THURSDAY, JANUARY 5, 1905.

MODERN OPTICAL METHODS.

Die Bilderzeugung in optischen Instrumenten, vom Standpunkte der geometrischen Optik. By the Scientific Staff of Carl Zeiss's Works. Edited by M. von Röhr. Pp. 588; with 133 woodcuts. (Berlin: Julius Springer, 1904.)

Grundzüge der Theorie der optischen Instrumente nach Abbe. By Dr. Siegfried Czapski. Second edition. Edited by Dr. O. Eppenstein, with the assistance of M. von Röhr. Pp. 490; with 176 woodcuts. (Leipzig: Johann Ambrosius Barth, 1904.)

THE old geometrical optics which we used to read at Cambridge was a delightful subject. It would have been a still more delightful subject had examiners set better questions on it. Probably no other branch of mathematics would lend itself so well to the kind of treatment which is now fortunately coming into fashion, viz. the use of graphical and experimental methods. If the German system of Lehrfreiheit prevailed in this country I would rather teach geometrical optics to an elementary class than geometry adapted to modern requirements.

This elementary optics, however, bears about the same relation to the optics treated in the first of these books that Newton's deductions from Kepler's laws bear to the planetary theory. The analogy is the more complete in that both the optician and the astronomer have found it impossible to obtain an exact solution by direct methods, and they have therefore been led to employ the method of trial and error in order to obtain successive approximations giving the desired results to closer and closer degrees of accuracy. As Messrs. Czapsky and Siedentopf point out (p. 25), the exact determination of the forms of the refracting surfaces required to produce exact images subject to given conditions has never been effected, except in a few cases, such as the Cartesian oval, in which rays from one focus converge to a point in the other. We therefore take spherical surfaces, and by calculating the various kinds of aberration, show how they may be corrected. It is, however, interesting to learn that the theory of non-spherical surfaces has quite recently been put into practice in the Zeiss works for the first time in the construction of lenses other than large reflectors and refractors for telescopes. It has, in fact, been found possible to correct certain residual aberrations by applying finishing touches to the lenses giving them a slight deviation from sphericity.

The analogy between the problems of the optician and the astronomer is made still closer by observing how different specialists have confined their attention to particular kinds of aberration in the one case and of perturbation in the other, and have devised special methods for simplifying the calculation of the corresponding terms.

In his preface Dr. Czapski tells us that the present work owed its origin to the demand for a revised edition of his "Theorie der optischen Instrumente nach Abbe," published in 1893. Being unable to undertake the work himself, the idea suggested itself that a better purpose would be served by obtaining the collaboration of a number of joint authors, and that no better body of men could be found for the purpose than the scientific staff of the Zeiss firm.

The work has been divided among the seven joint authors as follows:—The first chapter, dealing with the fundamental principles of optics, including the laws of refraction, the principle of minimum path, and the characteristic function, is contributed by Drs. Czapski and Siedentopf; Drs. König and von Röhr contribute the second chapter, on formulæ of calculation, and the fifth, on spherical aberration, in which latter is contained a complete exposition of Abbe's method of invariants and its application to the determination of the ten corrections determined by the problem of Seidel. The chapters on chromatic aberration and on determination of optic systems according to the theory of aberrations (chapters vi., vii.) are contributed by Dr. König alone. "The Geometrical Theory of Images after E. Abbe" is the title of the third chapter, by Dr. Mandersleb. In the fourth chapter, by Dr. P. Culmann, on the realisation of optical images, we actually do find our old friend the formula

$$\frac{\mu}{v} - \frac{1}{u} = \frac{\mu - 1}{r},$$

in a position, however, of subsidiary importance. Dr. Löwe contributes a chapter on prisms, while Dr. von Röhr is responsible for the last two chapters, dealing with the breadths of pencils, penetration, brightness of images, and similar matters.

The second of these books is of a more elementary and practical character. It contains a general discussion of images formed by small pencils, and illustrated descriptions of the principal optical instruments. The corrections are discussed, but the discussions are less mathematical. The theory of conjugate foci receives fairly full treatment, and among the interesting features which we notice at a first glance, attention may be directed to the series of sections of a pencil of light on p. 24, and the figures of an object and its image on p. 40, where the object is an arrow in a plane through the axis of a lens, and is bisected by the focal plane of the lens.

This is the second edition of a book of which the first edition was written for Winkelmann's "Handbuch der Physik." Of matter new in this edition, Dr. Eppenstein contributes chapters on screens, on projection apparatus, and on the illumination of objects; chapters on vision, on photographic objectives, and on spectacles are contributed by Dr. M. von Röhr.

The perfection to which the manufacture of optical instruments has been brought by the Zeiss firm is well known, and it is also pretty generally realised that the results attained could not have been accomplished by an establishment run on purely business lines by "practical men" falsely so-called. The usual stock form in which the last named class of individual recommends his wares to the public is the stereotyped statement that "The materials used in the preparation of these goods are of the best quality obtainable."

The present books furnish abundant proof that this statement is particularly applicable to the Zeiss instruments in regard to the quality of those materials most essential for the production of good optical apparatus, viz. brains and knowledge of advanced mathematics.

G. H. BRYAN.

AMERICAN CYTOLOGY.

Fecundation in Plants. By David M. Mottier, Ph.D. Pp. viii+187. (Washington: Published by the Carnegie Institution, 1904.)

Contributions to the Knowledge of the Life-History of Pinus, with Special Reference to Sporogenesis, the Development of the Gametophytes and Fertilisation. By Margaret C. Ferguson, Ph.D. Pp. 153. (Washington: Published by the Washington Academy of Sciences, 1904.)

MR. MOTTIER'S "Fecundation in Plants" gives to those who are interested in cytology an account of the phenomena of fertilisation throughout the vegetable kingdom, written by one who has carried on investigations in several branches of the subject with success. His practical acquaintance with his subject confers even on his descriptions of the investigations of others a freshness which makes his work a pleasure to read. The first chapter is perhaps the most generally interesting. In it he gives an account of some of the vexed problems of karyology which are at present calling out so much controversy among cytologists. Among these problems may be mentioned the existence of centrosomes, the homology of centrosomes and blepharoplasts, the nature of synapsis, the significance of the sexual process, and the numerical reduction of chromosomes. The author's method of discussion is candid. He avoids being dogmatic in expressing his own views, although he criticises somewhat severely the observations of others. He holds that centrosomes and centrospheres do not occur in plants higher than the liverworts, and are, indeed, only well established in a few of the Thallophyta. It is remarkable that he does not allude to the possibility that the radiations at the poles of mitoses may be in part artefacts produced by the fixing agents. He considers Belajeff hasty in coming to the conclusion that the centrosome is the homologue of the blepharoplast; but he admits later on that certain "facts lend encouragement to the belief that centrosome and blepharoplast may be homologous structures." Mottier regards synapsis as due in a large measure to the action of reagents. He accepts Strasburger's theory of the numerical reduction of chromosomes as a good working hypothesis, and he holds now that there is no evidence for Weismann's "reduction" to be found in the mitoses of plants. His candid expression of doubt as to the persistent individuality of the chromosomes preserved through the successive mitoses—so often assumed, though almost involving a miraculous resurrection—is typical of his attitude of independence.

The succeeding chapters give an account of fertilisation in types taken from the various subdivisions of the vegetable kingdom. These descriptions are most useful in bringing together what is scattered sporadically through botanical literature into the compass of a short, well written book. The work is illustrated by blocks in the text, which show in a satisfactory manner the points to be brought out.

Miss Ferguson's memoir has a more limited scope, but this allows her to devote more space to her own researches, which have been very extensive in the cytology of the spore-production of conifers. It is quite remarkable to see how two cytologists, writing almost simultaneously, can hold so divergent views on fundamental subjects. While Mottier sees in the fusion of sexual nuclei the blending of two lines of descent, Miss Ferguson's researches lead her to believe that no fusion-nucleus, combining the paternal and maternal hereditary substances, is formed. Rather the processes of mitosis allow these to be kept apart during the life of the offspring, and the "reduction" or qualitative division occurring some time during the life-cycle secures that the gametes shall be "pure." It is evident that the later writer is concerned with the relation of mitosis to Mendel's views rather than to Weismann's hypothesis. With regard to synapsis, Miss Ferguson believes it to be a normal stage in heterotypic mitosis. Another point of difference is the mode of origin of the double chromosomes of heterotypic mitosis. Miss Ferguson finds confirmation in her preparations for the view (first published by the writer of this review in 1896, *Proc.* Roy. Irish Acad.) that the two arms of the chromosomes are approximated pieces of the nuclear thread, and do not arise by longitudinal cleavage as Mottier believes. This interpretation seems to be gaining ground, and the Louvain school, once so much opposed to it, has recently accepted it, putting the folding back, however, to the synaptic stage. The reviewer's investigations seem to suggest the possibility that two distinct foldings take place, one during synapsis and another between that stage and the differentiation of the chromosomes. Whatever views are held on these disputed matters, all cytologists are indebted to the author for her beautiful drawings, which are reproduced in a series of twenty-four plates.

There is no doubt that the publication of these two memoirs, the one by the Carnegie Institution and the other by the Washington Academy, will be of much service to those engaged in cytological research.

H. H. D.

PHYSICAL RESEARCH AT LEYDEN.

Het Natuurkundig Laboratorium der Ryks-Universiteit te Leiden in de Jaren 1882–1904. Gedenkboek aangeboden aan den Hoogleeraar H. Kamerlingh Onnes, Directeur van het Laboratorium, by gelegenheid van zyn 25-jarig Doctoraat op 10 Juli 1904. Pp. viii+288. (Leyden: Eduard Ydo, 1904.)

THIS volume was prepared by colleagues and pupils of Prof. Kamerlingh Onnes, of Leyden University, and presented to him on the twenty-fifth anniversary of his receiving the degree of Ph.D. It differs in character from the usual collections of scientific papers which it has become the fashion on the Continent to present to eminent men of science on

similar occasions. Since 1882 Prof. Onnes has been director of the physical laboratory at the University of Leyden, and the book gives a description of the growth of the institution since his accession to the directorship, of its present condition, and of the work carried out by himself and by his pupils under his supervision. In a sense it is a matter for regret that by the nature of the case he himself had to be excluded from the list of contributors; on several of the subjects dealt with it would be interesting to have the director's personal views.

After an eloquent dedication from the hand of Prof. Bosscha, we find in the first chapter, compiled by Prof. Haga and others, a detailed description of the laboratory and of the more important machinery and fittings, particularly those belonging to the "cryogenic" department, to which Prof. Onnes has devoted most of his personal labours; the low temperature baths prepared here are extensively used throughout the laboratory for various researches.

In an appendix to this chapter Dr. Siertsema gives an interesting account of the training school for apprentice mechanics instituted by Prof. Onnes in connection with the laboratory. This institution is probably unique; it was started in 1886 with one pupil, and the number has risen steadily until this session no less than thirty-three boys are receiving systematic instruction in the various mechanical arts, with the object of qualifying themselves as instrument makers, glass-blowers, electricians, and for similar professions. The boys are supposed to assist to a certain extent in the routine work of the laboratory and earn corresponding small wages, while in the evening they have to attend classes in the municipal technical institute. A better training for the purpose could hardly be imagined, and one is not astonished to learn that after the completion of the three years' course the boys appear to be much in request in laboratories and various engineering and technical works.

In chapter ii. thermodynamical investigations are reviewed; Prof. van der Waals gives an account of Prof. Onnes's researches on thermodynamical surfaces, Prof. Kuenen writes on the phenomena of condensation of binary mixtures, and there are further articles on accurate isothermals of gases, on the construction of models of surfaces, and on capillarity and viscosity of liquids up to the critical region.

The third chapter, edited by Prof. Lorentz and others, is devoted to optical and magneto-optical work; here we find a discussion of experiments on the reflection of light by mirrors, on the magnetic rotation of the plane of polarisation in gases, liquefied gases and other liquids, on the influence of pressure on the rotation of sugar solutions, on the reflection of light by magnetised mirrors (Kerr's phenomenon), and an account of Zeeman's discovery of the modification in spectra by magnetic forces. The phenomenon discovered by Egoroff and Georgiewsky, that a sodium flame placed in a magnetic field emits partially polarised light, was investigated by Prof. Lorentz himself, and appears to be closely connected with Zeeman's phenomenon.

In the last chapter Prof. Zeeman gives a description of researches on Hall's phenomenon in bismuth at various temperatures down to the boiling point of oxygen, measurements of the dielectric constant of liquid oxygen and liquid nitrous oxide, and of the absorption of Hertz vibrations by salt solutions.

A detailed account of all the research work is published regularly in the *Communications* from the physical laboratory at Leyden, the issue of which was commenced in 1892, but the present papers give a useful general summary of the work carried out, presented in a manner which should make it intelligible to the uninitiated.

The volume bears ample testimony to the success which has attended Prof. Onnes's manifold labours for his laboratory, which owes to him its position as one of the best known institutions of its kind. It is well illustrated, and contains as a frontispiece a striking likeness of Prof. Onnes, apparently after a drawing.

PRACTICAL SILICATE ANALYSIS.

Manual of the Chemical Analysis of Rocks. By H. S. Washington, Ph.D. Pp. ix+183. (New York: Wiley and Sons; London: Chapman and Hall, Ltd., 1904.) Price 8*s.* 6*d.* net.

OF late years greatly increased attention has been directed to the chemical investigation of rocks, and the science of petrology has been enriched by many excellent analyses. Among these the work of the United States Geological Survey deservedly holds the highest place, both on account of its abundance and its thoroughness. The present treatise arises from an endeavour to make the methods used by Clarke, Hillebrand, and other chemists in the United States laboratory available to all workers. It is excellently clear and detailed, and though the experienced analyst will not find in it much that is not already published in more succinct form in the official *Bulletins* of the Survey, he will glean a few details of manipulation and discussions of the bearings of chemical petrology that will at any rate repay perusal.

The author intends his book to be used mainly by the rather numerous class of geologists and petrologists who combine a fair knowledge of chemistry with a desire to make their own rock analyses. Undoubtedly this is a far more satisfactory proceeding than, as is usually done, to have the analyses executed by some analyst who has no special knowledge of the intricacies of this part of practical chemistry, and follows methods which are discredited or discarded. In any case such a worker will do well to place himself, for a time at least, under some teacher who is thoroughly at home in the subject; we hope that this book will not stimulate the production of analyses of rocks by students in course of training. Much of the worst analytical work with which chemical petrology is burdened has been executed in that way. If it helps to spread the knowledge of the methods used by Clarke and Hillebrand this book will do much good, as it is desirable that these should henceforward be recognised as standards, from which any important departure should be notified when the results are published.

