fed on other vertebrates, the members of the genera Plioplatecarpus and Globidens were divers, the former feeding on belemnites and squids, and the latter on sea-urchins.

Many years ago the late Dr. W. T. Blanford asserted that the blackbuck (*Antilope cervicapra*) living on a spit of sand about thirty miles long between the salt Chilka Lake in Orissa, and the sea never drank water. With few exceptions, the statement was received with incredulity. That it may be practically true is, however, indicated by observations recorded by Dr. R. E. Drake-Brockman, in *The Field* of January 31 (vol. cxxiii., p. 244), relating to a herd of Pelzeln's gazelles (*Gazella pelzelni*), which have lived on the small island of Saad-ud-din, near Zeyla, Somaliland, since 1910. The usual annual rainfall is less than 3 in., and even when, as in 1911, it is considerably more, pools of water are only to be found for a few days after a heavy shower. The vegetation of the island is scanty. Dr. Drake-Brockman submits that "the result of the experiment sets at rest the question whether desert-loving antelopes can subsist without water save that which collects for a few days after a heavy shower of rain." Nothing is said with regard to the gazelles being able to obtain succulent roots or bulbs, such as those on which antelopes feed during the dry season in the Kalahari.

Under the title of *Mera Publications*, No. 1, we have received a copy of a paper by Messrs. Harold Swithinbank and G. E. Bullen on the scientific and economic aspects of the Cornish pilchard fishery, (1) "The Food and Feeding Habits of the Pilchard in Coastal Waters." In this are described some observations made on board the steam yacht *Mera* in 1913, and also certain results of inquiries made from 1905–7 off the Cornish coast. The authors conclude that the pilchard when feeding exercises some degree of selection, catching chiefly certain constituents of the zooplankton, such as copepods and larvæ of the higher crustacea, whilst other organisms,

such as medusæ, are avoided. They further think that zooplankton is preferred to phytoplankton, and that there is a certain amount of evidence to show that feeding is largely undertaken at nightfall, when the surface distribution of some highly nutrient plankton species reaches a maximum. We understand that copies of the publication will be supplied free of charge to students of marine biology on application to Mr. G. E. Bullen, the Hertfordshire Museum, St. Albans.

WE have received part i. of the sixth year's issue of *Der Fischerbote*, the new German fishery journal. The number is one of considerable interest. In addition to several articles on general marine biological and fishery subjects, there is the continuation of a series of accounts of the development of British fishing ports; the article in the current number deals with Fleetwood. *Der Fischerbote*, which is published fortnightly, is edited by Fishery-Director H. Lübbert and Prof. Ehrenbaum, of the Hamburg Natural History Museum.

AN interesting study on heredity of skin colour in negro-white crosses is published by Dr. C. B. Davenport in No. 188 of the Publications of the Carnegie Institution (1913). The data, which include very careful observations on more than 600 individuals, were collected chiefly in Bermuda and Jamaica. The difficulties in exactly determining the grade of skin colour, and more especially in getting trustworthy information about the ancestry, are explained, and reason is given for regarding the results as generally trustworthy. It is concluded that the results obtained fit on the whole rather well with the hypothesis that the negro is homozygous for two factors for the production of black pigment, both of which are absent from the European. Since each of these factors may be present singly or in duplicate among the descendants of a cross between negro and white, there may be five conditions—none, one, two, three, or four of the factors being present. When the whole number of individuals examined is plotted in a polygon, there are, in fact, five maxima. It is concluded that the stories of the production of "black" offspring by two full whites with negro ancestry on one or both sides are mythical. There is a yellow pigment in the negro independent of the black, which may appear strongly in the paler hybrids. Eye-colour and hair-colour and form are dealt with more shortly. There is no correlation between skin-colour and hair-form, but strong correlation between skin- and hair-colour.

THE Ipswich and District Field Club, in vol. iv. of its journal, includes a good colour-printed geological map of the Gipping Valley, by Mr. P. G. H. Boswell, and an account by Mr. J. Reid Moir of a workshop of Aurignacian flint implements revealed in a brickfield to the north of Ipswich. The types of implement are illustrated, and it is pointed out that hitherto remains of this stage of culture have not been found in England outside caves. Fire is believed to have been employed for fracturing the flints.

A PRELIMINARY account of the rainfall of 1913, from observations at selected stations of the British Rainfall Organisation, pending the more exhaustive examination of all available data, is published in *Symons's Meteorological Magazine* for January. The general annual fall for the whole of the British Isles was 1 per cent. below the normal; Scotland had a deficiency of 6 per cent., England and Wales one of 2 per cent., while Ireland had an excess of 5 per cent. July was the driest month, with little more than one-third of the average rainfall; August was also dry, England and Wales having exactly half the average. The wettest month was April, with a general excess of 61 per cent.; in England and Wales the excess was 80 per cent. In Scotland March was the wettest month, excess 59 per cent.; in Ireland the maximum occurred in January, excess 74 per cent. In September several rainstorms of great intensity occurred, the most notable being those at Newcastle-on-Tyne on September 16, and at Doncaster on the following day. As regards the geographical distribution the most striking feature was the deficiency in the east and the excess in the west of the country.

THOSE of our readers who are interested in meteorology, and have followed the recent progress in that science, will probably have noticed several important changes in the popular *Daily Weather Report* issued by the Meteorological Office. In January, 1911, arrangements were made for lithographing the report at the new office, and advantage was taken of the change to revise, *inter alia*, the arrangement of the maps. In place of the two showing pressure and temperature at 7h. a.m. of the current day, the information was combined on a single map, and the normal distribution of sea temperature was indicated by the depth of tint of the blue colour used to mark a distinction between sea and land. The area of the map then extended northwards to just beyond the Arctic circle, and included the Icelandic stations and Bodö in Norway. But from January 1 of this year an important extension has been made in the area of the principal 7h. a.m. chart, showing the observations at Vardö (extreme north of Norway), and those of the important Arctic station in Spitsbergen, while the area in the west and south is (as before) such as to allow of the inclusion of observations at Madeira and of timely wireless messages. It may be mentioned that much useful information bearing on the remarkable extensions of the telegraphic weather service in the last few years (especially since 1905) will be found in a lecture by Mr. Lempfert on British weather forecasts (Quart. Journ. R. Met. Soc., July, 1913).

NEARLY half the December number of the Bulletin of the Bureau of Standards is occupied with a paper by Mr. F. W. Grover on the methods available for determining the terms of a Fourier series to represent any periodic function, such as an alternating-current wave. The method finally adopted is that given by Runge in 1903, and complete descriptions of the methods of calculation and schedules for carrying it out rapidly are given. The author hopes by this means to enable electrical engineers to undertake the necessary analysis of the curves with which they deal without too much time having to be spent in the work.

SOME of the scientific and technical periodicals of Germany are beginning to use the symbols agreed on by the International Committee on units and symbols, and it may be useful to mention here some of the symbols adopted. Length l, mass m, time t, radius, r, volume V, velocity v, gravitational acceleration g, pressure p, temperature absolute T or θ, ordinary t, quantity of heat Q, specific heat at constant pressure c_p, at constant volume c_v, coefficient of linear expansion α, wave-length λ, intensity of magnetisation, $\mathfrak{I}$, magnetic field $\mathfrak{H}$, magnetic induction $\mathfrak{B}$, permeability μ susceptibility χ, electric current I, resistance R, electromotive force E, capacity C, quantity of electricity Q, self-inductance L.

THE Institution of Electrical Engineers has issued a programme of the meetings to be held by its local sections until the end of May next. The seven sections are:—Birmingham, holding its meetings at the University there; Dublin, holding its meetings at the Royal College of Science; Manchester, meeting at the physical laboratory of the University; Newcastle, which, in addition to the meetings at the Armstrong College of Science, has arranged also three meetings at Middlesbrough; the Scottish, with meetings at Edinburgh and Glasgow; the Western, with meetings at Bristol and Cardiff; and the Yorkshire Local Section, meeting at the Philosophical Hall, Leeds.

IN connection with wave-length and other measurements in wireless telegraphy, adjustable condensers are frequently employed, and in many cases the quantity to be measured varies with the square of the capacity of the condenser. For such purposes, therefore, an adjustable condenser following a square law should be useful, and Mr. W. Duddell, in a short paper in the Journal of the Institution of Electrical Engineers for February 2, describes the method he has used for working out the correct curve to give to the plates of a rotating sector condenser, with this object in view. The data obtained may save other experimenters from going through the work a second time.

THE British Fire Prevention Committee have found it necessary to formulate a standard test and a model specification for portable chemical fire extinguishers owing to the fact that several fatalities have occurred through these appliances bursting when being operated. There is at the present moment an unfortunate tendency to put various types of "cheap-jack" appliances on the market, and the committee direct attention to the reprehensible method which is frequently adopted by makers or their agents in country towns and villages of making use of faked demonstration tests to sell such appliances. The specification can be obtained from the offices of the committee, 8 Waterloo Place, Pall Mall, S.W.