In a few respects Dr. Washington has simplified the

standard American procedure. We think this is wise, and, while we endorse his opinion that only the best work should be aimed at, we do not think that this means that the very elaborate American analyses should be emulated by the ordinary worker. From twenty to twenty-five elements are usually sought for by the American chemists, and nearly one-half of these may be present in less than 1 per cent. of the total rock. Such analyses look exceedingly well on paper, but require the greatest experience and manipulative dexterity if they are to be trustworthy. Moreover, their value is as yet not beyond question. Certainly an analysis in which ten or twelve elements are determined as exactly as possible is more welcome than an analysis which is more elaborate but less accurate. We notice that the author discourages the routine execution of duplicates. No doubt this is right; they take up much time, and may be useless or misleading; it is better for the experienced chemist to occupy himself in the most thorough testing of his reagents, the purity of which is never above suspicion. Still, there can be no doubt that duplicate analyses do show how far it is possible for the results to vary when two samples of the same powder are analysed. They help to check any exaggerated confidence in analytical refinements. In this respect it would be interesting to know what are the probable limits of error in analyses executed by the methods given in this book. The author gives his opinion (apparently not founded on any special investigations), and it strikes us that he is more sanguine in this respect than the majority of experienced silicate analysts in Britain or on the Continent.

OUR BOOK SHELF.

Application of some General Reactions to Investigations in Organic Chemistry. By Dr. Lassar-Cohn. Translated by J. B. Tingle, B.A. Pp. 101. (New York: Wiley and Sons; London: Chapman and Hall, Ltd., 1904.) Price 4*s.* 6*d.* net.

IT would be difficult to say with what object and for what class of readers this little volume (it is scarcely more than a pamphlet, and may be read in an hour) was written. Yet anyone engaged in the practical pursuit of organic chemistry cannot fail to be interested in it. One may say roughly that the book treats of the unsystematic part of organic chemistry, *i.e.* of the ordinary reactions which do not succeed, and how they may be made to do so.

Without always offering a very satisfactory explanation of the causes of success or failure, for the terms "protective influence" and "contact action" are after all merely names, the author points out how an apparently unimportant modification may affect the whole course of a reaction and convert an unprofitable method into a successful or commercially lucrative one. Incidentally, he urges the systematic study of these anomalous reactions.

As an example may be mentioned the well known fact that the accidental introduction of a few drops of mercury into the experimental vessel, in which the preparation of phthalic acid from naphthalene was in progress, rendered the operation and consequently the production of artificial indigo a success.

As a rule the difficulties encountered by the anomalous behaviour of organic compounds are met not by more drastic treatment, but by milder reagents. The whole trend of modern organic synthesis seems to lie in this direction. Thus the caustic alkalis have been replaced in many cases by alcoholic solutions of sodium ethoxide, by diethylamine, pyridine, or chalk, the strong mineral acids by phosphoric, boric, or one of the organic acids. High temperatures have given place to lower ones. The days of so-called "pyrogenic synthesis" are past. No one nowadays makes organic compounds by the aid of a red-hot tube.

In this connection it is suggestive that the fundamental reactions of living matter which embrace oxidation and reduction of a far-reaching kind, as well as synthetic processes more complex than anything achieved in the laboratory, are all effected at ordinary temperatures and with the mildest reagents.

It follows, therefore, that the more closely organic chemists succeed in imitating these conditions the more surely will those mysterious contact or fermentation problems usually associated with living protoplasm, but not unknown in the laboratory, approach solution. J. B. C.

A Further Course of Practical Science. By J. H. Leonard and W. H. Salmon. Pp. ix+224. (London: John Murray, 1904.) Price 2*s.*

IN this book the principles of natural science are taught and enforced in a scientific manner by means of a course of experimental work, simple in character, but involving quantitative measurements, and carried out personally by the student. To begin with, lengths are measured with an ordinary rule, and tests are made in order to find out the limits of accuracy within which the measurements may be relied on. These measurements serve as an introduction to "physical arithmetic," or simple arithmetical computations specially suitable for dealing with numbers which are avowedly only approximately correct. Then follows a chapter on elementary mensuration involving the estimation of angles, lengths, areas, and volumes, the balance very wisely sharing in this work.

Experiments are devised to illustrate some of the fundamental properties of matter, such as those of indestructibility, inertia, porosity, ductility, &c. The next six chapters deal with mechanics, the subjects including uniform linear acceleration, Newton's laws, relative motion, statical equilibrium of uniplanar forces, and simple machines. This difficult section is not treated in a very satisfactory manner. The method is too deductive, the experiments are somewhat scanty and not very well chosen. Thus there is no direct verification of the fundamental principle of the conservation of momentum. Vectors, though introduced, are not made sufficiently prominent, and in the so-called "simple machines" it seems rather antiquated to find the three kinds of levers, the three systems of pulleys, the wedge, &c., introduced.

In the concluding chapters relating to the properties of liquids and gases, and the nature of heat, the authors are happier in their treatment, notwithstanding an occasional looseness in the statement of a principle. The book deserves to be very favourably received, and teachers will find that arrangements have been made to facilitate the purchase of the apparatus necessary for conducting the experiments.

Die drahtlose Telegraphie. By Dr. Gustav Eichhorn. Pp. x+256; numerous figures. (Leipzig: Veit and Co.) Price 5 marks.

THIS is an elementary exposition of the principles and practice of wireless telegraphy with especial reference to the systems developed by Dr. Braun. It is evidently intended to enable a practical man to become acquainted with this method without, at the same time, any attempt being made to give such a complete

account as would warrant its use as a class text-book. By means of the first five chapters a reader who knows a little about the elements of electricity and magnetism will be able to appreciate the nature of electric waves and of Hertz's achievement in producing them. Then, after briefly alluding to the early system of Marconi, the writer passes on to the particular devices of Dr. Braun. The book is well and clearly written, but is in no sense a complete compendium on the subject, and the reader who derives all his knowledge from it will be inclined to think that there is only one system in the world, and that Eichhorn is its prophet. More recent methods of detecting waves by means of effects arising from hysteresis in iron are dismissed in a couple of pages, where there is no reference to Rutherford's early detector working on the same principle, while Lodge's steel-mercury-contact detector does not appear even to be mentioned, although the "Literature" appendix at the end includes the year 1903. In appendix ii. the Thomson-Kirchhoff theory of the oscillatory discharge of a condenser is given; the credit, of course, belongs to Thomson (Lord Kelvin).

Notes on the Natural History of the Bell Rock. By J. M. Campbell. Pp. xv+112; title-piece. (Edinburgh: David Douglas, 1904.) Price 3*s.* 6*d.* net.

As a record of the various types of aërial and marine life commonly seen by the guardians of the lonely lighthouses of the east coast of Scotland in particular, and of the British coasts in general, these random notes are worthy of all commendation, more especially as they are written by a man who does not appear to have had a scientific training. Mr. Campbell was assistant light-keeper on the Bell Rock for the long period of nine years, and he is therefore well qualified to know all that is to be known with regard to the general habits of the commoner and more conspicuous species frequenting the environment of his station; while a period of such a length is sufficient to include the visits of many of the rarer stragglers. Most or all of the notes, it appears, have been previously published in the local Press of the neighbouring mainland, and they are certainly worthy of rescue from such oblivion. The only point for regret is, perhaps, that the author does not say more about bird migration. Mr. James Murdoch, late secretary to the Board of Northern Lighthouses, has contributed an interesting introduction on lighthouses and lighthouse-men in general.

R. L.

The British Journal Photographic Almanac, 1905. Edited by Thomas Bedding. Pp. 1612. (London: Henry Greenwood and Co., 1904.) Price 1*s.* 6*d.* net.

THIS bulky volume, with its mine of miscellaneous photographic information, is compiled on the same lines as the earlier issues, and will be found to be a necessary adjunct to the studio and library. Among the host of articles in these pages may be mentioned a condensed summary of the story of the *British Journal of Photography* and the almanac which appeared in the jubilee number of the above mentioned journal, and also a selected number of the jubilee articles. Recent novelties in apparatus, &c., by the editor, forms also a conspicuous feature, and represents the progress in this branch of photography. No less important are the practical notes on numerous subjects, the formulæ, tables, list of photographic societies of the United Kingdom, &c., all of which add to the utility of the volume. The full indices to advertisers and contents make a quick reference to any portion of the book quite an easy matter, an important consideration in a book containing 1612 pages. The processed illustrations and woodcuts are as numerous as ever.

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.*]

Mean Temperatures of High Southern Latitudes.

ON p. 131 of NATURE of December 8, 1904, you give an approximate calculation of the mean temperatures of high southern latitudes, by Mr. Krebs, based upon the observations of the most recent Antarctic expeditions.

For the new edition of my "Lehrbuch der Meteorologie" I have made a similar calculation, and have made use of the observations in order to calculate afresh the mean temperature of the southern hemisphere. My preliminary results are as follows:—

	50°	60°	70°	80°
S. latitude				
Yearly temperature ...	5·5 ...	−2·0 ...	−11·5 ...	−19·8 C.
January	8·3 ...	3·2 ...	− 0·8 ...	− 6·5 ,,
July	2·9 ...	−7·6 ...	−22·2 ...	−31·5 ,,

Mean temperature of both hemispheres:—

	January	July	Year	Annual variation
	°	°	°	°
S. hemisphere ...	17·3 ...	10·3 ...	13·6 ...	7·0 C.
N. ,, ...	8·0 ...	22·5 ...	15·2 ...	14·5 ,,
Whole earth ...	12·6 ...	16·4 ...	14·4 ...	3·8 ,,

Ferrel and myself formerly determined the mean temperature of the southern hemisphere to be 15° C. (from temperatures up to 55° S. lat.). The new observations in high southern latitudes have now shown that the southern hemisphere is considerably colder than the northern, viz. by about 1°·5 C. The publication of the temperature observations of the *Discovery's* second year will be very important for this question; in my calculations I could only make use of the observations relating to the first year.

Vienna, December 30, 1904. JULIUS HANN.

Reversal of Charge from Electrical Induction Machines.

LAST week, while working with a small Voss machine, I accidentally observed, on stopping the machine, giving about two turns in the wrong direction and then re-starting the machine in the original direction, that the poles had reversed. I repeated the experiment a dozen times, and invariably the reversal occurred. The reversal was observed by examining the spark between the knobs.

I mentioned the fact to Prof. Gray, and we then tried the effect with a vacuum discharge tube connected to the knobs. While the tube was fresh the reversal occurred, but after a little time the reversal occurred but seldom. It was found, however, that if the discharge was made to pass by connecting one terminal of the tube to earth, the other terminal to one pole of the machine, while the second pole of the machine was kept insulated, then the reversal invariably occurred when the procedure mentioned was followed.

We next tried the large Wimshurst machine in the laboratory with the same results. It was noticed, however, when the induction rods were so arranged that the machine excited both ways, that the reversal did not occur.

As I do not remember to have seen the experiment mentioned before, I think it worth directing attention to, as it provides a simple way of getting the discharge to pass in whatever direction it is required.

GEORGE W. WALKER.

Physical Laboratory, The University, Glasgow.

Fishing at Night.

THERE are, as I have explained in the book referred to by "S. W." in NATURE of December 29, 1904 (p. 201), many reasons for night-fishing by our pilchard and other fishing fleets. He quotes one, however, which is quite unsatisfactory, namely, the convenience of catching the morning

market. To a few ports this might apply, but as a general rule the fish-train for Billingsgate leaves the coast towns about six or seven in the evening, the fish reaching the central market by van first thing in the morning. The actual reasons for this preference for night-fishing are many. In the case of pilchards taken in drift-nets, the habits of the fish themselves furnish the explanation. In the case of trawlers, the reasons are diverse. In some cases the water is so shallow that the nets would be seen and avoided by the fish in daylight, and this, in fact, is still more the case with the drift-nets. Elsewhere, they trawl at night because they want soles, just as many Plymouth boats trawl by day because their best market is for the rougher kinds of fish. There is no night-trawling in Cornwall by reason of the local regulations, which clear the sea by night of other fishing craft in order that the drifters may work without interruption or risk. F. G. AFLALO.

14 Westover Villas, Bournemouth, Hants.

The Cost of Chemical Synthesis.

IN your review of Prof. Meldola's "Synthesis of Vital Products," your reviewer argues that though certain products, viz. alizarin and indigo, "can be synthesised so cheaply that natural products cannot compete with them in the market"; yet this is of little interest from the biochemical point of view.

May I point out that this argument is even stronger than it seems, for the *cheapness* is quite accidental, and due to the fact that the world requires coal gas, and iron.

If the syntheses above were dependent on anthracene and naphthalene obtained from coal treated strictly *ad hoc* this cheapness would disappear. R. J. FRISWELL.

43–45 Great Tower Street, London, E.C., January 2.

"Bastard" Logwood.

THE Jamaica *Bulletin* of the Department of Agriculture for November, 1904, prints a very interesting article on this subject by B. C. Gruenberg and William Gies, contributed originally to the *Bulletin* of the Torrey Botanical Club.

During the past few years the growers of logwood in Jamaica have been greatly disturbed by an apparent increase on their properties of an unmerchantable variety of the plant known as "bastard" logwood; the exportation of this wood along with real logwood has served to condemn all the logwood from the districts which have shipped it.

"Bastard" logwood differs from the genuine varieties, from the dyer's standpoint, in yielding little or no hæmatoxylin, but instead a yellowish-green pigment which is of no value, and which, when mixed with the commercial extract, reduces the characteristic tinctorial properties. Chips of the "bastard" logwood present a yellow, pale pink, white, or even chocolate coloured surface, instead of the dark red or deep purple bronze-tinted colour of the best logwood. There appears great uncertainty, even when the trees are cut down, as to whether a tree is really a "bastard" tree or not. What is known as a "bastard" tree is frequently dark enough when first cut to lead one to believe that it is a good red-wood tree, but instead of darkening with age it remains the same colour, or becomes lighter rather than darker. "Bastard" wood is not the result of disease or of any lack of vigour; the trees producing it are perfectly healthy and normal.

It is not the result of soil or climatic conditions, since bastard and normal trees are found growing side by side under absolutely identical conditions.

It is not the result of immaturity; aged trees may produce bastard wood.

These facts point to heredity as the probable cause of the trouble, that is, certain trees produce "bastard" wood because they grow from seed of a "bastard" tree; in other words, "bastard" logwood is a variety of *Haematoxylin Campechianum* that normally produces little or no hæmatoxylin. The chemical differences existing among all these logwoods are quantitatively very slight, and there are no striking structural differences among all the varieties of logwood.

There can be no doubt that "bastard" logwood is a distinct variety or subspecies of *Haematoxylin Campechianum*, notwithstanding the slight morphological difference that distinguishes it from the "red" logwood and blue logwood.

The Jamaica *Bulletin* has done good service to the colony in bringing the fact prominently before the planters that the admixture of useless wood which has been the source of unnecessary loss to them may be avoided.

S. N. C.

Intelligence of Animals.

THE instance of intelligence in a cat recorded by Mr. T. S. Patterson on p. 201 is not unusual. I have known several cats, all of them males, that were accustomed to rattle the handle or some part of the lock in order to get a door opened. F. J. ALLEN.

Cambridge.

A NEW CONTRIBUTION TO ASSYRIAN HISTORY.[1]

IN a handy little volume, to which we have much pleasure in directing the attention of our readers, Mr. L. W. King, of the British Museum, has published the cuneiform text and a translation of a very important historical Assyrian document, which has been recently exhibited in the Assyrian and Babylonian room in the British Museum. This document is a slab of limestone, about 15½ inches long and 11½ inches wide, which is inscribed with sixty-seven lines of cuneiform text, thirty-seven lines being on the obverse and thirty on the reverse. The writing is in bold, well formed characters, but it seems to have been cut somewhat hurriedly, for the mason was obliged to make nine erasures, and in two passages he has left out a sign, apparently without having detected the omission. We need not discuss the palæographical importance of the text, which is of considerable interest, and it is only necessary to state that it exhibits the style of Assyrian characters employed in monumental inscriptions in the early part of the thirteenth century before Christ.

The contents of the text, which is actually the official summary of the principal events in the reign of Tukulti-Ninib I., King of Assyria about B.C. 1275, fall readily into four divisions, which respectively record the king's name and titles, his military expeditions, the foundation of the city Kar Tukulti-Ninib, and an appeal to future rulers. The stone tablet or slab which supplies this information was either placed in a niche in the wall or laid in a box of stone or clay, and then built up in the foundation of the city Kar Tukulti-Ninib. In passing, Mr. King discusses briefly but clearly the question of foundation deposits, both in Egypt and Assyria, and shows how the ideas concerning them in the two countries agree in some respects and differ in others.

Turning now to the campaigns of Tukulti-Ninib I., we find that in the first he conquered the Kuti and the inhabitants of four other districts; in the second he became master of the land of Shubari, and ten other provinces; in the third he vanquished forty kings of the land of Na'iri; and in the fourth he defeated Bibeashu, King of Babylon, and completely subjugated the regions of Sumer and Accad. The last campaign was undoubtedly the most important of all, for with

[1] "Records of the Reign of Tukulti-Ninib I., King of Assyria, about B.C. 1275." By L. W. King, M.A., F.S.A. Pp. xvi+185, and 11 illustrations. (London: Luzac and Co., 1904.) Price 6s. net.

the fall of Babylon Tukulti-Ninib became master of all Mesopotamia. The resistance offered by the Babylonians was stubborn in the extreme, and the Assyrian king slew large numbers of them and destroyed their city wall. Tukulti-Ninib looted the city and plundered the treasuries of E-sagil, the great temple of Marduk, and he carried off to Assyria not only Bibeashu himself, but the statue of his god Marduk. No victory could have been more complete, and even at this distance of time it is impossible not to feel some sympathy with the vanquished Babylonian king when we read that he, a prisoner and bound in chains, was led, with his god Marduk, into the presence of Ashur, the great god of Assyria, as witnesses of the comprehensive manner in which Tukulti-Ninib had performed Ashur's commands.

The account of the conquest of Bibeashu and of the capture of Babylon by Tukulti-Ninib is especially important from a chronological point of view, for it establishes beyond a doubt the fact that these two kings were contemporaneous. For some time past it has been known from the "Babylonian Chronicle" that Tukulti-Ninib conquered Babylonia, but the name of the Babylonian king, although it occurs on this document, was not recognised. Both Mr. Pinches, who published a translation of this "Chronicle," and Dr. Winckler, who published a copy of the text, misread the passage in which the name occurs. The identification of Bibeashu and the correct reading of his name we owe to Mr. King, who has succeeded in establishing a new and very important synchronism in Assyrian and Babylonian history. Thus the system of chronology which made Bibeashu to live sixty or seventy years after Tukulti-Ninib I. is proved to be incorrect.

In connection with the conquest of Babylon by Tukulti-Ninib I., mention must here be made of the copy of an inscription which is found on a small clay tablet (K. 2673), now in the British Museum. This copy was made from a lapis-lazuli seal, on which the original inscription was engraved by a scribe of Sennacherib, who caused some lines to be added to commemorate his conquest of Babylon and the recovery of the seal by himself. The lapis-lazuli seal, as Mr. King tells us, was not made for Tukulti-Ninib I., as was once generally thought, but for Shagarakti-Shuriash, a Kassite king. When Tukulti-Ninib captured Babylon he found the seal there, and carried it off to Nineveh, and he had his own inscription engraved upon it without erasing that of Shagarakti-Shuriash. The seal was subsequently, in circumstances unknown to us, carried back to Babylon, where Sennacherib found it about 600 years later, and he, of course, restored it to Nineveh, and, having added his own inscription to it, had a copy of the inscription of the Kassite king, that of the King of Assyria, and of his own made on a tablet. The first to translate the copy of Tukulti-Ninib's inscription on the tablet was Mr. George Smith, but that of Shagarakti-Shuriash baffled him, and he failed to read the characters of which it was composed. Profs. Hommel, Bezold, and Schrader were likewise unable to translate it, and Mr. King has been the first to prove that, in addition to the words added to the seal by the order of Sennacherib, the copy contains two distinct inscriptions, namely, one of Shagarakti-Shuriash and one of Tukulti-Ninib I. The copy of Sennacherib's inscription is very important, for it enables us to assign the date of Tukulti-Ninib's reign provisionally to about B.C. 1275; its length cannot at present be stated with exactness.

In addition to the interesting text of Tukulti-Ninib, of which a general summary has been given above, Mr. King adds the inscriptions of Shalmaneser I. from the fragments of inscribed bowls now in the British Museum, a passage from the synchronous history, the inscriptions from the lapis-lazuli seal of Shagarakti-Shuriash, and Sennacherib's accounts of his capture of Babylon both in 702 B.C. and 689 B.C.; in fact, every bit of evidence which relates to the period of which his book treats, and is found in the cuneiform inscriptions, is appended for the assistance of the reader, with full transliterations and translations. That Mr. King has published not only a new, but important historical inscription is clear, and all who are in any way familiar with the subject will find his sober and concise observations on its contents helpful and stimulating. Messrs. Harrison's large cuneiform type has been used for printing the text, and paper and binding leave nothing to be desired. We note that the volume is the first of a series of "Studies in Eastern History" which Luzac and Co. are about to publish, and we feel that if the succeeding volumes are as valuable as the "Records of the Reign of Tukulti-Ninib I." the success of the undertaking is assured.

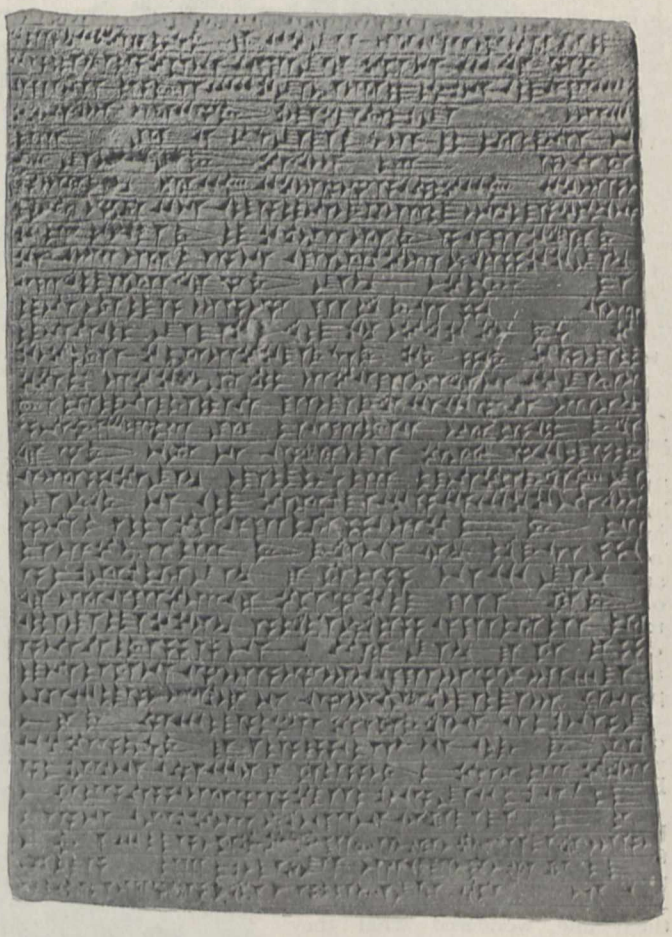


FIG. 1.—Limestone Tablet inscribed with the annals of Tukulti-Ninib I., King of Assyria. From "Records of the Reign of Tukulti-Ninib I."

SEISMOLOGY IN JAPAN.

UNDER the title of "Recent Seismological Investigations in Japan," Baron Dairoku Kikuchi, former Minister of Education, has issued for private circulation only an "address" prepared for the late exposition in St. Louis. When we look at this address, which is a quarto volume of 136 pages filled with illustrations, we feel that its author should have doffed his modesty and called it seismology as developed in Japan. To describe the work more closely, we shall not be far from the mark if we say it is an epitomised translation of a number of publications which to Europeans have hitherto been cryptogramic. It gives us not only a *résumé* of sixteen numbers of the publications of the Tokyo Earthquake Investigation Committee—called for short the E. I. C.—which have been published in a European language, and with which we are more or less familiar, but there is added an abstract of forty-seven numbers or volumes published in Chinese idiographs. Many seismologists have looked at them and wondered what they meant. The contents of these sixty-three publications have been epitomised, mixed, and systematised.

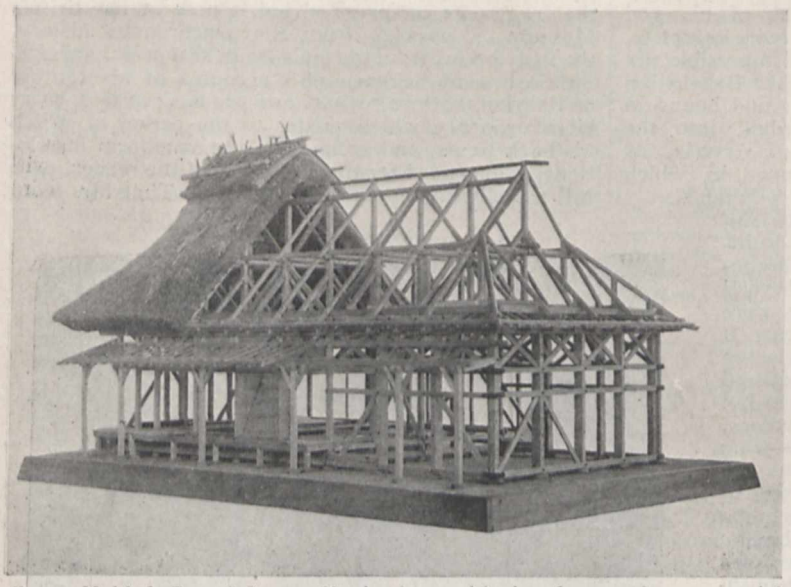


FIG. 1.—Model of a Farmer's Cottage. Showing the essential points of construction recommended by the Earthquake Investigation Committee. The chief points to be observed are diagonal bracing, the use of iron straps, and the avoidance of mortices and other cuts at joints.

After an introduction to the "recent" investigations, which tell us that the first earthquake recorded in Japan was in A.D. 416, and reference to various investigations made by Europeans in Japan, we are introduced to the system under which investigations and their results have been classified and discussed.

Under the heading "Statistical" we find data relating to the distribution of earthquakes in space and time, their relation to meteorological conditions, and various phenomena. Earthquakes which have a submarine origin are most frequent in summer, when the level of the Pacific Ocean bordering Japan is higher than in winter. Those originating on the land are most frequent in winter, at which season barometric pressure is at a maximum. Out of forty-seven destructive earthquakes which originated beneath the Pacific, twenty-three were accompanied by *tsunami* or sea waves, which probably means that on these occasions marked and sudden changes had taken place in the configuration of the sea bed.

Among the instruments which are described we notice a horizontal pendulum the bob of which is controlled by a small inverted pendulum. Although the vertical and horizontal dimensions of this apparatus are each only 1 metre, Prof. Omori tells us that a period of one minute can be obtained without difficulty. Macroseismic motion is described, and after this reference is made to microseisms or pulsations. These two classes of movement Prof. Omori finds alternate in their frequency, so that when the small movements are at a minimum the larger ones may be expected. This observation, we learn, has enabled him on several occasions to predict within ten or twelve hours the occurrence of an earthquake.

The geological investigations which have been made chiefly refer to the survey of volcanoes, which is a work outside that done by the Geological Survey.

The investigations of relationships that may exist between earthquakes and various physical phenomena which affect or are affected by strain in the earth's crust are particularly interesting. At present continuous magnetic observations are being made in Japan at five stations, from which, amongst other things, it has been observed that on several occasions magnetic

FIG. 2.—Nagoya Spinning Mill. Showing the effects of the Mino-Owari Earthquake of 1901 on a brick building and on a chimney constructed according to European practice.

needles have been disturbed before or at the time of large earthquakes. Speaking generally about these investigations, Baron Kikuchi considers that they promise to throw light upon the state of underground stress, and as one of the chief objects of the E. I. C. is to devise means to predict earthquakes which may be taken as announcements that stress has been relieved, it will be recognised that the inquiries relating to local magnetic disturbance are of a promising nature.

Other phenomena which receive attention are variations in latitude, the determination of gravity, underground temperatures, *seiches*, changes in the level of water in wells, and the elastic constants of rocks.

The last section of this interesting volume is an account of investigations which have been made with the object of reducing the disastrous effects of earthquakes to a minimum. To the practical person this is no doubt the most important branch of all seismological research. Already it has accomplished much, and after a severe shaking we have learned that in Japan new types of structures are to be seen standing amongst the ruins of older types.

We welcome Baron Kikuchi's volume, and trust that although its circulation is private it may also be wide.

THE FOUNDER OF AUSTRALIAN ANTHROPOLOGY.[1]

DR. A. W. HOWITT is our highest authority on the native tribes of Australia. Ever since the publication of "Kamilaroi and Kurnai," in 1880, he has been adding to our knowledge of the most instructive and interesting aboriginal population in the world. The present work, therefore, which summarises the data collected by him during forty years of personal intercourse with the "blackfellows," is of the greatest importance. Most of the material here incorporated was written up before 1889; a few modifications of theory and many new facts have been introduced, and some corrections made, but the broad deductions remain unaltered.