NO. 13 of the Technologic Papers of the Bureau of Standards of the Department of Commerce of the United States deals with the question of electrolysis in concrete, and is an experimental investigation of the problem by Messrs. E. B. Rosa, Burton McCollum, and O. S. Peters. The report is illustrated by numerous photographs and tables of data, and fills 136 pages. Of the numerous theories that have been advanced to account for the cracking of reinforced concrete that one which attributes it to the oxidation of the iron anode following electrolytic corrosion has been fully established. The oxides formed occupy a volume which is 2·2 times as great as the original iron, and the pressure resulting from this causes the block to crack open. Many points of great interest to the architect and engineer are dealt with in full detail in the report.

HITHERTO aëroplane problems have received very little attention from workers in pure science, and it is not so very long ago that an attempt by Prof. Herbert Chatley to investigate mathematically the stresses in the various parts of an aëroplane met with a very discouraging reception. We have now received a paper by Prof. H. Reissner on the strength of flying machines, published in the *Jahrbuch der wissenschaftlichen Gesellschaft für Flugtechnik*, vol. i., dealing with the general principles involved in the study of aëroplane stresses. As the author points out, the increasing use of aëroplanes in all kinds of weather, often driven at high speeds for racing purposes carrying heavier loads, and subjected to vibration for extended periods, has brought this question of safety into greatly increased prominence. Among various methods of testing strength, one consists in suspending the machine in an inverted position and loading its supporting surfaces with sand. Prof. Reissner advocates experiments in which aëroplanes are strained to the breaking point, although the cost of such tests would preclude them from being made except when a large number of machines of a particular type are being built. At the present time all aëroplanes have some of their parts strained beyond the elastic limits of the materials, a circumstance which greatly increases the difficulty of the problem.

MR. SIJIL ABDUL-ALI dealt with the doctrine of the first matter as held by the alchemists, and particularly by Thomas Vaughan, in a paper read before the Alchemical Society on February 13. He pointed out that the alchemical quest was of a different nature from that pursued by the experimental chemist, and needed a different mental point of view for its appreciation. Alchemy, he said, had a secret tradition, and, in that light, a scriptural faith; it started with a theory of creation and a psychic doctrine, a symbolic presentation of which it sought in a chemical experiment. The lecture was mainly concerned with the doctrinal implications of this "first matter," and their significance for modern philosophy.

THE sixteenth technological paper from the Bureau of Standards (Washington) deals with the manufacture of lime. It describes an attempt to study the effects of various impurities on the properties of lime, and to compare the efficiency of various types of manufacturing processes used in the transformation of limestone into slaked- and quick-lime. The brochure is a particularly interesting contribution to the literature of that neglected industry—lime burning; the pamphlet is of equal interest to the consumers—architects and builders—since they seek the best possible mortar, &c., for building purposes. The quality of

the mortar is not only dependent upon efficient burning, but also on skilful slaking and proper mixing. The deterioration in the quality of quick- and slaked-lime with keeping also receives attention.

ANOTHER of Prof. H. B. Baker's interesting studies of the properties of purified substances is described in a recent issue of the Chemical Society's Journal, vol. ciii., p. 2060, in a paper published jointly with Mr. L. H. Parker. Two years ago, at a meeting of the Faraday Society, an experiment was shown in which water prepared under special conditions acted much more slowly than ordinary distilled water on sodium amalgam. It was remarkable that this difference persisted even after a considerable amount of caustic soda had been formed; it was therefore not due to the non-conducting properties of the special water, and has now been traced to the "catalytic action" of traces of hydrogen peroxide. These are present in ordinary samples of water, and in water prepared from pure hydrogen and oxygen in presence of palladium, but are destroyed by distilling from metallic vessels and superheating the steam. One sample of water prepared in this way in a platinum apparatus had no perceptible action on sodium amalgam in three hours, and liberated only 0·1 c.c. in four hours, 0·4 c.c. in five hours, and 0·6 c.c. in six hours. On the other hand, the addition of one part of hydrogen peroxide to 100,000 parts of another sample of water increased the amount of hydrogen liberated from 0 to 3·8 c.c. in one hour, and 4·1 to 32·4 c.c. in three hours, although it did not appreciably affect the conductivity of the water.

A CATALOGUE of periodicals and publications of literary and scientific societies, including standard sets and library editions, which they have on sale, has been published by Messrs. W. Heffer and Sons, Ltd. An inspection of the catalogue suggests that men of science and librarians have here a good opportunity of completing their sets of transactions and of making additions to their libraries at a moderate cost.

A COPY has been received from Cairo of the almanac for the year 1914 compiled in the Government Publications Office for the Egyptian Government. The object of the almanac is to furnish information likely to be useful to the various Government administrations in their relations with each other and also to the general public. In the section concerned with the Ministry of Finance, full particulars are given in connection with the Survey Department; details as to schools and colleges are included under the heading, Ministry of Education; and an exhaustive section, entitled "General Information," supplies up-to-date facts as to rainfall and other meteorological data, magnetic values, scientific societies, weights and measures, in addition to other matters of importance.

OUR ASTRONOMICAL COLUMN.

DETONATING FIREBALL OF JANUARY 19.—A considerable number of records of this object have now been received by Mr. W. F. Denning, and it is certain that the fireball descended to within a very small distance of the earth's surface, if indeed it did not actually fall to the ground. The observations are not sufficiently exact to indicate the precise spot where the meteor fell, if it came to earth, and the event might easily pass unnoticed if it occurred in a country place where no one happened to be near enough actually to witness it.

Several observers carefully timed the interval between the meteor's brilliant flash and explosion and the sound which followed. This was half a minute near Oxford and one minute a little further off in the same part, while at several other places the times are given as one minute to five minutes, according to the varying distance from the scene of the disruption. One minute's interval equals a distance of about twelve miles, and as part of this was horizontal distance and not all vertical height, it is clear the fireball was only a very few miles high at the time of its final outburst.

Inquiries should be instituted in the west part of Berkshire, near Lambourn, for it is possible evidence may be obtained as to the exact locality of the fall, if it occurred. The radiant of the meteor was south of Ursa Major, either at 132°+47°, or 154°+41° probably.

THE TOTAL SOLAR ECLIPSE OF AUGUST 21 NEXT.—*The Observatory* for February publishes particulars of the provisional arrangements which have been made by the Joint Permanent Eclipse Committee with regard to the observations of the total solar eclipse of August 21 next. Under the auspices of the committee Prof. Fowler, Mr. W. E. Curtis, and Father Cortie, with Major Hills and Father O'Connor as volunteers, will be situated at or near Kiev. The first two-named, with Major Hills, will devote their attention to photographing the spectrum of the chromosphere during the partial phases with iron arc comparisons. The other two will take photographs of the corona and its spectrum, chiefly in the region of longer wave-lengths. The Royal Observatory of Greenwich will be represented by Mr. Jones and Mr. Davidson, who will attempt large-scale photographs of the corona, and its spectrum, with special reference to the ultra-violet region; they will be stationed at Minsk. The Solar Physics Observatory of Cambridge will send a party of three, namely, Prof. Newall, Messrs. Stratton and Butler, and this will be stationed at Feodosia, in the Crimea. Their programme will include direct photographs of the corona on large and small scales, the former for studies of "arches," and the latter for extensions. The chromospheric spectrum will be attacked with a concave grating without slit, for comparison with the slit spectra of Prof. Fowler's programme. Polariscopic observations will also be made.

THE ABSORPTION OF LIGHT IN SPACE.—An ingenious method of trying to detect the absorption of light in space is that of photographing the spectra of stars which have similar spectra, but the stars themselves should be at very different distances from the earth. The spectrum of the more distant star should exhibit a greater absorption towards the violet than that of the nearer star, if such absorption be present in space. This method was proposed by Prof. Kapteyn, and a first attempt has been made by Mr. Walter S. Adams, using the Cassegrain spectrograph of the Mount Wilson Solar Observatory; his results are printed in the current number of *The Astrophysical Journal* (January, vol. xxix., No. 1). The choice of stars was facilitated by the use of the ample material previously accumulated for line of sight work, and the pairs finally compared had spectra which were similar line for line. Stars of various spectrum types were employed, and of the twenty pairs investigated seven pairs were of class Ko, two from each of B8, G5, and G6, and one from each of Ao, F4, F7, G8, K2, K4, and K6. While six pairs showed no appreciable difference between the

two ends of the spectrum, fourteen displayed a marked difference which is stated to be very great in some cases. In every case the star which is relatively faint at the violet end of the spectrum is the star of small proper motion. Mr. Adams points out that the evidence of this small amount of material is two slight to warrant any extended discussion on its application to the problem of the absorption of light in space.