The main body of the work is preceded by a useful summary and criticism of the principal views that have been put forward as to the origin and ethnological affinities of the Tasmanian-Australian stock; Dr. Howitt rejects both the Dravidian and the Malayan hypotheses. The tribes here dealt with came into contact with the white man at a date too early, perhaps, to allow them much chance of survival; many of them are now practically extinct, and most of them are at least deorganised. The area they occupied is about one-quarter of the continent, extending on the north to near the tropic of Capricorn, and on the south bordered by the Southern and Pacific Oceans, connected by Bass Strait. This area has a wide range of climate and temperature, and the tribes themselves present almost every variety of social organisation, from that of the Dieri and central districts through the ordinary Australian types to the unique system of the Kurnai in Gippsland. Excellent maps, very numerous and complete, illustrate both the tribal areas and the range of the various social systems.

In this matter of organisation Dr. Howitt traces the gradations in a way conclusive enough to point to the probable course of evolution. In particular he reduces the problem of exogamy to the bisection of the community into two exogamous intermarrying moieties—the typical Australian system—which bisection is based, as he implies, on the prohibition of marriage between brothers and sisters. It is to be regretted that he does not fully discuss this ground of exogamy. He quotes Dr. Frazer and the present writer as having independently reached the same conclusion, and it seems that we are at last approaching unanimity as to this primal law of human social relations. He

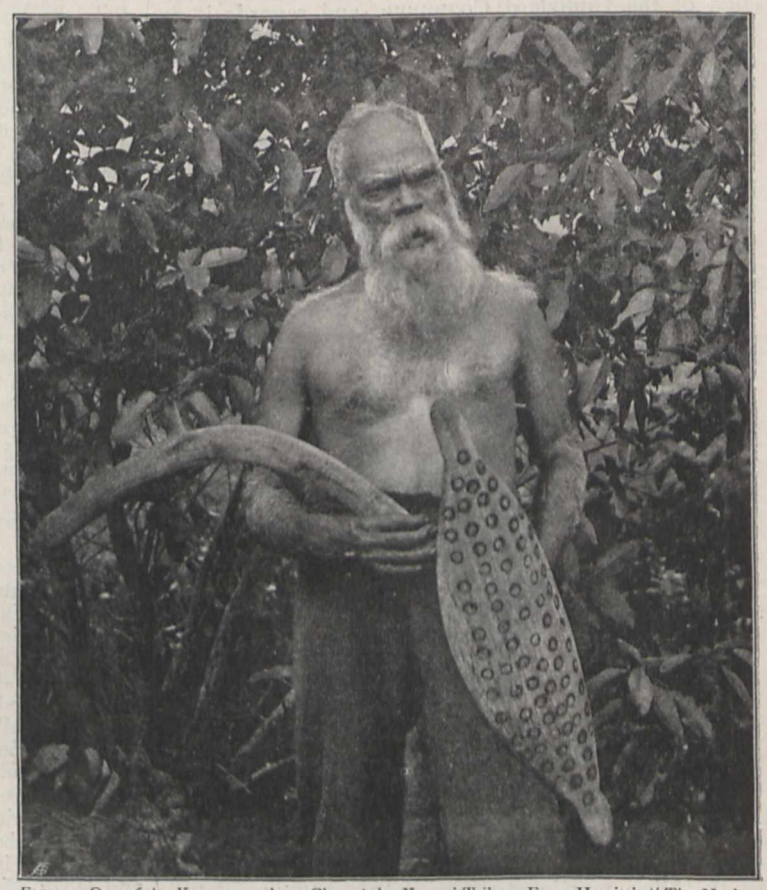


FIG. 1.—One of the Krauatungalung Clan of the Kurnai Tribe. From Howitt's "The Native Tribes of South-East Australia."

agrees with Spencer and Gillen that the primary functions of totemism were in existence before exogamy became established, and that the relation between totemism and exogamy is secondary only. On the other hand he sees no reason to modify his original view that the bisection was a reformatory measure, instituted after a long reign of the "Undivided Commune." It is doubtless impossible to deny some purposiveness to the innovation, if innovation it was; Mr. Lang is here inclined to agree. But to engineer such bisection in a large undivided commune seems beyond the powers even of primitive man. A shorter way may be easily suggested:—the moieties practically correspond to two groups of intermarrying relatives; we may suppose, then, to begin with, two small families or fire circles, A and B, making inter-

[1] "The Native Tribes of South-East Australia." By A. W. Howitt, D.Sc. Pp. xix+819; illustrations and maps. (London: Macmillan and Co., Ltd., 1904.) Price 21*s.* net.

marriage, and continuing to do so in successive generations. Now here we have in A and B not only the two moieties of the future tribe, but the tribe itself, in the making. The bisection *grew* out of a quasi-purposive exogamous instinct against marriage within the fire-circle.

There seems to be nothing against Aristotle's view that the tribe grew out of the family, except the curious but fashionable prejudice in favour of an organisation for primitive man of the baboon type. Mr. Atkinson in a remarkable paper has dealt the latest and one of the shrewdest blows at this prejudice, and doubtless anthropologists may in time revert to Darwin's suggestion that the earliest form of the human family resembled rather that of the unsocial anthropoids, such as the gorilla. It is noteworthy that Dr. Howitt modifies considerably the earlier conception of the Undivided Commune, and regards it as having been originally something like "what occurs when the modified Communes of the Lake Eyre tribes reunite." The battleground of the two schools is, of

FIG. 2.—The *Bret* or Dead Hand. From Howitt's "The Native Tribes of South-East Australia."

course, the so-called group-marriage of the tribes last named. In this connection the author does good service by putting together a full and revised account of the Dieri marriage-system, with its *Tippa-malku* or individual marriage, and its *Pirrauru* or group-union. We are thus enabled with some certainty of data to compare the notorious Urabunna and Arunta systems. But when Dr. Howitt says, "the germ of individual marriage may be seen in the Dieri practice; for as I shall show later on, a woman becomes a *Tippa-malku* wife before she becomes a *Pirrauru* or group-wife" (p. 179), the logic strikes one as curious. The inference should surely be that the group-marriage has been evolved from the individual system, and not the other way about.

The author still regards the practice, as amongst the Wiimbaio, of exchanging wives on the approach of a pestilence, as a survival of group-marriage, and the right of access as a survival of the *jus primae noctis* and an "expiation" for individual marriage. One had thought that these two last categories had been relegated to the limbo of outworn fictions anthropological. Noticeable details are that the action of jealousy is very strong in the Dieri tribe; that, as the Rev. O. Siebert puts it, "the practice of *Pirrauru* is worthy of praise for its strength and earnestness in regard to morality, and in the ceremonial with which it is regulated, since no practice could be less in accord with the hetairism which Lord Avebury has imagined for the Australian aborigines" (p. 186).

It is disappointing to find that no mention is made of Cunow's theory of the four and eight subclasses; it would have been instructive to see what light an unrivalled personal knowledge of the system and an acquaintance, doubtless extensive, with the dialects might have thrown on the view that these classes are age-divisions, and have primarily nothing to do with marriage-restrictions. The Kurnai with their totems which do not affect marriage, and their local, not class-divisions, present a fascinating problem, and no one knows more about the Kurnai than does Dr. Howitt. Their marriage by elopement, and the systematic use therein of priestly assistance, are remarkable customs. "It was the business of the *Bunjil-yenjin* to aid the elopement of young couples. For instance, when a young man wanted a wife, and had fixed his mind on some girl, whom he could not obtain from her parents, he must either go without her, persuade her to run off with him, or call in the aid of the *Bunjil-yenjin*. In the latter case his services were retained by presents of weapons, skin-rugs, or other articles." The *Bunjil-yenjin* then sang a magic song until he thought his magic strong enough to secure the "covering up" of the parents in a state of coma.

The author in a very interesting essay applies the facts of "maternal descent" to the Teutonic Salic Laws. Among the more important features of the book is the masterly and final settlement of the vexed questions of the native headmen, and the belief in supreme beings, like *Daramulun*. The connection between the two questions is that the headman in the sky is the analogue of the headman of the tribe on the earth. Among the Kurnai—to note another difference between many of the south-eastern tribes and those studied by Spencer and Gillen—the knowledge of *Mungan-ngaua* is confined to the initiated men, who impart it in all sincerity to their novices; the Arunta, as Spencer and Gillen inform us, take this opportunity of explaining their deity away as a being only believed in by women and children. Among further details of interest are the Kurnai custom of the Dead Hand, the performance of the Indian Rope Trick by Kurnai medicine-men, the magical influence which exists between opposite sexes, and the belief that the initiated elders infuse their own magical power into boys at confirmation.

The book is a fitting crown to Dr. Howitt's labours, and is, in effect, the most considerable and important of all studies of the Australian race.

A. ERNEST CRAWLEY.

CHANGES UPON THE MOON'S SURFACE.

UNTIL within the last few years there has been a very general opinion that the moon was a cold, dead world, or, as it has been sometimes expressed, a burned out cinder, upon which nothing ever happened. This view was apparently due to the fact that the men who wrote the text-books on astronomy were not the men who studied the moon. Among the selenographers themselves, those astronomers who made a special study of the moon, there is not one, so far as the writer is aware, who has not expressed his belief that changes of some sort, volcanic or otherwise, occasionally occur upon our satellite. Reference

is made to such men as Mädler, Schmidt, Webb, Elger, and Nieson.

As the result of his lunar observations in Peru, Jamaica, and California, the writer has come to the conclusion that physical changes do occur upon the moon, and that they may be classified under three heads, those due to volcanic action, those due to the formation and melting of hoar frost, and those due to vegetation.

In the first class the classical example is that of Linné, which, according to the measurements of Lohrmann, Mädler, and Schmidt, prior to 1843, had a diameter of between four and seven miles. Its diameter at present is three-quarters of a mile. A few years ago a new crater was announced by Klein in the vicinity of Hyginus. The writer is not sufficiently familiar with this region to speak from personal experience, having but a few sketches of it, but he believes that a change there of some sort is generally admitted by selenographers.

Perhaps no area of its size upon the moon has been so thoroughly examined as the floor of Plato. It has been studied at intervals of about eleven years, first in 1870 by a committee of the British Association, next by A. S. Williams and others in 1881, and again a few years later, then by the writer at Arequipa in 1892, and again this past summer in California. In each survey about forty craterlets have been mapped, and each time some new ones have been discovered, while at the same time a few of those previously observed had ceased to be visible. The original trigonometrical survey of 1870 was based upon four craterlets located near the centre of the floor, and selected as primary stations. The easternmost of these was last seen as a crater in 1888. A trace of it was suspected in 1892, but a search for it this past summer with a 16-inch telescope working under most favourable climatic conditions failed to reveal any trace of it whatever. Even the large white area upon the floor which formerly marked its position has partially disappeared.

A map of the floor of Plato, based on a survey made in 1892, is given in the Harvard *Annals* (xxxii., plate x.). On this map the craterlet numbered 3 corresponds to craterlet number 22 of the older surveys. This craterlet was tenth in order of conspicuousness in 1870. In 1881 it had risen to the seventh place. In 1892, although carefully looked for, it could not be found, and it was entered on the map as a missing crater. A study of this region during the past summer revealed the presence of what appeared to be a large crescent-shaped bank of sand, six miles in length by from one to two miles in breadth. Its height was computed at not far from 1000 feet. It is the only object of the sort upon the floor, and the writer has so far found no previous record of its existence. When the sun is setting upon Plato it is by far the most conspicuous object within the crater walls, and was readily revealed by a 6-inch objective in Cambridge, Mass., working under very unfavourable atmospheric conditions. At sunrise it was also in part seen without difficulty under fair conditions. It seems incredible that so conspicuous an object as this should have been overlooked by all the earlier observers, had it then been visible.

I accordingly wrote to Mr. Williams, and he kindly sent me a list of forty-two observations made during the years 1879 to 1890, dealing with the particular portion of the crater floor where this formation was situated. Five of these observations were made during that portion of the lunar day when the object is now conspicuous, and when it is much more so than any of the craterlets upon the floor. Three of Mr. Williams's observations record that nothing was visible upon this portion of the floor. One observation records two small white spots, one of which he thinks may have been the original crater, and the other is possibly a neighbouring hill. Both of them as shown by this sketch were evidently very small objects as compared to the present formation. The fifth observation records a bright streak passing through the spot in question and extending for about thirty miles across the floor. Evidently if the present sandbank had been in existence at that time Mr. Williams could not have failed to have seen it and recorded it upon his sketches. Between this sand heap and the crater wall a large craterlet now exists. It is, in fact, the largest upon the floor, measuring about two miles in diameter, but owing to its peculiar position, and also to the fact that it is never bright like most of the others, it can only be seen at lunar sunset, and even then is not conspicuous.

Turning now to the second class of physical changes visible upon the moon, those due to the formation and disappearance of hoar frost, we find numberless examples scattered over the surface, but in most cases favourable atmospheric conditions and a large glass are necessary to render them clearly visible. Before dealing with any specific cases, however, it may be well to endeavour to answer some of the objections raised on theoretical grounds to the possibility of the existence of water vapour upon the moon.

The writer believes that he himself was one of the first to point out that if water vapour existed upon the lunar surface, it must sooner or later be dissipated into outer space (*Astronomy and Astrophysics*, 1892, xi., p. 781). That such a dissipation must have been going on in times past seems to be inevitable, but before reaching a conclusion as to the present existence of water vapour upon the moon, there are one or two important considerations that must be taken into account.

Vulcanologists are now generally agreed that the vast quantity of water, amounting to thousands, and sometimes to millions of tons, given off during volcanic eruptions is not rain water, nor yet water that has reached the interior from the ocean, but is water that either is being expelled for the first time from the earth's interior or is being expelled by heat from the rocky materials of the earth's crust with which it was previously united by the forces of crystallisation. If the earth is still discharging such large quantities of water from its interior there is no reason why the moon should not be doing the same thing. It is true the moon is smaller, but then also it began life later than the earth. The reason why the earth has oceans is that it is large enough and massive enough to retain the expelled water in that form. The moon, on the other hand, is too small to do so, and the water therefore appears scattered widely over its surface in the form of hoar frost before being dissipated into outer space.

Another objection to the theory of the existence of water vapour that has been raised is the statement that there is no evidence of erosion upon the moon. This statement is clearly a mistake, but the eroded valleys are small, and it requires good atmospheric conditions to detect them. Fairly conspicuous examples, however, exist upon the central peaks of Theophilus and Eratosthenes. Although the valleys are small, it is hard to understand how the comparatively minute amount of hoar frost at present found in these regions could have produced so great an effect, and we must conclude that formerly there must have been a great deal more of it. The only strong evidence that water in the liquid state ever existed upon the surface of the moon lies in the dry river-beds. The best example of these lies on the eastern slopes of Mt. Hadley, at the base of the Apennines. Another river-bed, partially fragmentary, discovered this past

summer lies sixty miles due south of Conon. Although difficult objects, the former has been seen in Cambridge, Mass. A sketch of it is given in the Harvard *Annals*, xxxii., plate vii.

Turning now from theory to fact, one of the clearest evidences of hoar frost upon the moon is found in connection with the pair of small craters known as Messier and Messier *A*. Sometimes one of these craters is the larger and sometimes the other. Sometimes they are triangular and sometimes elliptical in shape. When elliptical their major axes are sometimes parallel and sometimes nearly perpendicular to one another. When the sun first rises on them they are of about the same brilliancy as the *mare* upon which they are situated, but three days later they both suddenly turn white, and remain so until the end of the lunation. When first seen the white areas are comparatively large, especially that surrounding Messier itself, but it gradually diminishes in size under the sun's rays. By the eighth day little is left outside the crater itself, while at the end of the lunation only the bottoms and interior western walls remain brilliant. The general character of these changes can be followed even with a 4-inch telescope working under only moderate atmospheric conditions. Photographs of these craters showing their varying shapes and sizes will be found in the Harvard *Annals* (li., p. 28). Those to whom the *Annals* are not accessible will find these photographs and most of the other illustrations referred to in this article in my book "The Moon."

FIG. 1.—1901, July 26, 2·6 days, 43°.

FIG. 2.—1901, March 31, 3·5 days, 54°.

The white area surrounding Linné also shows evidence of change in size during the lunation. Soon after sunrise it measures 4″ in diameter, at noon 2″, and at sunset 3″·5. The change is evidently analogous to that shown by the polar caps of the earth and Mars, lunar noon in this case corresponding to midsummer for the planets, and sunrise and sunset to spring and autumn.

In the crater Eratosthenes there is a brilliant white area on the summit of the central mountain range. When the sun first rises on it it measures five miles in length by two in breadth. It soon, however, begins to dwindle, and two and a half days later all is gone save two little spots, each about a mile in diameter. They reach their minimum size five days after sunrise, when the smaller is about half a mile in diameter. They then begin to increase, the northern one attaining a length of five miles shortly before sunset. If these markings are due to white quartz, or some similar rock, it is difficult to account for their change in size.

The third class of physical changes with which we shall deal the writer believes to be due to the presence of vegetation. Changes of this class are more conspicuous than those of either of the other two, and if the explanation of vegetation is admitted, both the other explanations almost necessarily follow. It is therefore important to study these changes with the greatest care.

Before describing the facts, it may be well first to deal with the principal objection that has been made to the suggested explanation, namely, the lack of water on the moon in the liquid form. The reason that we believe liquid water to be lacking is that it is known that as we reduce the atmospheric pressure the boiling point of water is gradually lowered, until when we reach a pressure of 4·6 millimetres the boiling and freezing points coincide. Below this pressure ice changes at once into the gaseous form without passing through the liquid state. While, therefore, there can be no free water upon the surface of the moon, there is yet nothing to prevent it from occurring beneath the surface of the ground, retained by the capillary action of the soil. This action is so strong that, as has recently been shown by Cameron (*Science*, 1903, xviii., p. 758), it is capable of extracting water from a membrane against a calculated osmotic pressure of 36 atmospheres.

Since on the earth plants can live on moisture which they have in turn extracted from such a soil, there seems to be no difficulty in understanding how they could live on the moon, in a soil which could thus retain considerable moisture in spite of the low atmospheric pressure. Although in a state of nature, even in desert regions, all plants are occasionally exposed to water in the form of rain or dew, yet under artificial conditions we know that even such highly organised structures as house plants can flourish on water that

in the liquid form reaches them only by capillary absorption from the soil.

Turning now to our observations, as early as 1837 it was pointed out by Mädler that there were two small spots in the crater Alphonsus which always became very dark at about the time of full moon, while earlier and later they were much lighter. A similar observation had been made by him regarding a region just to the south of the Mare Crisium. Little else was known regarding the matter until 1892. Since that date spots presenting these characteristics have been found all over the moon's surface, except in the vicinity of the poles. The most northern spot known is in latitude $+55°$, the most southern in latitude $-60°$. It is possible that some of the *maria*, notably Tranquillitatis, and part of the borders of Serenitatis and Vaporum, are covered with these spots, but in any case they do not cover more than 5 per cent. of the moon's visible surface, and possibly it is very much less.

It should be mentioned here that the western spot shown by Mädler in Alphonsus is now comparatively inconspicuous, but that north and south of it lie two others, which with Mädler's eastern spot form a very striking isosceles triangle at full moon.

We will now direct our attention to the crater Eratosthenes, which has been more carefully studied than any other region presenting these phenomena, and which exhibits the changes on a sufficiently large scale to enable us to make use of photography. The four photographs here shown were taken in the Island of Jamaica in 1901, and are enlargements from some of the negatives used in printing the Harvard "Atlas of the Moon." Beneath each figure is given the date on which it was taken, the number of terrestrial days that had elapsed since the sun rose upon it, and the colongitude of the sun, taken from Crommelin's ephemeris. The photographs are all on the same scale of 1/2,000,000, or about thirty-two miles to the inch. Upon this scale the moon would be 68·5 inches in diameter.

When the sun rises upon this formation the whole of the floor is at first of a light grey tint, whatever detail there is being but faintly marked. This tint is maintained by the south-western quadrant of the floor throughout the lunation. About three days after sunrise a dark spot appears on the north-western slopes of the central mountain range. The regions at its immediate base darken at about the same time, and an irregularly mottled dark sector appears as the result. On the fourth day the centre of the sector lightens, leaving two canal-like forms radiating from the central peaks. Although in a small telescope these canals appear straight, yet when well seen with a large glass they are found to present considerable irregularity of structure. On the eleventh day the southern one fades out, and just before sunset the northern one also disappears.

A faint X-shaped marking distinguishes the north-eastern quadrant of the floor at sunrise. The centre rapidly darkens as the sun rises upon it, and soon becomes intensely black. Three branches of the X successively fade away, leaving only the south-eastern one, which on the seventh day becomes very pronounced. A new branch or canal forms by gradual darkening on the east, while the canal on the north-east, which had disappeared, forms anew by a progressive growth downwards from the crater rim. This growth progresses for five days at a nearly uniform rate of 250 feet per hour, or about 4 feet a minute.

FIG. 3.—1901, April 2, 5·6 days, 79°.

FIG. 4.—1901, March 5, 7·0 days, 97°.

The south-eastern quadrant, while very light at first, soon surpasses all the others in darkness. The dark area on the outer wall, which in the first figure is undoubtedly in part due to shadow, must very soon be partly due also to something else, for it still shows upon the third figure, which was taken but 0·8 day before full moon, when shadows are geometrically impossible. The last figure was taken 0·8 day after full moon, and the darker portion of the spot is seen to have rapidly increased in size and to have grown downwards with considerable velocity towards the central peaks.

Since this dark area cannot be shadow, our only alternative seems to be that we have here a real change in the character and brightness of the lunar surface. Since we do not know of any mineral which gradually darkens as the sun shines upon it, and later fades out again, our only alternative seems to be to call in the

aid of vegetation. At all events nobody has ever cared to propose any other explanation of the facts, so far as the writer is aware.

As the lunation progresses the western portion of this dark area slowly fades out, while the eastern is absorbed in the gathering shadows of the lunar night.

In various parts of the crater, but especially in the south-eastern and northern portions, numerous small canals and lakes present themselves. These markings are practically identical in appearance with those seen upon the planet Mars. They are too small to be well shown in the photographs, and seem to be of much more regular structure than the larger markings, which are here also called canals. It is possible that this difference is due merely to the fact that the larger markings are better seen. A more detailed account of the phenomena here described will be found in the Harvard *Annals* (liii.).

WILLIAM H. PICKERING.

SIR LOWTHIAN BELL, BART., F.R.S.

SIR Lowthian Bell, whose death at the age of eighty-eight has already been announced, studied physical science at the University of Edinburgh and the Sorbonne at Paris, and at the age of twenty-four entered the Walker ironworks, near Newcastle. There, we learn from the obituary notice in the *Times*, he remained until 1850, when he became connected with the chemical works at Washington, in North Durham. He greatly enlarged the works and laid down extensive plant for the manufacture of an oxychloride of lead introduced as a substitute for white lead by his father-in-law, Mr. H. L. Pattinson, F.R.S., with whom he was associated in the business at Washington. There, too, was introduced in 1860 almost the first plant in England for the manufacture of aluminium by the Deville sodium process.

Soon after the discovery of the main bed of Cleveland ironstone near Middlesbrough, Sir Lowthian Bell, in conjunction with his brothers, Thomas and John, started ironworks in 1852 at Port Clarence, on the north bank of the Tees. The Clarence works was one of the earliest and is now one of the largest iron-smelting works on the Tees. About half a century ago the Tees then flooded ground where iron furnaces now stand. Sir Lowthian Bell and his brothers acquired their own ironstone mines, collieries, and limestone quarries, while they were always prompt to adopt any improvement in process or apparatus that seemed likely to be advantageous.

In the development of the Cleveland iron industry the Bell firm played a very important part, and what has been the extent of that development may be judged from the fact that whereas the district in 1850 produced less than 25,000 tons of pig iron, at the present time Middlesbrough produces about one-quarter of the total output of this country. The firm was active in prosecuting those technical studies by which processes have been devised enabling Cleveland ores to compete as raw material for the production of iron and steel with others possessing greater natural advantages. In regard to steel, the great trouble with those ores is the high percentage of phosphorus (1.8 to 2.0 per cent.) contained in the cast iron which they yield; yet Middlesbrough, largely as a result of experiments carried on under Sir Lowthian Bell's direction, at a cost, it is said, of between 40,000*l.* and 50,000*l.*, produces steel rails in which this percentage is reduced to 0.07 or less.

When the British Association met at Newcastle in 1863, Sir Lowthian Bell contributed a paper on the manufacture of iron in connection with the Northumberland and Durham coalfields. In 1870 he wrote a paper on the sanitary condition of Newcastle, and more recently he compiled an elaborate account of the iron trade of the United Kingdom, compared with that of the other chief iron-making countries. On the chemistry of iron he was a high authority. The establishment of a chemical laboratory in connection with the Clarence works shows how fully he realised the importance of the scientific study of industrial processes, and his own researches on the chemistry of iron and steel have become classic. Many of these appeared first in the form of papers read before the Iron and Steel Institute, and a number of them were subsequently collected and published in a volume entitled "The Chemical Phenomena of Iron Smelting." Sir Lowthian was also the author of a book on the "Principles of the Manufacture of Iron and Steel," as well as of many papers contributed to other scientific societies.

He was one of the original founders, in 1869, of the Iron and Steel Institute, and filled the office of president from 1873 to 1875, and in 1874 became the first recipient of the gold medal instituted by Sir Henry Bessemer the year before. He was a member of the Institution of Civil Engineers and of the Chemical Society, and a past president of the Institution of Mechanical Engineers. In 1874 he was elected a fellow of the Royal Society. In recognition of his services as juror of the international exhibitions at Philadelphia in 1876, and at Paris in 1878, he was elected an honorary member of the American Philosophical Institution, and an Officer of the Legion of Honour. He was elected on the council of the Society of Arts in 1876, and in 1895 was awarded the Albert medal of the society "in recognition of the services he has rendered to arts, manufactures, and commerce by his metallurgical researches, and the resulting development of the iron and steel industries." The honour of a baronetcy was conferred on him in 1885, and in 1893 he received the degree of LL.D. from Edinburgh University.

NOTES.

A SELECTION from the specimens recently presented to the British (Natural History) Museum by His Majesty the King of Portugal has recently been placed on public exhibition in the north hall.

THE annual meetings of the American Association for the Advancement of Science and of the American Physical Society were held in Philadelphia, Pa., in "Convocation Week," from December 26, 1904, to January 2.

THE International Botanical Congress will meet at Vienna in June next, when a discussion will take place on the important question of uniformity of nomenclature, regarded both from a scientific point of view and in connection with international reports.

UNDER the title "Lichtenstein Prize," the Montpellier Academy of Sciences offers a prize for the best essay dealing with any question of zoology not referring to man. The last day is November 1, 1905. Printed memoirs more than three years old, or papers which have gained previous prizes, are excluded.

THE third International Congress of Philosophy will be held at Heidelberg in 1908. Among the English speaking members of the organising commission the name has been added of Prof. Strong, of Columbia University. A detailed account of the congress held this year at Geneva is given in a special number of the *Revue de Métaphysique et de Morale* for November, 1904.

THE Postmaster-General has made provisional arrangements with the Marconi International Marine Communication Company for the acceptance and prepayment at telegraph offices in the United Kingdom of telegrams for transmission from wireless stations on the coast to ships at sea. The arrangement came into operation on January 1.

PROF. R. S. WOODWARD, dean of the faculty of pure science, Columbia University, has been elected president of the Carnegie Institution. Prof. C. A. Young, who has held the chair of astronomy at Princeton University since 1877, will retire at the close of the present academic year.

CAPTAIN R. F. SCOTT, leader of the National Antarctic Expedition, has been awarded a gold medal by the Royal Danish Geographical Society.

WE learn through *Science* that Mr. Andrew Carnegie has given 108,000*l.* for the establishment in Boston of an institute similar to Cooper Institute, which is to be added to a fund of 54,000*l.*, which has grown from 1000*l.* left one hundred years ago by Benjamin Franklin.

THE twenty-second annual dinner of the old students of the Royal School of Mines will be held on Thursday, February 9. The chair will be taken by Mr. T. A. Rickard. Applications for tickets should be made to Mr. D. A. Louis, 77 Shirland Gardens, London, W.

A CORRESPONDENT of the *Times* states that Frédéric Mistral, the Provençal poet recently awarded 2000*l.* as half share of the Nobel prize for literature, intends to devote this sum to the development and adequate installation of the ethnographical museum—Le Musée Arletan—founded by him some years ago at Arles. For this purpose the municipal authorities agree to make over an old palace, now used as a college, the restoration and adaptation of which will cost 10,000*l.* An American resident at Avignon, Mr. Edward Leon, has offered 2000*l.* as a subscription, and will arrange for five lectures in the United States to help on the fund thus inaugurated.

THE prizes for the year 1904 have been awarded, we learn from *La Nature*, by the Paris Society for the Encouragement of National Industry. The grand prix of the Marquis d'Argenteuil has been awarded to MM. Auguste and Louis Lumière for their discoveries in photography. The "chemical arts" gold medal has been awarded to M. Héroult for his works on electrometallurgy, and the "constructions and fine arts" medal to M. Arnodin. Gold medals have also been awarded to M. Boulanger for his micrographic work, to M. Grey for a rolling-mill, to M. Guillet for his work in metallurgy, and to M. Schwœrer for his system of superheated steam.