WHO'S WHO IN ASTRONOMY.—The very excellent book, entitled "Astronomical Observations and Astronomers," and published under the auspices of the Royal Observatory of Belgium, which first appeared in the year 1907, is well known to most of the readers of this column, and no doubt has been found a very useful book of reference. The work was from the pens of the astronomers at the Royal Observatory of Belgium, and the task of collecting and arranging the information was no light one. It is now proposed to bring the contents thoroughly up to date, and with this intention circulars have been widely distributed requesting that the printed forms be filled in. These forms ask for a brief statement as to *personnel*, instruments, researches, and publications of observatories, and it is hoped that everyone will do his best to make the volume as complete as possible, and so render more light the labours of M. P. Stroobant and his co-workers.

WORK OF THE VIENNA RADIUM INSTITUTE.[1]

OF the seventeen papers before us, from the Radium Institute at Vienna, five by Drs. von Hevesy and Paneth, both of whom are well known in this country, contain notable advances in our knowledge of the chemistry of the radio-active elements. The chemical identity of the several members of a group of isotopic elements has been further put to the proof and extended to include the electro-chemical properties. An elegant application of this new phenomenon of isotopy has been made in analytical chemistry in the determination of the solubility of such excessively insoluble compounds as lead chromate, sulphide, &c. The principle of the method is to add to the common element its radio-isotope in unweighable, but intensely radio-active, amount, and to estimate the distribution of the former after any chemical operation from the experimental distribution of the latter by radio-active measurements. Thus radium D, derived from the decay of radium emanation, is added to lead before its precipitation by potassium chromate. Radium D being isotopic with lead, the ratio of the lead and radium D must remain unchanged by the precipitation. The quantity of lead in the filtrate is, of course, analytically undetectable, but the quantity of radium D is easily estimated. In this way the solubility of lead chromate in water at 25° was found to be 0·012 mg. per litre, or twelve parts in a thousand million.

Another important direction, in which these investigators are extending, is in the application of colloido-chemistry to the radio-elements. Often, as they and Godlewski in France have independently concluded, even these extremely attenuated solutions of the radio-elements behave as colloids rather than as electrolytes and their transport under the electric current is due to electrophoresis rather than to electrolysis. Polonium is the centre of interest in many of these researches, for it is a new element, in the sense that it is isotopic with no previously known one, and occupies a separate place in Mendeléeff's table, so that its properties cannot, like those of the majority, be exactly determined by proxy.

V. F. Hess describes a convenient method of determining quantities of radium by the γ-ray method, the quantity being read off by the constant deflection of an Elster-Geitel single quartz-thread electrometer, in conjunction with one of N. R. Campbell's high resistances of xylol and alcohol. A long attempt to arrange a standard measuring instrument, calibrated once for all, which would give the quantity of radium without the necessity of employing a radium standard, might have been more successful if the author had been acquainted with A. S. Russell's work on the measurement of γ rays and the necessity, if disturbances from secondary rays are to be avoided, of using lead, not brass, for the walls of the electroscope. In the same field Flamm and Mache continue the account of their attempts to measure the radium emanation quantitatively by the absolute value of the ionisation current in a guard-ring plate condenser.

Hess has continued his determinations of the penetrating radiation of the upper atmosphere by means of balloon ascents, and arrives at the startling conclusion that above 2000 metres there is a rapid increase in the intensity of the penetrating rays. At these heights the penetrating rays from the earth itself would be absolutely negligible, whilst that from the radium emanation in the air, which has its origin in the earth and is of limited life, must be, at any rate, less than at the surface. The conclusion that a great part of the penetrating radiation cannot come from the known radio-active constituents of the earth and atmosphere is one that must evoke general interest, and calls for the further radio-active exploration of the upper atmosphere.

Other papers deal with chemical decomposition produced by radium rays and ultra-violet light (Kailan), the solubility of radium emanation and other gases in liquids (Stefan Meyer and Martin Kofler), the variation in the ranges of the individual α particles through the probability variations in the number of molecules they encounter in their path (Freidmann), and the life periods of uranium and radium (Stefan Meyer). The latter research treats critically the known data from which these constants can be derived, and leads to the result that there is complete agreement among values obtained by independent methods. The most probable values for the periods of average life of radium and uranium respectively are 2500 and $7{\cdot}23 \times 10^9$ years. Incidentally, it may be pointed out, this makes the perennial problem of the origin of actinium more of a mystery than ever, for there should be no such agreement among the methods, if, as is supposed, some 8 per cent. of the uranium atoms branched off into actinium at some point before radium is arrived at. But it may still be doubted whether some of the data chosen, particularly the equilibrium ratio between radium and uranium, are not at fault. F. S.

[1] Mitteilungen aus dem Institut für Radium-forschung, xxxviii–li i. Ueber Neuerungen und Erfahrungen an den Radium-messungen nach der γ-Strahlenmethode. By V. F. Hess (*Verh. D. Physikal. Ges.*, 1913, xv., Nr. 20).

SMOKE AND SMOKE PREVENTION.

"A BIBILIOGRAPHY of Smoke and Smoke Prevention," prepared by Mr. E. H. McClelland, has been published by the University of Pittsburg, Pa. (Bulletin 2, 1913, pp. 164; price 50 cents). The bibliography has been compiled for the use of the Melton Institute of Industrial Research, consisting of a body of scientific experts, who are about to embark on an inquiry, the nature and extent of which is set forth in the first bulletin issued by the institute ("Outline of the Smoke Investigation"). It contains an apparently complete

list of publications dealing with smoke, its cause, effects, and prevention. In looking through the bibliography, we are struck by the extent and varied sources of the literature, a fact which clearly indicates that the smoke nuisance has no mere "local habitation," but possesses a widespread interest. English, American, German, and French volumes predominate, and if we were to estimate the extent of the nuisance in these countries by the number of publications England would stand easily first. Still, it is some consolation to think that we do not suffer alone. The question then arises, how long will the present state of apathy on the part of the public authority continue, and when will the limit to public endurance be reached? It is true that we have the smoke clauses of the Factory Acts; but a perusal of these will immediately dispel any faith in their efficacy. We have also local bylaws; but experience will teach the most casual observer that in most industrial centres atmospheric purification has undergone little change. Indeed, in some of the most notoriously bad localities average convictions do not exceed one a year. There is, we believe, a Bill to be introduced into the House of Commons, and promoted by a large and influential body of citizens connected with various industrial centres, which, it is hoped, will find its way to the statute-book. In the meantime, there is no question that demands more immediate and drastic treatment than the smoke problem owing to its effects on the health, cleanliness, and general comfort of the community.

ANTARCTIC PROBLEMS.[1]

The Problem of the Antarctic Andes and the Antarctic Horst.

AS the Weddell Sea will be the objective this year of no fewer than three Antarctic expeditions, some of its features as bearing on the above problem may be discussed first.

The continuity of Coat's Land, discovered by Dr. W. S. Bruce in the *Scotia* in 1904, with Prince Regent Luitpold Land, discovered by Dr. Filchner in the *Deutschland* in 1912, has still to be traced. Filchner sighted three Nunataks of dark rock rising from the inland ice to the south of "Vahsel Bucht," thereby proving indisputably the existence of land under the inland ice. The inland ice there rose gently from its shore cliff of from 25 ft. to 65 ft. high, up to more than 3000 ft. at a distance from the shore of about thirty miles. Of far greater importance is the tracing inland of the unknown coast to the south of Luitpold Land.

This is one of the greatest of the geographical problems which the Shackleton Expedition should solve. Amundsen, on his journey to the south pole in 1911, proved that the south-easterly trend of the Queen Alexandra Range, discovered by Shackleton at the Beardmore Glacier, is not maintained in the Queen Maud Ranges, but that the latter ranges bend to the right as one follows a great circle from the Beardmore Glacier to Graham Land. So far, this favours the theory of Penck that Antarctica is divided into a West and East Antarctica respectively, by a strait connecting the Ross Sea with the Weddell Sea, for the trend of the Queen Maud Ranges, if continued farther north in the western hemisphere, would carry it to Luitpold Land.

There can be little doubt that this Queen Maud Range is bounded by heavy fractures, of the order of several thousands of feet, for geological reasons which will be stated presently; and that these trend lines are, perhaps, as strongly pronounced as are any in the world. If, therefore, the ranges, to which they give origin, extend towards Luitpold Land, they are certain to be strongly marked, and should be capable of accurate delineation by the Transantarctic party of the new expedition. If, on the other hand, as seems more probable, the Queen Maud Ranges, when traced into the Weddell Quadrant, bend back towards Graham Land, and become continuous with Charcot Land and King Oscar II. Land, then Shackleton's other party, operating from his main base at the head of Weddell Sea, should be able to solve this all-important problem. With its length already proved of no fewer than 1400 miles, and its height of from 8000 to 15,000 ft, its stupendous fracture lines, involving displacements of 5000 to 6000 ft., and its profound influence on the meteorological conditions of Antarctica, and probably of the southern hemisphere, it is not the least important of the mountain ranges of the world, and certainly yields to none in its geological interest and the extreme difficulty of the problems which it presents.

At the Graham Land end of Antarctica, Arctowski, Nordenskjöld, Gunnar Andersson, Charcot, and Gourdon have proved that petrographically and tectonically the rocks are distinctly Andean. Granodiorites, and Andesitic rocks, in which zoned soda-lime felspars are characteristic, are there predominant. Boulders of gneissic rocks present in Tertiary strata at Seymour Island suggest a pre-Cambrian foundation complex at no great distance. Recently Dr. W. T. Gordon has identified well-preserved Archæocyathinæ in a large block of limestone dredged up by Dr. W. S. Bruce in the *Scotia*, from lat. 62° 10′ S., long. 41° 20′ W., from a depth of 1775 fathoms, near the South Orkney Islands, and specimens of *Pleurograptus ceratiocaris* and *discinocaris*, previously described by Pirie, from the collections by Bruce in the South Orkneys, proves the existence there of Ordovician rocks. The sedimentary rocks are largely formed of Jurassic plant-bearing strata, with one of the richest known fossil floras of that age in the southern hemisphere. In the west and central parts of Graham Land these have been strongly folded, and mostly overfolded to the east, as has been the case with the greater part of the formations developed in the South American Andes. Farther east in James Ross Island, Snow Hill, and Seymour Islands, &c., there is a gently inclined series of marine Cretaceous rocks, followed by Middle Tertiary rocks (Upper Oligocene to Older Miocene) with fossil leaves of Fagus, Araucaria, &c., a geological structure recalling that of East Patagonia and southern Argentina, as compared with the folded highlands of west Patagonia and southern Chile.

Then the zone of active or dormant volcanoes, which intermittently characterises the Andean Chain, is met with on both sides of Graham Land, in Bridgman, Paulet, and Deception Islands, on the west, and in Lindenberg, Christensen, Sarsee, and the Seal Island volcanoes on the east side. If now a comparison of the broad structural features of West Antarctica be made with those of East Antarctica in the Ross region it will be noticed that a great volcanic zone stretches along the western shore of Ross Sea from at least so far south as Mounts Erebus, Morning, and Discovery, to so far north as Cape Adare. This main volcanic zone of the Ross Sea region is crossed by lesser zones trending more or less east and west, like the Mounts Terror, Terra Nova, Erebus, and Dry Valley zone, the zone of the Balleny Islands, &c. If, however, this Ross Sea volcanic zone with the adjacent mountains be compared with the ranges and volcanic zones of West Antarctica, the fact at once becomes obvious that the ranges of the Ross area are entirely devoid of folding, and are of a block-faulted plateau type,

[1] Summary of a paper read before the Royal Geographical Society on February 9 by Prof. Edgeworth David, C.M.G., F.R.S.

whereas the lavas and tuffs of the Ross region are very distinct from those of West Antarctica, being strongly alkaline, of the nature of trachytes, phonolites, kenytes, &c., and of as distinctly Atlantic type as the West Antarctic rocks are of Pacific type.

The problem is further complicated by the fact that, meagre as it is, our knowledge of the geology of the King Edward Land area shows the eruptive rocks there, in which granodiorites are conspicuous, to be more nearly allied to Andean rocks than are those of Ross Sea. There, too, in the Ross Sea region, a vast coalfield with nearly horizontal strata sheets over all the older rocks from near the south pole itself to near Dr. Mawson's base in Adélie Land, a distance of more than 1600 miles. According to the preliminary report published in "Scott's Last Expedition," vol. ii., Mr. F. Debenham considers these Coal Measures to be of Upper Palæozoic age. Like the Coal Measures of Santa Catharina in southern Brazil and the northern Argentine, lying far to the east of the Andean fold area, they are but very little disturbed. Moreover, the structure of the mountains to the west of Ross Sea resembles in some respects that of the Falkland Islands, which again lie a little to the north-east of the Andean fold lines.

In the Falkland Islands undulating Devonian sandstones and quartzites lie with strong unconformity on a pre-Cambrian (?) crystalline complex, and are themselves succeeded by a nearly conformable group of Permo-Carboniferous strata with a well-marked glacial bed at its base which links it up at once with the Orleans glacial conglomerate of the Santa Catharina Coal Measure system. In his recent paper to this society, Mr. T. Griffith Taylor mentioned that the fossil fish-scales recently discovered by Mr. F. Debenham and himself at Granite Harbour, were considered by Dr. A. Smith Woodward to be of Devonian age, and the fossil tracks figured respectively by H. T. Ferrar from the lower Beacon Sandstone of East Antarctica, and by Nordenskjöld from the Devonian rocks of the Falkland Islands, show such a remarkable similarity to one another as to suggest that they are both of Devonian age. Now these late Palæozoic Coal Measures and Devonian rocks, more or less horizontally stratified, are far more characteristic of the outer foreland of the Andes, that is, the vast lower plateau or plain country lying to the east of the Andes, than they are of the Andes themselves. Sections are exhibited across typical portions of the Andes and their foreland massifs, together with type sections showing the probable geological structure of West as compared with East Antarctica, and a comparison is made between the structure of the Antarctic Horst with the "ice divide" on the lower plateau to the west, and that of the main divide between southern Chile and southern Patagonia, as described by H. Steffen, F. P. Moreno, and others. It is suggested very tentatively that in the Andean problem of the Antarctic a new physiographic enigma is propounded, viz.: When does a mountain range lose its identity as a definite unit, and become another range worthy of a different name?

The South American Andes are characterised and defined by both folds and faults. In West Antarctica the folds are present with the thrust directed easterly as in the Andes; the volcanic zone is present, and fractures are also present, as well as typical Andean eruptive rocks. In the Ross Sea region in the mountains along its western shore, the great fracture lines are perhaps continuous with those of Graham Land, but the Andean folding has died out, as well as the petrographical Andean province which is found rather in King Edward Land than in the mountains to the west of Ross Sea.

Provisionally it is suggested that while Arctowski's term, the "Antarctandes," may be used for the mountains of West Antarctica, some such term as the "Antarctic Horst" may be applied to the great ranges of the Victoria Quadrant. The party to be dispatched by Shackleton from his Weddell base westwards for 400 or 500 miles, which should include someone who is both an experienced geologist and physiographer, should be able to throw a flood of light on this great Andean problem.

Then, too, a great opportunity is offered by this expedition for sending a strong party from the Ross Sea base, not only to lay out depôts so far as to the head of the Beardmore Glacier to meet the Trans-Antarctic party on their arrival from over the great inland plateau, but also to collect systematically from the highly interesting Coal Measures, at the head of the Beardmore, with their associated fossil flora. The Shackleton expedition found wood, apparently allied to, if not identical with, coniferous wood, at the head of the Beardmore Glacier, and fossil rootlets in the adjacent shales suggest that the wood grew near where it is now found; and Captain Scott's party have brought back specimens of fossil plants scientifically of the utmost value from the same locality. There, too, at Buckley Island, or Nunatak, thick beds of Cambrian limestone with traces of Archæocyathinæ underlie the Coal Measures. It is difficult to imagine any spot in the world more fascinating from the point of view of geology, palæontology, and many allied sciences.

The problem of how trees, like modern forest trees, could flourish within 300 geographical miles of the south pole itself, which now for five months of the year is in almost total darkness, is one which involves the question as to whether the south pole was in late Palæozoic time in its present position, or whether, if the position of the earth's axes of rotation have remained constant throughout geological time, the continents may not have crept horizontally over considerable distances, as suggested by Sir John Murray and G. W. Lamplugh. The presence of the rich Jurassic flora at Hope Bay in Graham Land and of the Miocene flora of Beech and Araucaria at Seymour Island presents a similar problem.

Coast Survey.—The existence or not of New South Greenland, originally reported by Morell, is of importance for study by the various expeditions which should be in that vicinity this year and next year. Soundings, currents, and meteorological conditions suggest that New South Greenland really exists.

The recent fine piece of coastal survey work by Dr. Mawson and his Captain, J. K. Davis, whereby about 1300 miles of new coast have been added to the map, greatly needs to be extended, so as to join up with Lieut. Pennell's latest surveys to the east, on the Scott expedition, and also to connect westwards with Kemp Enderby Land and Coat's Land. Obviously the Andean problem cannot be finally settled until the great unknown area between Charcot Land, King Edward VII. Land, and Carmen Land is thoroughly explored and charted.