AN optical convention will be held, under the presidency of Dr. R. T. Glazebrook, F.R.S., at a date toward the end of May next, at the Northampton Institute, Clerkenwell, London, E.C. The object of the convention is to bring into cooperation men interested in optical matters. A subcommittee has been appointed to consider the subjects of papers on optical questions which should be brought before the convention, and suggestions as to subjects for discussion will be welcomed. It has been decided to organise an exhibition, of a scientific character, of instruments manufactured in this country, with a view to show the progress recently made and to stimulate further efforts. In order that interest in the convention may be not confined to London workers in optics, a subcommittee is being formed to secure the assistance of local representatives. The honorary secretary of the convention is Mr. F. J. Selby, Elm Lodge, Teddington.

WRITING on the subject of "Greek at Oxford," a correspondent of the *Times* again expressed the common belief that "Darwin regretted not having learnt Greek." A letter from Mr. Francis Darwin in the *Times* of December 29, 1904, shows that the statement is altogether opposed to Darwin's views. Darwin says of his education at Shrewsbury School:—"Nothing could have been worse for the development of my mind than Dr. Butler's school, as it was strictly classical, nothing else being taught, except a little ancient geography and history" ("Life and Letters," i., 31). He was, in fact, a victim of that "premature specialisation" which is generally referred to in a somewhat one-sided spirit, and from which the public schoolboy is not yet freed. Mr. Darwin adds:—"If the name of Charles Darwin is to be brought into this controversy it must not be used for compulsory Greek, but against it. In 1867 he wrote to Farrar, 'I am one of the root and branch men, and would leave classics to be learnt by those alone who have sufficient zeal and the high taste requisite for their appreciation' ('More Letters of Charles Darwin,' ii., 441)."

THE Aëro Club of Paris has asked permission from the municipal authorities to make experiments in aviation in the Galerie des Machines next February. Under the head of aviation, among other experiments will be some in mechanical aërial direction. The building is so large that the results will be almost the same as would be obtained in the open air, with the difference that the disturbing effect of wind need not be feared.

ST. CATHERINE'S Lighthouse, situated on the south coast of the Isle of Wight, has just been provided with a new light of 15,000,000 candle-power, as against 3,000,000 obtained with the old apparatus. Seen from the land there are three distinct beams of light revolving in view, one just on the point of disappearing behind the "blank" or shield, while the others pass rapidly over the waters of the English Channel. The new lens is by Messrs. Chance Brothers, Birmingham; and the whole of the revolving part floats in a trough of mercury, instead of being on rollers, which has hitherto been usual, about 816 lb. of mercury being required to float it. Hitherto chain has been used in lighthouses for suspending the weights, but in this case a fine steel cable, about ¼ inch in diameter, has been adopted.

THE annual report of the Russian Geographical Society gives the full list of medals awarded by the society at its annual sitting. The following medals were awarded:—the Constantine medal to the veteran geologist Friedrich Schmidt, the Count Lüthe medal to Sir John Murray, and the Semenoff gold medal to Prof. N. I. Kuznetsoff. Five small silver medals were awarded, to V. A. Vlasoff, Th. N. Panaeff, and W. M. Nedzwiedski for meteorological work, to M. M. Siazoff for the part he took in the expedition of Grum-Grzimailo, and to E. L. Byakoff for the support he gave to the same expedition.

ACCORDING to information communicated by the Meteorological Observatory of Irkutsk, the earthquake which took place in Transbaikalia on September 28 last covered an area of about 4500 square miles, representing an imperfect oval elongated from N.W. to S.E., its furthest points being Troitzkosavsk in the south-east and Balagansk in the north-west. The centre of this earthquake, which was undoubtedly of tectonic origin, was located in the neighbourhood of the station Pereyemnaya, on the south-east shore of Lake Baikal. No less than three earthquakes have had their origin at this centre during the past three years.

In the *Zoologist* for December Mr. A. H. Patterson records a number of more or less remarkable specimens of fishes captured off Great Yarmouth during the year. Several examples of flat-fish with the two sides of the same colour are recorded, a plaice of this type being further remarkable from the fact that the dorsal and anal fins united beneath the tail. In a second article Mr. G. Dalgleish directs attention to the recent migration into India of birds native of eastern Central Asia—notably the mandarin-duck.

The October issue of the *Proceedings* of the Philadelphia Academy contains two papers devoted to the histology and early development of invertebrates. In the first Dr. J. A. Nelson discusses that puzzling creature Dinophilus, referred by some authorities to the turbellarians, and by others to the annelids. If the "trochophore" be regarded as a larval form common at least to all annelids, the development of Dinophilus cannot be considered as primitive. Rather it may be looked upon as an annelid the larval stage of which has become one towards which development tends, and which has consequently become specially modified. In the second of the two papers Mr. T. H. Montgomery gives the results of his investigations into the development and structure of the larva of the parasitic thread-worm Paragordius.

The December issue (vol. vii., No. 2) of the *Journal* of the Marine Biological Association of the United Kingdom contains a full list of the marine invertebrate fauna of Plymouth, compiled from the records of the association. An excellent map of the Plymouth district accompanies the list, together with notes on the various dredging-grounds and their characteristic zoological products. Some of these grounds, which formerly yielded rich harvests, have been more or less completely spoiled by being made the receptacle for rubbish and refuse from the neighbouring towns. Attention is directed to the large number of species of marine organisms attacking the limestone of which the Plymouth breakwater is constructed. To such an extent, indeed, is the stone eaten into by these creatures that considerable damage is done to the structure, and constant repairs are rendered necessary.

We have received copies of three papers by Dr. J. E. Duerden dealing with the morphology, development, and relations of corals and sea-anemones. Their titles are respectively "The Antiquity of the Zoanthid Actinians" (*Rep. Michigan Acc.*, No. 6, pp. 195–8), "Recent Results on the Morphology and Development of Coral-Polyps" (*Smithson. Miscell. Contrib.*, vol. xlvii. pp. 93–101), and "The Morphology of the Madreporaria," No. 5 (*Biol. Bull.*, vol. vii., No. 2). The main thesis of the first two papers is that, since ordinary hexamerous coral-polyps differ from sea-anemones to a great extent only by the absence of a skeleton, and the presence of such skeleton is a secondary development, the second group must be older than the first. From this basis it is argued that the tropical polyps known as zoanthids, which differ in regard to the number of their septa from the hexamerous group, bear a similar relationship to the Palæozoic tetramerous "rugose" corals, and are consequently of still more ancient origin. In the author's own words, "The Rugosa and Zoantheæ undoubtedly constitute a common group of skeleton-forming and skeletonless polyps, just as do the modern Madreporaria and ordinary hexamerous Actiniaria."

Three papers by Dr. R. Broom on the fossil reptiles of South Africa and their relationship to mammals appear in vol. xxv., part iii., of the *Transactions* of the South African Philosophical Society. In the most important of these the author discusses the origin of the mammalian carpus and tarsus. After a brief review of the nature of these two portions of the skeleton in other groups, Dr. Broom points out that in dicynodonts and theriodonts the mammalian approximation is most marked. To quote his own words, "In these latter we find more or less approximation to the mammalian type, but if we take into consideration the extreme mammalian specialisation—the presence of a large tibiale and fibulare, with a centrale which is not in the centre but comes between the tibiale and the first tarsale, then we are driven to the conclusion that the mammalian ancestor must have been a dicynodont, a theriodont, or a form belonging to a closely allied order. From the examination of the skull we have good reason to believe that the ancestor was a theriodont, and the evidence of the tarsus fully confirms that drawn from the skull and other parts of the skeleton; and the carpus, while it does not add any very strong evidence, certainly does not afford any evidence that is not in harmony with this conclusion."

A remarkable instance of what the author thinks may be true mimicry among plants is described by Dr. R. Marloth in the *Transactions* of the South African Philosophical Society, vol. xv. p. 97. Years ago, it appears that the traveller Burchell picked up on stony ground an object he mistook for a pebble, but which on exaimnation proved to be a plant of the genus Mesembrianthemum. Both in colour and in form this plant, previously named *M. truncatum*, presented a remarkable resemblance to the stones among which it grew. A second species, *M. bolusi*, growing on the hills around the Karru, generally produces two leaves about the size of a duck's egg, which have a surface like weathered stone, and a brownish grey colour tinged with green. In this state it closely resembles the surrounding stone, although for a short time its bright yellow flowers render it conspicuous enough. *M. nobile* is very similar. A fourth species of the same genus, together with *Anacampseros papyracea* (in which the leaves are covered with white papery stipules), resembles the quartz pebbles among which it grows. In the author's opinion, *M. bolusi*, *M. nobile*, and perhaps *M. truncatum* (which, unlike some of the other plants mentioned, do not change their characters under cultivation), may afford instances of true mimicry, or "homoplasy."

We have received a report on forestry in the Transvaal by Mr. D. E. Hutchins, conservator of forests, Cape Town. The report deals with the immediate necessity for the afforestation of those large tracts of land in the colony which are unsuitable for agriculture. The importance of forestry in the Transvaal cannot be over-estimated, as a perusal of this report will show. After a tour of inspection, Mr. Hutchins has been able to indicate in his report the organisation and equipment necessary for the scheme. A list of trees suitable for cultivation in the Transvaal is given, together with short notes on their sylvicultural characteristics and uses. It may be interesting to mention that the common ash, *Fraxinus excelsior*, does not thrive in the Transvaal.

Messrs. F. Darton and Co., St. John Street, E.C., have submitted to us a very handy and portable little instrument, the "Piesmic" barometer, invented by Mr. A. S. Davis. It consists of a glass tube about seven inches long, bent in the form of a syphon, the longer arm being of strong capillary tubing of one-tenth inch bore, the shorter arm being of thin quill tubing. The end of the longer tube opens into a small cast iron cistern, containing mercury;

when the instrument is out of action the tube lies horizontally, and the mercury lies on one side of the cistern, leaving the open end of the tube exposed to the air. When the tube is brought into a vertical position the mercury flows over and closes the mouth of the tube, and then flows down the tube to a greater or less depth, dependent upon the atmospheric pressure at the time. We have made a number of comparisons with a mercurial standard barometer, and find that its indications are correct to within about 0·12 inch. The readings, to the nearest tenth of an inch, or, by interpolation, to the hundredth of an inch, can be rapidly obtained. As a weather-glass it appears to be very useful, and even less likely to get out of order than an aneroid, but it would not be suitable for accurate scientific observations like an ordinary mercurial barometer. It has the advantage of being less costly, small in size, and easier of transport than an ordinary barometer.

We have received from Messrs. C. F. Adolph and Co., of 14 Farringdon Road, E.C., their new price list of selenium cells and apparatus. This firm has introduced a new type of selenium cell which possesses the advantage over the old form of cell that it is exposed to the light on two surfaces with a consequent increase in the sensibility of fully 75 per cent. Complete sets of apparatus for demonstrating the sensitiveness of selenium to light and the transmission of sound by means of light are also described and illustrated in the list.

In No. 21 of the *Physikalische Zeitschrift* Mr. Josef Rosenthal describes a number of improvements which he has introduced in the construction of mercury air-pumps of the Sprengel type. These pumps usually suffer from the disadvantage that the glass tube in which the mercury falls is liable to sudden fracture after the pump has been in action during a few weeks. The fracture appears to be due to the friction of the mercury on the glass producing an electrical charge which, by influencing the moist air without, converts the glass wall of the tube into the insulator of a condenser. The possibility of a discharge through the glass is eliminated by surrounding the dropping tube with a larger glass tube filled with oil, which acts as an efficient insulator. It is stated that a tube protected in this way lasted five months, although in daily use.

The *American Journal of Science* for November, 1904, contains an investigation by Mr. Bertram B. Boltwood of the radio-activity of natural waters which is of particular interest because of an attempt that is made to explain its origin. It is shown that neither hot nor cold water dissolves any appreciable quantity of radium, as such, from a mass of finely powdered uranium minerals consisting principally of uranophane, although a brief contact with these minerals is sufficient to impart to water enough of the radium emanation to produce a very marked radio-activity. Water can also acquire a measurable quantity of the radium emanation by simple contact with gaseous mixtures which contain it. It is considered that an extremely minute trace of uranium minerals in the rocks and soils through which a water percolates would be sufficient to impart to it a measurable radio-activity. But waters such as those of Bath and Baden Baden, which contain true dissolved radium, must owe the presence of the latter to a special decomposition taking place under the influence of high temperature and great pressure.

Messrs. Longmans and Co. have in the press a translation, by Mr. J. Garcin, of M. Blondlot's papers on *n*-rays communicated to the Paris Academy of Sciences. The volume will contain additional notes and instructions for the construction of phosphorescent screens.

Messrs. Macmillan and Co., Ltd., have published an edition of "An Elementary Course of Mathematics," by Messrs. H. S. Hall and F. H. Stevens, in which parts i. and ii. of the authors' "School Geometry" have been substituted for the parts of Euclid's elements contained in previous editions.

Messrs. F. Vieweg and Son, Brunswick, have issued the fifth edition of Wiedemann and Ebert's comprehensive work on practical physics—"Physikalisches Praktikum." The book contains a good systematic course of practical work in physics, the experiments being well arranged and clearly illustrated.

The issue of the *Antiquary* for January commences the first volume of a new and enlarged series. The magazine, which is devoted to the study of the past, has been enlarged by the addition of eight pages. A new section, called "At the Sign of the Owl," has been introduced, and consists of about two pages of notes concerning books of archæological interest. A good selection of articles is promised for the present year.

There has now been published at the Patent Office a subject list of works on the fine and graphic arts (including photography), and art industries, in the library of the Patent Office. The list consists of two parts—a general alphabet of subject headings, with entries in chronological order of the works arranged under these headings, and a key, or summary, to these headings shown in class order. The catalogue includes some 2916 works, representing 5373 volumes.

OUR ASTRONOMICAL COLUMN.

Another New Comet (1904 *e*).—A telegram from the Kiel Centralstelle announces the discovery of a new comet by M. Borrelly at Marseilles on December 29, 1904. The position of the object at 9h. 7m. (Marseilles M.T.) was

R.A. = 1h. 13m. 40s., dec. = −10° 0′,

and its apparent daily movement was found to be +1·6m. in R.A. and −54′ in declination. A nucleus was seen.

A further telegram states that the comet was observed by Dr. Cohn at Königsberg on December 31 at 6h. 22·2m. (Königsberg M.T.), when its position was as follows:—

R.A. = 1h. 15m. 56·53s., dec. = −8° 29′ 59″.