Meteorology.—R. C. Mossman has shown that Antarctica is of vast importance in controlling weather, not only in its own immediate neighbourhood, but even so far north as the subtropics of Chile. This very important result from the establishment of Dr. Bruce's Meteorological Station at the South Orkneys, and the later system of meteorological stations in the far south, instituted and maintained continuously by the enterprise and insight of the Argentine Government, is likely to be confirmed in the case also of East Antarctica. Just as ice conditions in the Weddell Sea largely control the rainfall of subtropical Chile, so it is probable that ice conditions in the Ross Sea may control some portions of Australasian rain-

fall. Unquestionably very important results have been obtained from the establishment of Dr. Mawson's wireless meteorological station at Macquarie Island in the sub-Antarctic. The Federal Government is so much impressed with the importance of the results that it has decided to maintain this station for a time, experimentally, at its own cost.

In the coming expeditions it will be important to get meteorological data as to the location of the chief cold pole of Antarctica, and as to whether the low-pressure area of Ross Sea ever leads to air being sucked over from the Weddell Sea region, or *vice versâ*. Both are low-pressure areas, so that, when their seas are ice-free, air obviously would stream into them normally from the high polar plateau. The trend of the dominant Sastrugi should be systematically mapped en route by all sledging expeditions. Measurements of the upper-air currents to supplement the work of G. C. Simpson, so admirably carried out on the Scott expedition, are much to be desired, as well as studies of evaporation and ablation generally in regard to precipitation. A meteorological observatory at the head of Weddell Sea should greatly enhance the value of the Argentine southern observatories.

Glaciology.—These problems are also interesting and important. The Weddell Barrier, as shown by the soundings, has, like the Ross Barrier, recently retreated at least 100 miles south of the position which it once occupied in late geological time.

It will be important to ascertain whether in the Weddell Sea, as at Gaussberg, at Adélie Land, at Termination Land, as well as in the Ross Barrier region, the ice has everywhere been recently retreating. The importance of the evidence of moss ice ("respirator ice") in the lids of crevasses, as indicating sea-water underlying barrier ice, should not be overlooked. The position of the Main Ice Divide on the south polar plateau should be carefully determined, as well as the directions and rate of movement of the inland ice and of the outlet glaciers. The origin and history of the outlet valleys—amongst the deepest in the world—which transect the Antarctic Horst, offers a most fascinating problem. Shafts of moderate depth should be sunk in the far inland snowfields to determine the crystallinity of the material.

Biological, physical, including magnetic, observations, as well as *chemical,* and particularly *oceanographical* investigations should, of course, not be neglected. In regard to oceanography, it may be suggested that not only should a general survey be made to develop the continental shelves, submarine ridges, and banks and deeper basins, but detailed surveys should be made in the neighbourhood of large floating piedmonts, so as to determine the existence or not of ice-scooped rock-hollows where such glaciers reach the sea floor, and of something like a terminal moraine where the barriers ended when at their maximum extension. Careful sets of serial temperatures should be taken at close vertical intervals in the sea around such floating glacier piedmonts and barriers at various seasons of the year. These should throw much light on the amount of annual loss, through melting at their base, that such floating barriers must undergo.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The council of the Senate has issued certain regulations relating to the directorship of the observatory. It is proposed that the director shall be appointed by the Observatory Syndicate at a stipend of 150*l.* a year. He will be expected to reside at the residence attached to the observatory, which will be free of rent, rates, and taxes. It is assumed that the director will in future, as in the past, be one of the professors of the University.

Mr. R. A. Peters has been re-elected to the Benn W. Levy studentship for one year.

The master and fellows of Sidney Sussex College have offered 50*l.* a year for five years toward the stipend of a University lecturer in forestry. The General Board of Studies is of opinion that the offer should be gratefully accepted, and that the lecturer should be appointed for a period of five years. The General Board has consented to a request from the forestry committee that it should have power to appoint Mr. H. Jackson as University teacher in Indian forestry.

DR. E. E. FOURNIER D'ALBE, assistant lecturer in physics in Birmingham University, has been appointed special lecturer in physics in the University of the Panjab, Lahore.

THE following advanced lectures, to which admission is free without ticket, are announced in the *London University Gazette*. A course of four lectures on the theory of wave-motion, with special reference to earthquake waves, will be given at the University by Prof. Horace Lamb, on Fridays, beginning on February 20. A course of four lectures on the Assouan Dam will be given at the Institution of Civil Engineers, Great George Street, Westminster, by Mr. J. S. Wilson, on Wednesdays, beginning on March 4.

IT is announced in *Science* that the General Education Board of the United States has given 150,000*l.* toward an endowment of 300,000*l.* for the medical department of Washington University, St. Louis, to create full-time teaching and research departments in medicine, surgery, and pediatrics. The conditions of the gift provide that all teachers in these departments, while free to render any medical or surgical service, must not derive therefrom any personal gain. Their entire time must be devoted to hospital work, to teaching and research, as it is believed that medical education in the past has suffered from the fact that the teachers have had to rely on private work for the greater part of their income. The General Education Board has also made conditional grants of 20,000*l.* each to Knox College, Galesburg, Ill., and to Washburn College, Topeka, Kan.

IN the issue of *Science* for January 23 last Prof. Rudolf Tombo, jun., of Columbia University, publishes another of his useful articles on American university statistics. On this occasion he deals with the registration returns for November 1 of last year of thirty of the leading universities in the United States. Prof. Tombo points out that these universities are neither the thirty largest universities in the country, nor necessarily the leading institutions. The only universities which show a decrease in the grand total attendance (including the summer courses) are Harvard, Western Reserve, and Yale, the attendance of the two institutions last named having remained practically stationary. The largest gains, including the summer attendance, but making due allowance by deduction for the summer course students who returned for instruction in the autumn, were registered by New York University (965), Illinois (944), and Columbia (927). This year twelve institutions exhibited an increase of more than 200 students in the autumn term attendance, as against eight in 1912. According to the figures for 1913, the institutions with an attendance of more than 5000 students, inclusive of the summer courses, rank as follows:—Columbia (9,929), California (7,071), Chicago (6,834), Michigan (6,008), Pennsylvania (5,968), Wisconsin (5,890), Har-

vard (5,627), Cornell (5,612), New York University (5,508), and Illinois (5,259). The largest number of officers is found at Columbia, where the staff of teaching and administrative officers consists of 907 members, as against 737 at Illinois, 731 at Harvard, 725 at Cornell, and 633 at Wisconsin.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 12.—Sir William Crookes, O.M., president, in the chair.—S. G. **Brown**: Chemical action that is stimulated by alternating currents. This paper describes experiments on the effects produced by passing a rapid alternating current through simple voltaic cells, the general effect being to stimulate chemical action and to cause the cells to give a greater supply of continuous current which otherwise would not be produced.—R. D. **Oldham**: The effect of the Gangetic alluvium on the plumb-line in northern India. The depression occupied by the Gangetic alluvium along the southern face of the Himalayas, as determined by geological observation, has a nearly vertical face on the north, and a floor sloping upwards in a southerly direction to the surface. The effect of the defect of mass in the Gangetic depression is calculated and shown to be capable of producing about 30″ of northerly deflection of the plumb-line at the margin of the range, a deflection which drops rapidly on either side of the margin, but more rapidly to the south than the north. At twenty to thirty miles south, the distance depending on the width of the trough, it becomes zero, and at greater distances is replaced by a southerly deflection.—G. W. **Walker**: Note on the origin of black-body radiation.—Prof. H. M. **Macdonald**: The transmission of electric waves along the earth's surface. A series is obtained which represents the magnetic force at any point on the surface when the oscillator is also on the surface; the series converges rapidly for large values of θ, and for not very large values the first term is a sufficient approximation. For small values of θ the series converges very slowly.—Dr. G. T. **Beilby**: Transparence or translucence of the surface film produced in polishing metals (see page 691).—Dr. S. W. J. **Smith** and J. **Guild**: A thermomagnetic study of the eutectoid transition point of carbon steels. The magnetic properties of steel at temperatures near the eutectoid transition point (A1) seemed to deserve further examination. Simultaneous observations of intensity of magnetisation and of temperature were made over various ranges of heating and of cooling in different magnetic fields. Nine steels containing percentages of carbon ranging between 0·1 and 1·5 were used. Each steel contained about 0·2 per cent., or less, of silicon and manganese. It was found that the temperature corresponding with the beginning of the transformation of the eutectoid during heating (Ac1) could be fixed within ±1° C. under suitable conditions. This temperature was 735° C., and was the same for all the steels.—W. R. **Bousfield**: Note on osmotic pressure. It is shown that the assumption that the molecular interspaces of a solution are filled with vapour, which there behaves as a perfect gas, leads to the same general relation between vapour pressure and osmotic pressure as is given by thermodynamical considerations. The anomalous fact that the osmotic pressure of a decinormal sucrose solution is found to be greater at 0° C. than at 5° C. is explained by reference to the constitution of water and the effect of compression upon the ice molecules.