The position of the comet is near to that of θ Ceti.

Comet 1904 *d* (Giacobini).—Further observations of comet 1904 *d* are published in No. 3986 of the *Astronomische Nachrichten*, together with Herr Ebell's elements and ephemeris. A photograph taken at the Konigstuhl Observatory, Heidelberg, on December 19d. 17h. 37·3m. (Konigstuhl M.T.) showed a short tail and a complex nucleus, whilst the position of the object for 1904·0 was

R.A. (app.) = 16h. 19m. 38·8s., dec. (app.) = +28° 23′ 9″.

Observations of Leonids at Harvard, 1904.—Several observers at Harvard kept the eastern part of the sky under observation for meteors from 12h. to 17h. on the night of November 14–15. As a rule, four observers kept watch, whilst a fifth wrote down their results, and between them they saw 275 meteors, of which 183 were Leonids.

The following table shows the horary rate, for a single observer, at intervals of twenty minutes:—

Nov. 14–15 h. m.	Rate	Nov. 14–15 h. m.	Rate	Nov. 14–15 h. m.	Rate
14 40	40	15 40	28	16 40	24
15 0	36	16 0	26	17 0	28
15 20	29	16 20	25		

Of the total number 35 were of the first magnitude or brighter, but none exceeded magnitude −2·0. At the moment of explosion the heads were generally blue or white, but in two cases, at least, the colour was clearly red or

orange, probably indicating, according to Prof. W. H. Pickering, a different chemical constitution.

The radiant appeared to cover a considerable area, about 8° in diameter, and seemed to be double, the two principal centres being situated at R.A.=9h. 56m., dec.=+24°, and at R.A.=9h. 40m., dec.=+26°.

Although elaborate preparations were made for securing photographs, only two trails appeared on the resulting negatives. One, due to a Leonid, commenced at R.A.=9h. 17·2m., dec.=+28° 57′, and ended at R.A.=9h. 8·8m., dec.=+29° 52′, a more careful measure showing that the meteor passed through a point having the position R.A.=9h. 57·0m., dec.=+24° 14′ (1855). The other trail extended from R.A.=4h. 52·5m., dec.=+0° 52′, to R.A.=5h. 10·7m., dec.=−4° 39′ (1855), and was, therefore, not due to a Leonid (Harvard College Observatory *Circular*, No. 89).

LIGHT-CURVE OF δ CEPHEI.—Employing the method used by Dr. W. J. S. Lockyer in his discussion of the observations of η Aquilæ (Göttingen, 1897), Dr. B. Meyerman has reduced the observations of δ Cephei.

As a result he obtained the following as the formula for determining the epochs of maxima:—

1840 September 26·3588+5·366404 E. (Bonn).

A comparison of the phases determined from this formula with observed values gives small differences which compare favourably with those previously obtained by other observers. The new observations are consistent with an invariable period (*Astronomische Nachrichten*, No. 3985).

STRUCTURE OF THE THIRD CYANOGEN BAND.—Some interesting results concerning the structure of the third cyanogen band have been obtained by Herr Franz Jungbluth at Bonn. By employing the third order of a Rowland grating having 630 lines to the millimetre (*i.e.* about 16,000 to the inch) and a focal length of 6·6 metres (about 21·6 feet), he obtained a greater dispersion than has hitherto been used for this purpose.

His results, stated briefly, are as follow:—(1) the third cyanogen band consists of double lines; (2) the maximum intervals between successive lines in the four strongest series form an arithmetical progression; (3) the view of King, that the inverted "heads" are to be regarded as "tails" of the bands connected with the known "heads," possesses a high degree of probability; (4) the connection of groups of "heads" and "tails" is such that the *first* "head" and the *last* "tail" belong to the same series, the second "head" to the penultimate "tail," and so on; (5) the hypothesis of Thiele, that the intervals between successive lines in a band increase only to a certain point and then *decrease* until the series ends in a tail, *appears to be correct*; (6) the lengths of the successive series form an arithmetical progression (*Astrophysical Journal*, vol. xx., No. 4).

NEW REFRACTION TABLES.—A set of new refraction tables whereby one may find the refraction correction to 0·01 of a second of arc are given in No. 3983 of the *Astronomische Nachrichten* by Dr. L. de Ball, of Vienna. The tables are adaptable to a range of atmospheric temperatures and pressures and of zenith distances. Knowing the temperature and pressure at the place of observation, one finds the logarithm of the actual density of the atmosphere from table i., and with this and the known zenith distance finds the refraction correction to the second decimal of a second of arc from table ii.

THE "ANNUAIRE" DU BUREAU DES LONGITUDES.—Continuing the scheme inaugurated in last year's "Annuaire" for the alternation of various subjects in the successive issues, the volume for this year contains, in addition to the astronomical data, tables regarding statistics, geography, &c., to the exclusion of data for chemistry and physics.

The astronomical section contains, among many other things, the following useful information:—A table for calculating the altitude from readings of the barometer, a complete table of the elements of variable stars of known periods, tables of stellar parallaxes, double stars and proper motions, and an article of stellar spectroscopy by M. Gramont, whilst the sun-dial, solar physics, the table of minor planets, &c., are reserved for the issue of 1906.

ECLIPSE RESULTS AND PROBLEMS.—In the December (1904) number of the *Bulletin de la Société astronomique de France* M. le Comte de la Baume Pluvinel reviews the results obtained during the total solar eclipses of the last thirty years, and in connection with the study of each eclipse phenomenon he outlines the problems which yet require further elucidation. To those interested in eclipse work the article will be found to be a useful *résumé*.

BIBLIOGRAPHY OF CONTEMPORARY ASTRONOMICAL WORKS.—We have received from Prof. Ernest Lebon, of the Lycée Charlemagne, Paris, an extract from a plan of an analytical bibliography of contemporaneous writings on historical work in astronomy, as submitted by him to the International Congress of Historical Science held at Rome in April, 1903. Judging from the list of authors named in the plan and the specimen extracts given therein, the bibliography will be found extremely useful by those workers in astronomy who have occasion to refer to previous results obtained since 1846.

PRIZES PROPOSED BY THE PARIS ACADEMY OF SCIENCES FOR 1905.

GEOMETRY.—The Francœur prize (1000 francs), for discoveries or work useful for the progress of pure or applied mathematics; the Poncelet prize (2000 francs), for work in applied mathematics.

Mechanics.—A Montyon prize (700 francs), for the invention or improvement of instruments useful in the progress of agriculture, the mechanical arts or sciences; the Poncelet prize (2000 francs), for a work on applied mathematics; the Fourneyron prize (1000 francs), for a memoir on the theoretical or experimental study of steam turbines.

Navigation.—The extraordinary prize of 6000 francs as a recompense for any work tending to increase the efficiency of the French naval forces; the Plumey prize (2500 francs), for an improvement in steam engines or any other invention contributing to the progress of steam navigation.

Astronomy.—The Pierre Guzman prize (100,000 francs), for the discovery of a means of communicating with any celestial body other than the planet Mars; failing the award of the capital sum, the interest will be awarded every five years for a work important to the progress of astronomy. The Lalande prize (540 francs), for the observation, memoir, or work most useful to the progress of astronomy; the Valz prize (460 francs), and the G. de Pontécoulant prize (700 francs), under similar conditions. The Damoiseau prize (2000 francs); the question proposed for this prize is as follows:—there are a dozen comets the orbit of which, during the period of visibility, is shown to be of a hyperbolic nature. The problem set is to find out whether this was the case before the arrival of the comet in the solar system, going back to the past history of the comet, and allowing for the perturbations of the planets.

Geography.—The Gay prize (1500 francs), for an explorer in Africa who has determined with great precision the geographical coordinates of the principal points on his journey; the Tchihatchef prize (3000 francs), as a recompense or encouragement for naturalists of any nationality who have most distinguished themselves in the exploration of the Asiatic continent, more especially in the lesser known regions; the Binoux prize (2000 francs).

Physics.—The Hébert prize (1000 francs), for a discovery or treatise on the popular applications of electricity; the Hughes prize (2500 francs), for a work contributing to the progress of physics; the Gaston Planté prize (3000 francs), for a discovery, invention, or important work in the field of electricity; the L. la Caze prize (10,000 francs), awarded in one sum for works important in physics.

Chemistry.—The Jecker prize (10,000 francs), for work in organic chemistry; the Cahours prize (3000 francs), for the encouragement of young chemists; the Montyon prize, unhealthy trades (2500 francs and a mention of 1500 francs), for a means of rendering a trade less unhealthy or dangerous; the L. la Caze prize (10,000 francs), for the best work on chemistry during the last two years; the Bordin prize (3000 francs), for a memoir on the silicides and the part played by them in metallic alloys.

Mineralogy and Geology.—The Delesse prize (1400

francs), for a work concerning geology, or, failing that, mineralogy; the Fontannes prize (2000 francs), for the best publication on palæontology; the Alhumbert prize (1000 francs), for a memoir on the period of the last volcanic eruptions in France.

Botany.—The grand prize of the physical sciences (3000 francs); the question proposed is the demonstration of the various modes of formation and development of the egg in the Ascomycetes and the Basidiomycetes. The Desmazières prize (1600 francs), for the best work published during the preceding year on Cryptogams; the Montagne prize (1500 francs), for work having for its object the anatomy, physiology, development, or the description of the lower Cryptogams; the Thore prize (200 francs), for work on the cellular Cryptogams of Europe.

Anatomy and Zoology.—The Savigny prize (1300 francs), for the assistance of young travelling zoologists, not receiving Government assistance, who have especially occupied themselves with the invertebrates of Egypt and Syria.

Medicine and Surgery.—A Montyon prize (2500 francs and a mention of 1500 francs), for works and discoveries useful in the art of healing; the Barbier prize (2000 francs), for a valuable discovery in surgical, medical, or pharmaceutical science, or in botany having relation with medicine; the Bréant prize (100,000 francs), for the discovery of an absolute specific against Asiatic cholera, or to point out in an irrefutable manner the causes of Asiatic cholera, so that the suppression of the disease will follow. Failing the award of the capital sum, the annual interest will be given for a rigorous demonstration of the existence in the atmosphere of matter capable of playing a part in the production or propagation of epidemic diseases. The Godard prize (1000 francs), for the best memoir on the anatomy, physiology, and pathology of the genito-urinary organs; the Baron Larrey prize (750 francs), for the best work dealing with the subject of military medicine, surgery, or hygiene; the Bellion prize (1400 francs); the Mège prize (10,000 francs); the Serres prize (7500 francs), for a memoir on general embryology applied as far as possible to physiology and medicine; the Dusgate prize (2500 francs), for the best work on the diagnosis of death and the prevention of premature burial.

Physiology.—A Montyon prize (750 francs), and the Philipeaux prize (900 francs), for work in experimental physiology; the Lallemand prize (1800 francs), for work on the nervous system; the Pourat prize (1000 francs), for an essay on the origin of muscular glycogen.

Statistics.—A Montyon prize (500 francs), for a memoir on French statistics.

Among the general prizes offered in 1905 are the following:—the Binoux prize (2000 francs), for a work on the history of science; the Trémont prize (1100 francs), the Gegner prize (3800 francs), the Lannelongue prize (1200 francs), the Wilde prize (4000 francs), the Saintour prize (3000 francs), the Petit d'Ormoy prizes (two of 10,000 francs), all for work useful in the promotion of scientific knowledge. Of these prizes those bearing the names of Pierre Guzman, Lalande, Tchihatchef, La Caze, Delesse, and Desmazières are especially mentioned as being awarded without distinction of nationality.

GEOLOGICAL NOTES.

VERY little geological information appears to have been published on the State of Durango, in western Mexico. The observations therefore recorded during a brief journey by Dr. O. C. Farrington are of considerable interest (Field Columbian Museum, No. 89, geological series, vol. ii., No. 5). His route extended from the city of Durango, which is situated upon an alluvial plain hemmed in by low and rugged hills, to the silver-mining town of Villa Corona or Ventanas, distant about seventy miles in a direct line. The ground, which forms part of the interior plateau of Mexico, rises from about 6000 feet at Durango to 9000 feet. While large tracts of the area are semi-arid and sparsely covered with soil and vegetation, in some places corn is successfully grown, and elsewhere there occur extensive pine forests with oaks. Views of the scenery are given. Eruptive rocks prevail, and near the Ciudad ranch, on one of the highest parts of the plateau, there is a tract of weathered masses known as La Ciudad de Rocas ("The City of Rocks"). The outlines of the rocks are domed and rounded, and they appear to be due to the weathering of fairly homogeneous rhyolitic materials.

Particular attention is directed by the author to the famous Cerro Mercado or Iron Mountain, a hill largely made up of solid iron-ore, and situated less than a mile north-east of Durango City. It rises abruptly from the alluvial plain to an average height of about 300 feet, with single peaks 50 feet to 100 feet higher. The length of the hill is about $1\frac{1}{8}$ miles, and its average width about one-third of a mile. The ore appears to be chiefly hæmatite, although some magnetite also occurs; in physical characters it varies, being hard and soft, black, red, specular, and earthy. Hard, solid black ore, however, forms the chief mass of the "mountain," the black colour being in striking contrast to the yellow and green of the surrounding plain. The ridge is almost bare of vegetation, except for straggling cacti, and its outline is bold and rugged. Steep cliffs 10 feet to 20 feet high are not infrequent, and in places they exhibit a distinct columnar structure like that of basalt (see Fig. 1). The existence of this hill appears to have been made known in 1552 A.D., but the first serious attempt to work the iron-

FIG. 1.—Cliff showing columnar structure of iron-ore at western end of the Cerro Mercado or Iron Mountain of Durango, Mexico.

ore was made in 1828. Successful operations were not conducted until 1888, and only within the last five years has a steady production been maintained. The amount of ore exposed above the level of the plain is estimated at 360 million tons. The author briefly discusses the origin of the iron-ore, regarding it as probably igneous. The associated rocks of the district are rhyolites, probably of later Tertiary age, but the relation, either in time or manner of origin, between the associated eruptive rock and the iron-oxide, and the origin of the iron-oxide itself, seem as yet difficult to determine.