Physical Society, January 23.—Prof. C. H. Lees, vice-president, in the chair.—P. R. **Coursey**: Some characteristic curves and sensitiveness tests of crystal and other detectors. Experiments were described recently conducted on types of wireless detectors, and undertaken with a view of finding out whether any relation could be traced between the sensitiveness and characteristic curves of a detector. Sample curves for some common detectors are included, and show that in some cases a fairly good agreement exists between the sensitiveness curve of a detector and the second differential of its characteristic, this being most notable in stable crystal detectors, but it is evident that the flexure of the characteristic curve cannot be the only cause of the response of a detector to wireless signals, but that at least a second action must also be present, as it was observed, notably in the electrolytic detector, that the maximum ordinates on the second differential were at places where the measured sensitiveness was either zero or extremely small, showing that there are probably two actions opposing one another at this point. This action when present in other detectors is perhaps electrolytic in nature, or the received oscillations when superimposed on the direct-current boosting voltage partake of the properties of some "trigger" action. This view is supported by experiments with detectors of the tellurium-aluminium type. —W. **Duddell**: A water model of the musical electric arc.—C. R. **Darling**: Further experiments with liquid drops and globules.—James **Walker**: A note on aberration in a dispersive medium, and Airy's experiment. Lord Rayleigh's view that in the case of aberration we are concerned with the group-velocity instead of with the wave-velocity, makes it necessary to consider the experiment of Airy, in which he measured the angle of aberration with a telescope filled with water. A modification of Lord Rayleigh's explanation leads to the result that the angle of aberration thus determined corresponds to an angle $\mu^{-1}v/U$ measured in air. The same result is obtained from an analytical investigation, and a numerical calculation shows that the increase in the angle is about 1 per cent.—an amount that is probably too small to be detected.

Mineralogical Society, January 27.—Dr. A. E. H. Tutton, president, in the chair.—T. **Crook**: The genetic classification of rocks and ore deposits. The general principles of the classification of rocks were considered, the term rock including all mineral deposits. The exact nature of genetic grouping was defined. Both rocks and ore deposits fall into broad natural divisions in accordance with a geological grouping of formative agents and processes, the type being determined by the last operative agent or process that gave the rock its individuality. The two main groups are (1) endogenetic deposits, arising from internal causes, and (2) exogenetic deposits, of superficial origin, and these are subdivided in a consistent genetic manner. "Sedimentary" and "metamorphic" products cannot be regarded as constituting two independent subdivisions. A historical review of the application of genetic-geological principles to the classification of rocks and ore deposits was included. —Prof. A. F. **Rogers**: Lawsonite from the central coast ranges of California. Crystals from new localities were described; prismatic and tabular in habit and usually small, they displayed the forms 010, 001, 011, 110.—A. F. **Hallimond**: Uniaxial augite from Mull. The small, lath-shaped crystals, which seldom exceed ½ mm. in diameter, have refractive indices *o* 1·714, *e* 1·744, specific gravity, 3·44, pronounced dichroism (*o* smoky-brown, *e* pale yellow), two cleavage directions nearly at right angles, and an extinction angle of 30½° on the cleavage. A chemical analysis revealed distinct differences from ordinary diopside, and the composition approximates to that of hypersthene.—H. H. **Thomas** and W. Campbell **Smith**: Apparatus for grinding crystal plates and

prisms. A gun-metal cylinder with its axis normal to a triangular brass-plate, about 5 cm. in diameter, resting on three screws, one of which has a graduated head, is movable vertically along, and rotatable about its axis, and by rotation of the graduated screw the axis of the cylinder is inclined at a known angle to the grinding lap. A crystal suitably mounted is brought by means of these two rotations into any desired position, a series of chucks of different inclinations being provided for holding it. The zero position is determined optically. A graphical method of determining the requisite rotations was described.

Zoological Society, February 3.—Sir John Rose Bradford, vice-president, in the chair.—G. A. **Boulenger**: Collections of Batrachians and reptiles made by the British Ornithologists' Union and the Wollaston Expeditions in Dutch New Guinea. Four species of Batrachians and eight species of reptiles were described as new.—Dr. F. E. **Beddard**: Further observations upon the Cestode genus Urocystidium, Beddard.

Mathematical Society, February 12.—Prof. H. F. Baker, vice-president, in the chair.—G. T. **Bennett**: Exhibition and explanation of some models illustrating kinematics.—Prof. H. M. **Macdonald**: Formulæ for the spherical harmonic $P_n^{-m}(\mu)$, when $1-\mu$ is a small quantity.—Prof. E. W. **Hobson**: The representation of the symmetrical nucleus of a linear integral equation.—Dr. W. F. **Sheppard**: Fitting of polynomials by the method of least squares (second paper).—H. **Bateman**: The differential geometry of point-transformations between two planes.—Major **McKendrick**: Studies in the theory of continuous probabilities.

MANCHESTER.

Literary and Philosophical Society, January 27.—Mr. F. Nicholson, president, in the chair.—T. A. **Coward**: The willow titmouse in Lancashire and Cheshire. The author, after defending the subdivision of geographical races of birds into subspecies with distinctive trinomials, described how the Holarctic black-capped titmice fell naturally into two main groups, having as their types *Parus palustris* and *P. atricapillus*, L. The marsh-tit, the British representative of the first group, has long been recognised and accepted, but only within recent years has it been discovered that a British willow titmouse is referable to the *atricapillus* group. The willow-tit occurs along with the marsh-tit in many English counties, and it apparently replaces the latter bird in Scotland. It is found in both Lancashire and Cheshire, and in 1913, at any rate, nested in Cheshire. Most writers on British birds have described the typical marsh-tit, apparently in ignorance of the occurrence of both forms. Macgillivray, whose specimens were obtained in Scotland, accurately describes the willow titmouse. Both birds, however, are figured and described in the "British Bird Book," edited by F. B. Kirkman.—Dr. A. D. **Imms**: Observations on *Phromnia marginella* in India. He discussed the recorded instances of insects of the Fulgorid genus Phromnia, or Flata, bearing a close resemblance to certain flowers. One species, observed by J. W. Gregory, exists in two forms, one green and one reddish, and he (Gregory) describes the insects so grouped on a stem that the green individuals occupy the upper portion with the red individuals immediately beneath them, thus closely resembling a flowering spike with the green unopened buds above. On the occasions on which the author observed *P. marginella*, in the Himalayan foothills of Kumaon, the two types—one green, the other pinkish-buff—were closely intermixed. Poulton suggests that the first specimens of a group to emerge are red, and those that issue later green. Gregory may have come across undisturbed groups which, therefore, had the green specimens above and the red ones below. The groups noted by other observers may have reassembled, and thus lost the possible arrangement possessed on emergence from the pupæ. Long waxy filaments, closely related chemically to Chinese white wax, issue from the hinder extremity of the larva of *P. marginella*.

DUBLIN.

Royal Dublin Society, January 27.—Prof. J. Joly, in the chair.—Prof. W. **Brown** and J. **Smith**: Subsidence of torsional oscillations in nickel wires when subjected to the influence of alternating magnetic fields. The experiments showed that a remarkable decrease takes place in the internal friction of the wire when under the influence of alternating magnetic fields, the influence being more marked the higher the frequency of the alternations. There was shown also a very marked difference in the behaviour of the nickel wires in the hard and soft states, the hard wire after being subjected to an alternating magnetic field of high frequency, say 100 to 140 a second, became temporarily non-magnetic, which the authors call magnetic fatigue. That this fatigue is temporary is shown by the fact that it can be cured in several ways.—Prof. T. **Johnson**: The fouling of a water supply by Oscillatoria and its purification. In the spring of 1913, when the London water supply was contaminated by the two diatoms Asterionella and Tabellaria, an important water supply in Ireland also suffered from the presence of a Myxophycean, *Oscillatoria tenuis*, Ag., var. *natans*, which gave the storage water (360 million gallons) a fishy, mouldy smell. The water was cleared of the weed without injury to fish or man by treating it with copper sulphate (1 to 10 lb. in 1,000,000 gallons of water), as recommended by Moore and Kellerman, of the U.S. Department of Agriculture. Mud dredged from the shallow bottom of the upper end of the storage mountain lake gave the "water-bloom" of writers on examination in the laboratory.—Prof. H. H. **Dixon**: Note on changes in the sap caused by the heating of a branch. The changes which might be anticipated in the sap of the conducting tracts of a branch by the rendering permeable of the plasmatic membranes of the adjoining cells and the consequent discharge of their contents may be experimentally demonstrated by cryoscopic and conductivity measurements, and by various chemical tests. It is found that sap centrifuged from a heated branch is from four to six times more concentrated than that similarly extracted from a living one. This change in concentration of substances not rapidly absorbed would act as a physical poison on the cells of the leaves supported by the branch, and would alone explain the changes observed in these leaves. It was also found, in four cases out of five, that the sap of a steamed branch acted as a protoplasmic poison to the cells of Elodea leaves, while during the same time the sap from fresh branches was innocuous.—Prof. H. H. **Dixon**: Note on the tensile strength of the sap of trees. It has recently been stated that while water sensibly free from dissolved air has considerable tensile strength, it has been impossible to demonstrate this cohesion in the sap of trees. This statement is negatived by previous experimental work. However, it seemed of interest to test the tensile strength of sap directly. Experiments were carried out on sap centrifuged from the branches of trees. Berthelot's method of generating tension was used, but allowance was made for the distortion of the containing tube during the experiment. It was found easy to generate tension in both boiled and unboiled sap. In both cases the sap was almost, if not quite, saturated with dissolved air. The highest tension obtained with the boiled sap was 72·5 atmospheres, but with the unboiled 208 atmospheres was obtained.—Prof. J. **Joly**:

A deep-sea hydraulic engine. This engine is for developing power in depths from 200 fathoms downwards, for the purpose of boring into the deep-sea deposits. The water at the great pressure prevailing is the working substance, and after actuating the boring engine, is discharged into steel bottles which are coupled to the engine by high pressure tubing. The power available is very considerable. A full description of the entire machine, and of the methods of lowering, controlling, and raising it, were given, and working drawings were shown.

CALCUTTA.

Asiatic Society of Bengal, January 7.—Gouripati **Chatterji**: A demonstration apparatus for determining Young's modulus. An optical lever method is described, simplified so that measurements of the modulus can be made to 5 per cent. in about ten minutes for lecture demonstration purposes.—M. S. **Ramaswami**: A new species of Diospyros from the Tinnevelly Hills. A description of a hitherto undescribed Indian species of the genus Diospyros is presented.—M. S. **Ramaswami**: Studies on the leaf structure of *Zoysia pungens*, Willd. A detailed discussion of the structural adaptations, noticeable in the leaf of the maritime sandgrass *Zoysia pungens*, Willd., due to its peculiar habitat.—J. Coggin **Brown**: Grooved stone hammers from Assam and the distribution of similar forms in eastern Asia. An account of certain hammer stones with well-marked grooves or belts, from the Tezpur district, Assam. Such forms are of the greatest rarity among the numerous Neolithic stone implements in which certain parts of the Indian Empire abound. Grooved stone hammers only occur sporadically in eastern Asia, and the short list of recorded instances is given for comparison. On the other hand, they abound in the North American culture area, and are generally distributed throughout the United States. The subject is of some importance for the additional light it throws on the relation of the prehistoric archæological types of the eastern Asian and North American culture areas. It is concluded that there is no evidence to prove that the stone axe did not revolve as an independent unit in the latter area.—H. H. **Mann** and S. R. **Paranjpye**: Intermittent springs at Rajapur in the Bombay Presidency. These springs flow at very irregular intervals, generally for a month or two at a time, and are held in great veneration in western India. In this paper they are fully described and figured, their traditional history and the folklore connected with them are set forth, and partial analyses, showing that the water does not differ materially in composition from that of other springs in the Deccan Trap area, are given.

BOOKS RECEIVED.

Les Récents Progrès du Système Métrique. By C. E. Guillaume. Pp. 118. (Paris: Gauthier-Villars.) 5 francs.

Foods and Household Management: By H. Kinne and A. M. Cooley. Pp. xv+401. (London: Macmillan and Co., Ltd.) 5*s*. net.

A History of Education in Modern Times. By Prof. F. P. Graves. Pp. xv+410. (London: Macmillan and Co., Ltd.) 5*s*. net.

The Continents and their People. South America. By J. F. and A. H. Chamberlain. Pp. viii+189. (London: Macmillan and Co., Ltd.) 3*s*.

Die Süsswasser-Flora Deutschlands, Oesterreichs und der Schweiz. Edited by Prof. A. Pascher. Heft. i. Flagellatæ 1. By E. Lemmermann. Pp. iv+138. (Jena: G. Fischer.) 3.50 marks.

Elementary Commercial Geography. By Dr. H. R. Mill. Revised by F. Allen. Pp. xii+215. (Cambridge University Press.) 1*s*. 6*d*. net.

Konstitution und Vererbung in ihren Beziehungen zur Pathologie. By Prof. F. Martius. Pp. viii+258. (Berlin: J. Springer.) 12 marks.

Handbuch der vergleichenden Physiologie. Edited by H. Winterstein. 40 Lief. (Jena: G. Fischer.) 5 marks.

Commission Polaire Internationale. Procès-Verbal de la Session Tenue à Rome en 1913. Pp. 293. (Bruxelles: Hayez.)

Handbuch für biologische Uebungen. Zoologischer Teil. By Prof. P. Röseler and H. Lamprecht. Pp. xii+574. (Berlin: J. Springer.) 27 marks.

Catalogue of the Ungulate Mammals in the British Museum (Natural History). Vol. ii. By R. Lydekker, assisted by G. Blaine. Pp. xvi+295. (London: British Museum (Natural History); Longmans and Co.) 7*s*. 6*d*.

The Anthropology of the Greeks. By E. E. Sikes. Pp. xi+112. (London: D. Nutt.) 5*s*. net.

Physical Chemistry and Scientific Thought. By Prof. W. C. McC. Lewis. Pp. 20. (Liverpool University Press.) 1*s*. net.

Smithsonian Institution. U.S. National Museum. Bulletin 71. A Monograph of the Foraminifera of the North Pacific Ocean. By J. A. Cushman. Part iii. Lagenidæ. Pp. ix+125+47 plates. (Washington: Government Printing Office.)

Report of the Secretary of the Smithsonian Institution for the Year Ending June 30, 1913. Pp. 119. (Washington: Government Printing Office.)

Annual Report of the Director of the Weather Bureau for the Year 1910. Part iii. Pp. 268. (Manila: Bureau of Printing.)

Intermediate Mechanics for Indian Students. By F. C. Turner and Prof. J. M. Bose. Pp. xii+332. (London: Longmans and Co.) 4*s*. 6*d*.

Monistische Bausteine. By E. Haeckel. Edited by W. Breitenbach. Erstes Heft. Pp. vii+224. (Brackwede i.W.: Dr. W. Breitenbach.) 3 marks.

The Socialized Conscience. By Prof. J. H. Coffin. Pp. viii+247. (Baltimore: Warwick and York, Inc.) 1.25 dollars.

Die Europaeischen Schlangen. By Dr. F. Steinheil. Heft 4. 5 plates. (Jena: G. Fischer.) 3 marks.

Die Kultur der Gegenwart: ihre Entwicklung und ihre Ziele. Teil iii. Abt. iv. Band 4, Abstammungslehre, Systematik, Paläontologie, Biogeographie. By R. Hertwig and R. v. Wettstein. Pp. ix+620. (Leipzig und Berlin: B. G. Teubner.) 22 marks.

The People's Books:—Wild Flowers. By M. Skene. Pp. 92. Applications of Electricity for Non-Technical Readers. By A. Ogilvie. Pp. 93. (London and Edinburgh: T. C. and E. C. Jack.) 6*d*. net each.

Ueber die Konstitution und Konfiguration von Verbindungen höherer Ordnung. By Prof. A. Werner. Pp. 21. (Berlin: J. Springer.) 1.20 marks.

The Elements of Qualitative Chemical Analysis. By Prof. J. Stieglitz. Vol. i. Parts 1 and 2. Pp. xi+312. Vol. ii. Parts 3 and 4. Pp. viii+153. (London: G. Bell and Sons, Ltd.) 6*s*. net each.

A Text-Book on Spherical Trigonometry. By Prof. R. E. Moritz. Pp. vi+67. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 4*s*. 6*d*. net.

Practical Mathematics for Technical Students. Part I. By T. S. Usherwood and C. J. A. Trimble. Pp. 370. (London: Macmillan and Co., Ltd.) 3*s.* 6*d.*

Rubber: its Sources, Cultivation, and Preparation. By H. Brown. Pp. xiii+245. (London: J. Murray.) 6*s.* net.

Wild Game in Zambezia. By R. C. F. Maugham. Pp. xii+376. (London: J. Murray.) 12*s.* net.

Board of Agriculture and Fisheries. Annual Report of the Horticulture Branch. Pp. 57+maps. (London: H.M.S.O.; Wyman and Sons, Ltd.) 2*s.* 2*d.*

The History of the Indian Museum. By the Hon. Justice Sir A. Mookerjee. Pp. 76. (Calcutta.)

Memoirs of the Geological Survey of India. Vol. xliii. Part I. Indian Geological Terminology. By Sir T. H. Holland and G. H. Tipper. Pp. 127+v plates. (Calcutta.) 2*s.* 8*d.*

The Algebra of Logic. By L. Couturat. Translated by L. G. Robinson. Pp. xii+98. (Chicago and London: Open Court Publishing Company.) 3*s.* 6*d.* net.

Royal Botanic Gardens, Kew. Bulletin of Miscellaneous Information, 1913. Pp. iv+426+iv appendices. (London: H.M.S.O.; Wyman and Sons, Ltd.) 4*s.* 6*d.*

The Theory of Proportion. By Prof. M. J. M. Hill. Pp. xx+108. (London: Constable and Co., Ltd.) 8*s.* 6*d.* net

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 19.

ROYAL SOCIETY, at 4.30.—The Brain of Primitive Man, with Special Reference to the Cranial Cast and Skull of Eoanthropus (The Piltdown Man): Prof. G. Elliot Smith.—Oxidases: Prof. A. J. Ewart.—A New Malaria Parasite of Man: Dr. J. W. W. Stephens.—Investigations Dealing with the Phenomena of "Clot" Formations. II: The Formation of a Gel from Cholate Solutions having many Properties Analogous to those of Cell Membranes: S. B. Schryver.—The Influence of the Position of the Cut upon Regeneration in *Gunda ulvae*: D. Jordan Lloyd.

INSTITUTION OF MINING AND METALLURGY, at 8.15.—The Assay of Tin Ores: H. W. Hutchin.—The Assay of Tin Ores and Concentrates: The Pearce-Low Method: E. A. Wraight and P. Litherland Teed.—Formation of Mineral Deposits: Precipitation and Stratification in the Absence of Gels: W. P. Dreaper.—A Device for Filling Ore Sacks: T. R. Archbold.—A Mining Model: E. O. Marks.

LINNEAN SOCIETY, at 8.—The Origin of Species by Crossing: Dr. J. P. Lotsy.

CHILD STUDY SOCIETY, at 7.30.—Speech Defects of Children and their Treatment: Dr. E. W. Scripture.

FRIDAY, FEBRUARY 20.

ROYAL INSTITUTION, at 9.—Busts and Portraits of Shakespeare and of Burns: An Anthropological Study: Prof. Arthur Keith.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Annual General Meeting.—Some Modern Methods of Welding; T. T. Heaton.

INSTITUTION OF CIVIL ENGINEERS at 8.—The Use of Reinforced Concrete in Connection with Dock and Other Maritime Work: C. S. Meik.

SATURDAY, FEBRUARY 21.

ROYAL INSTITUTION, at 3.—The Electric Emissivity of Matter: Dr. J. A. Harker.

MONDAY, FEBRUARY 23.

ROYAL SOCIETY OF ARTS, at 8.—Artistic Lithography: J. Pennell.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Sea Route to Siberia: Dr. Fridtjof Nansen and J. Lied.

TUESDAY, FEBRUARY 24.

ROYAL INSTITUTION, at 3.—Animals and Plants under Domestication: Prof. W. Bateson.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—The Bantu Coast Tribes of the East African Protectorate: Miss A. Werner.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Rail-steels for Electric Railways: W. Willox.—Rail-corrugation and its Causes: S. P. W. D'Alte Sellon.

WEDNESDAY, FEBRUARY 25.

ROYAL SOCIETY OF ARTS, at 8.—Rural Housing: T. Brice Phillips.

GEOLOGICAL SOCIETY, at 8.—Acid and Intermediate Instrusions and Associated Ash-Necks in the Neighbourhood of Melrose (Roxburghshire): Rachel W. McRobert.—Correlation of the Dinantian and the Avonian: Dr. A. Vaughan.

THURSDAY, FEBRUARY 26.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Diffraction of Light by Spheres of Small Relative Index: Lord Rayleigh.—(1) Studies of the Properties Operative in Solutions. XXXI. Sulphonic Acids and Sulphuric Acid as Hydrolytic Agents: A Discussion of the Constitution of Sulphuric and other Polybasic Acids and of the Nature of Acids; (2) Studies of the Properties Operative in Solutions. XXXII. The Influence of Sulphonates on the Hydrolytic Activity of Sulphonic Acids: A Contribution to the Discussion on the Influence of Neutral Salts: Prof. H. E. Armstrong and Prof. F. P. Worley.—Morphological Studies of Benzene Derivatives. V. The Correlation of Crystalline Form with Molecular Structure: A Verification of the Barlow Pope Conception of "Valency-Volume": Prof. H. E. Armstrong. R. T. Colgate, and E. H. Rodd.—The Magnetic Properties of Iron when Shielded from the Earth's Magnetism: Prof. E. Wilson.—The Occurrence of Ozone in the Upper Atmosphere: Dr. J. N. Pring.—(1) A Meteoric Iron from Winburg, Orange Free State; (2) The Electrification Produced during the Raising of a Cloud of Dust: W. A. D. Rudge.—The Electrical Ignition of Gaseous Mixtures: Prof. W. M. Thornton.

CONCRETE INSTITUTE, at 7.30.—Calculations and Details for Steel-frame Buildings from the Draughtsman's Standpoint: Cyril W. Cocking.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Motor and Control Equipments for Electric Locomotives: F. Lydall.

SOCIETY OF DYERS AND COLOURISTS, at 8.—The Industrial Possibilities of Nitrocellulose: C. A. Higgins.—Notes on the Fading of Dyed Silk: A. Jones and G. W. Parr.

FRIDAY, FEBRUARY 27.

ROYAL INSTITUTION, at 9.—Surface Combustion: Prof. W. A. Bone.

SWEDENBORG SOCIETY, at 8.15.—The Body and the Soul in Swedenborg's Philosophy: Dr. L. de Beaumont-Klein.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Use of Reinforced Concrete in Connection with Dock and other Maritime Work: C. S. Meik.

SATURDAY, FEBRUARY 28.

ROYAL INSTITUTION, at 3.—Recent Discoveries in Physical Science: Sir J. J. Thomson.

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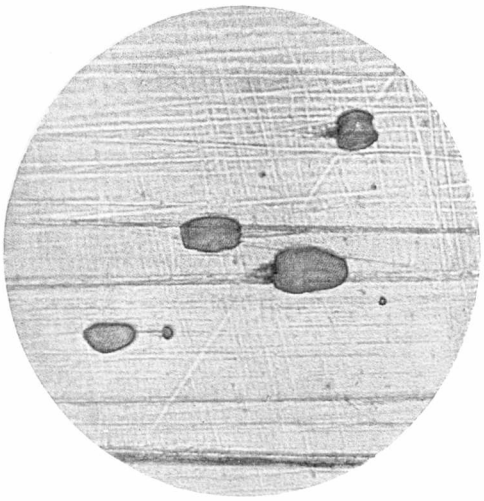

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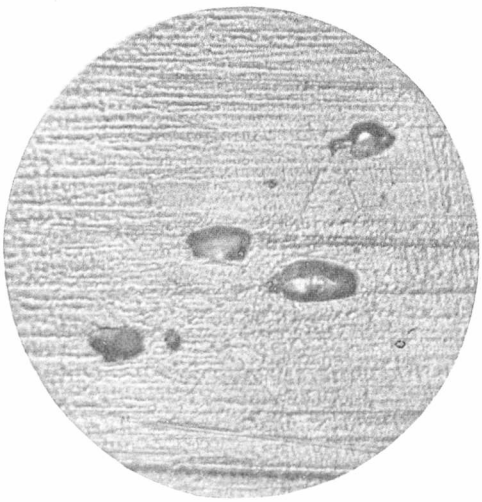

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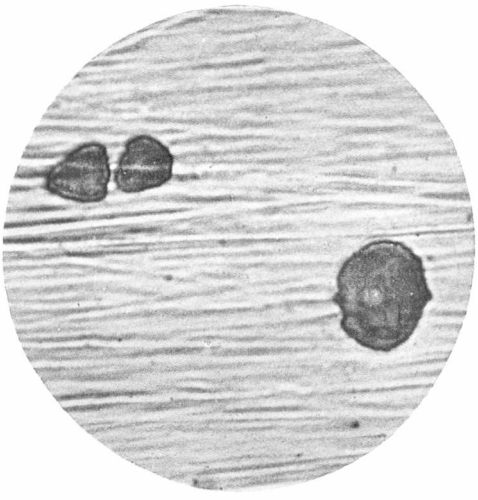

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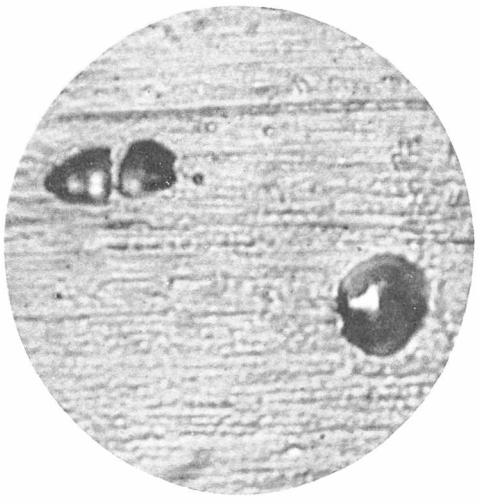

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