A geological description of the Baraboo iron-bearing district of Wisconsin, by Dr. Samuel Weidman, has been issued by the Wisconsin Geological and Natural History Survey (*Bulletin* No. 13, economic series No. 8). The area is formed mainly by pre-Cambrian quartzites, which stand out in bold north and south ranges, so connected both on the east and west as to constitute a cordon of bluffs enclosing a depressed drift-covered interior. Isolated areas of still older rocks, rhyolite, granite, and diorite, occur along the outer borders of the ranges. Potsdam sandstone is found beneath the drift, and on the slopes of the Baraboo quartzites, while later Palæozoic strata are met with at higher levels. Special interest has recently been aroused by

the discovery of large deposits of iron-ore beneath the drift-covered valley, a discovery made while digging or drilling the farm wells in this otherwise well settled agricultural district. The iron-bearing rocks, termed the Freedom formation, from the town of North Freedom, comprise slate, chert, dolomite, and iron-ore, and all gradational phases between these kinds of rock, including banded ferruginous chert like that in the iron-bearing series of Lake Superior. The author points out that the Baraboo pre-Cambrian series may be compared with the upper portion of the Lower Marquette series, the Freedom formation corresponding with the Negaunee iron-bearing formation. Detailed accounts are given of the various rocks and drift deposits, and of the circulation of underground water.

The recent numbers of the *Boletin del Cuerpo de Ingenieros de Minas del Peru*, issued during 1904, continue to testify to the energy and activity of the Government officers charged with the development of Peru. No. 8, by Señor Venturo, describes important deposits of hæmatite in the extreme north of the country, the ore appearing on the surface, and being probably derived from the dehydration of an old lake-iron deposit. Fragments of rocks from the margins of the former lake are found surrounded by the iron oxide, and the iron itself seems to have been dissolved out from the acid igneous masses in the neighbourhood.

In view of the demand for nickel for plating, for alloying steel, and for coinage, Señor Eduardo de Habich was sent to report on the nickeliferous veins of the province of La Mar, which present practically a virgin field. His memoir (No. 11) seems encouraging, the chief ores being ullmannite and nickeline (kupfernickel), occurring mostly in veins of quartz, which may also contain both gold and silver. No. 12 has probably the widest interest for geologists in general, giving as it does the results of a visit to central Peru by Dr. Gustav Steinmann, of Freiburg-im-Breisgau, early in 1904. Señor Elmore is the author of *Boletin* No. 13, on the water-supply of the Rimac valley. It is shown that the permeable subsoil in the valley-floor, from Chosica downwards, becomes charged with a good potable water by infiltration from the River Rimac, and this is capable of furnishing a healthy supply wherever it may be desirable to tap it. The marked rise of this underground water in Callao is interestingly attributed to the obstacle furnished by the neighbouring island of San Lorenzo. The economic aspect of Señor Elmore's report is sure to be widely welcomed in a populous and practically rainless district.

The fourteenth volume of the *Berichte der naturforschenden Gesellschaft zu Freiburg-im-Breisgau* (1904) contains several papers of geological interest. A. Freiherr von Bistram's studies on the dolomitic region of the Alps of Lugano were commented on when they first appeared in separate form (NATURE, vol. lxix. p. 112). Walther Schiller and W. Paulcke are both concerned with the structure of the Engadine, the former giving a detailed account of the region south-east of Schuls, of which the Piz Lischanna forms the centre, while the latter examines the structure of a wider area, from Landeck to the basin of the Po.

Palæontological papers seldom contain so much personal revelation as is to be found in Herr Georg Boehm's first section of his *Beiträge zur Geologie von Niederländisch-Indien* (*Palaeontographica*, supplement iv., Stuttgart, 1904). The splendid series of ammonites therein described, probably from a Tithonian horizon, were obtained for the most part from the collection of a postmaster of Sula Besi, and from one of "die Alfuren," the latter name being applied to any uncivilised natives. Some specimens were even extracted from concealment in the scanty clothing of the boatmen. The postmaster and his allies appear, consciously or unconsciously, to have lost touch with the true locality of their finds, and to have opened up a delusive route through the forest in Taliabu, whereby Herr Boehm was led to a spot where he found abundant belemnites and Nuculæ, but none of the highly prized ammonites. The "Alfuren-Sammlung" proves to be of unusual interest, and may perhaps grow in the course of time, if judicious sums are expended on the "uncivilised" population. The inclusion of fossils smuggled in from other places is now, however, a possibility against which it will be difficult to guard.

Part ii. of the seventh volume of the *Transactions* of the Geological Society of South Africa (Johannesburg, 1904) bears witness to the prevalence of research in Africa in all branches of geology. Dr. Hatch contributes two papers, one in conjunction with Prof. Corstorphine, who has been drawn off from the service of Cape Colony into a more adventurous field. Mr. J. P. Johnson shows that two types of stone implements are found in the Taaibosch Spruit, the older and rougher lying beneath 15 feet of alluvium, and the newer type upon the surface. Mr. F. W. Voit furnishes a paper of general interest on the geology of German South-West Africa, in which a large series of ancient metamorphic rocks is dealt with; these are accompanied by intrusions of granite. The author urges that some of what might be regarded as ordinary contact-phenomena are here carried out on a regional scale, and must be referred to the action of pressure rather than to the invasion of the granite. The metamorphic rocks are impregnated with important deposits of copper-ore, sometimes localised in quartz veins, and sometimes spread in cloud-like masses through the schists.

In the first part of the *Jahrbuch der k.k. geologischen Reichsanstalt* for 1904 (September 15), Franz Toula describes the results of his journey to the Dobrudscha in 1892, and discusses in particular the forms of Exogyra met with. Dr. Petrascheck, in examining the granitic mass near Brixen, in the Adige valley, reviews the nature of Sederholm's "Myrmekite," an intergrowth of triclinic felspar and quartz, and concludes that it is a primary product of the consolidation of the igneous magma. Dr. Ampferer's important examination of the terraces along the valley of the Inn (pp. 91–160) should be considered by all who seek to explain the topography of glaciated areas. The author finds that the terraces of gravel rest on an earlier series of terraces cut in the rock, which are at very different levels on opposite walls of the valley. He summarises his results in a series of fifty-six propositions, among them being the conclusion that the Inn valley, on the retreat of the ice, exhibited a succession of shallow basin-like excavations, which were filled in later by a continuous deposit of alluvium. These hollows, like the smaller details of the ice-erosion, were formed independently of the hardness of the rocks concerned, and Dr. Ampferer believes that the variation in the activity of a glacier as an abrading agent depends in reality on variations in the local pressure and velocity. With reduced pressure and greater velocity the same amount of erosion can be performed as with greater pressure and less velocity. The author opposes the view that rock-obstacles on the walls of a valley are inevitably worn away by the passage of glacier-ice; he urges, on the other hand, that such irregularities may be left standing out, while others are actually produced by the lack of uniformity in the forces of erosion, to which he specially directs attention.

The *Verhandlungen der k.k. geologischen Reichsanstalt*, Nos. 9–12, for 1904, continue to be rich in papers on Bohemia and Moravia, and students of petrology in the broad sense, as well as of Palæozoic and Mesozoic faunas, must endeavour to keep pace with the monthly observations furnished by Dr. Katzer, Jaroslav J. Jahn, Friedrich Trauth, and others. The Dalmatian islands also receive attention in Dr. Waagen's reports of his recent journeys.

AGRICULTURAL EDUCATION AND RESEARCH.

THE writings of Henry, Babcock, King, and others have made the University of Wisconsin familiar to English agricultural students, so that considerable interest attaches to the twentieth annual report of the experiment station, which contains a short history of the College of Agriculture, and summarises the results of twenty years' research. The college is one of the best known in the United States, and its record is typical of many similar institutions. A professor of agriculture was appointed in 1866, there was the usual attempt to teach before the materials for a course of university grade existed, and there was the usual failure. Then, when the indignation and forcible action of "some thirty representative farmers" led the regents of the uni-

versity to realise the need of "better directed measures," there was a change of policy. The farmer's educational requirements were studied, suitable courses were devised, and research in his interests was begun. The success of this changed policy is testified to by every chapter of the report, and is strikingly shown by the material progress of the institution. When the present director took charge in 1880 the buildings consisted of a dwelling house and two barns, worth about 1000*l.*; the present buildings are worth more than 60,000*l.* In 1881 the income of the agricultural department was represented by the salary of the professor and a grant of about 1000*l.* for experiments. In 1903 the College of Agriculture had an income of 10,000*l.* for administrative and teaching purposes, and of 6000*l.* for research; and in addition free instruction in languages, mathematics, and pure science was provided for agricultural students in other departments of the university.

But the "better directed measures" of the regents of Wisconsin University have had an influence outside the College of Agriculture. At the jubilee of the university last summer, Prof. Chamberlin, of Chicago, delivered an address on "The State University and Research." In this address it was argued that "the fundamental promotion of education lies in an increase in the intellectual possessions of a people, and in the mental activities and attitudes that grow out of the getting, the testing, and the using of these possessions" (*Experiment Station Record*, xvi., 3). As an illustration of the effects of properly directed research on a community, the work of the Wisconsin Experiment Station was referred to in the following words:—"It was my privilege to compare the Agricultural conventions of this State at two periods separated by a decade, within which the experiment station became a potent influence. The dominant intellectual and moral attitude of the earlier period was distinctly disputatious and dogmatic. . . . In the second period the dominant attitude was that of a scientific conference. . . . The whole was characterised by a notable approach to the methods of approved scientific procedure. The intellectual and moral contrast of the two periods was one of the most pronounced expressions of advance in the higher education in a great mass of people in the midst of a practical life which it has ever been my privilege to witness."

The educational value of research may be traced here and there in our English shires, where agricultural experts have won the confidence of farmers by conducting well devised experiments in their midst. But our education authorities still view research with suspicion, and one finds agricultural experiments, for example, labelled "demonstrations" for no other reason than to satisfy the county auditor! One wishes that our education committees, entrusted as they are with funds for the encouragement of agriculture, would study the "better directed measures" which have been so successful in Wisconsin, and not in Wisconsin only, but throughout the States. They would probably find in the American institutions confirmation of a view expressed by Prof. Chamberlin in the above quoted paper.

He remarks that while it is a good thing to provide technical instruction in agriculture, it is "a much higher and truer function to develop the science of agriculture, to increase the intellectual activity of every farmer, to improve the agricultural art on every farm, and by such improved art to furnish better and safer food to every citizen."

T. H. MIDDLETON.

SCIENTIFIC REPORTS OF THE LOCAL GOVERNMENT BOARD.[1]

AS is customary, the report under notice is divided into three portions, (1) an excellent digest by the principal medical officer, Mr. Power, of the contents of the volume; (2) statistics of vaccination and details on outbreaks of disease investigated by the board's inspectors; and (3) the reports of scientific investigations carried out for the board, and of the board's vaccination department.

It is reassuring to learn that abstention from vaccination seems to be steadily diminishing, the percentage of births remaining unvaccinated being 20·8 in 1899, 19·9 in 1900, and 17·3 in 1901. The epidemic of small-pox which raged in London in 1901–2 again directs attention to the danger of small-pox hospitals in disseminating this disease in their vicinity. Practically all the London cases were removed to the hospital ships moored in the Thames at Long Reach, opposite to which is the village of Purfleet, containing a number of unvaccinated persons, and an excessive incidence of small-pox prevailed there attributable to aërial conveyance of infection from the ships. The populations of Purfleet garrison and of the training ship *Cornwall* close by were, however, thoroughly vaccinated and re-vaccinated, and not a single case of small-pox occurred in these communities, another instance of the protective power of vaccination. The report by Dr. Bulstrode on outbreaks of typhoid fever at Winchester and Southampton attributable to infected oysters has already been noticed in these columns (see NATURE, vol. lxviii. p. 303).

An outbreak of throat illness at Lincoln attributable to milk was the subject of investigation by Dr. Mair. Although bearing considerable resemblance to scarlatina the outbreak was conclusively proved not to be one of this disease. From a few of the cases a yeast was isolated from the throat by Drs. Klein and Gordon which proved pathogenic to mice, and reproduced on inoculation some of the features of the human disease.

Dr. Bulstrode's report on the excessive incidence of typhoid fever at Bridgend (Glamorgan) supplies an instructive instance of the superiority of properly conducted bacterioscopic examination over chemical analysis for detecting a *slight* degree of pollution of water supplies. Turning to the scientific investigations carried out for the board, it is difficult in a short space to give adequate notice of their contents and importance.

Dr. Klein records some observations on the bacteriological diagnosis of plague, and the manifestations of this disease in the rat. He regards the natural disease in this animal as one of slight virulence and feeble infectivity, and considers that it is spread from rat to rat mainly through their fighting propensities. Dr. Klein, in continuation of his study of agglutinins, also details experiments made to test the ability of two or more agglutinins to coexist in the blood of the same animal. Cultures of *B. typhosus* and *B. enteritidis* (Gärtner) injected simultaneously in an animal were found to produce agglutinins corresponding to each of these microbes. But if the cultures were injected not simultaneously, but in sequence, the agglutinin of the first microbe was to a large extent replaced by that of the second microbe injected.

Dr. Sidney Martin has continued his investigations of the toxic substances elaborated by diarrhœa-producing bacteria, dealing in the present instance with those of the *Proteus vulgaris*. He finds the toxin to be proteid in nature, but not albumose, and readily extractable from the bacterial cells by distilled water. An injection of the toxin produced diarrhœa with depression of temperature.

The report by Dr. Mervyn Gordon on a bacterial test for the estimation of pollution of air is one of great interest and importance. First examining the natural bacterial flora of the saliva, he found that a streptococcus having the power of producing acid in glucose and in lactose media, acid and clot in milk, and of changing the colour of an anilin dye neutral red, was extremely abundant, no less than 10,000,000, and in some cases 100,000,000, being contained in 1 c.c. of saliva, and by using a neutral red broth and incubating anaërobically minute traces of saliva may be detected. By placing, therefore, dishes of neutral red broth at varying distances from a speaker, and subsequently incubating and examining, the distance to which particles of saliva may be carried can be ascertained. It was found that particles of saliva were present in the air no less than 40 feet in front of and 12 feet behind the speaker during loud speaking. Dr. Houston has carried out an exhaustive study of the bacterial flora of human dejecta, with special reference to the colon bacillus. He finds that not less than 90 per cent. of the total number of this organism present have the characters of the typical *B. coli*.

The same observer details the results of the chemical and bacteriological examination of Tunbridge Wells deep well waters, and, in conjunction with Dr. Klein, reports on the use of nutrose agar for the identification of the typhoid bacillus.

[1] Supplement containing the Report of the Medical Officer for 1902–03. (Thirty-second Annual Report of the Local Government Board, 1902–03.)

The remainder of the volume is occupied with reports of scientific investigations carried out in the board's vaccine laboratories by Dr. Blaxall, Mr. Fremlin, and Dr. Green, and a number of excellent plates illustrating the various researches. R. T. HEWLETT.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—During the first fortnight of last month some four hundred candidates were being examined at Cambridge for entrance scholarships. The majority of the larger colleges are now combined into two groups, the larger of which includes Pembroke, Gonville and Caius, Jesus, St. John's, Christ's, King's, and Emmanuel, whilst the smaller comprises Peterhouse, Clare, Trinity Hall, Trinity, and Sidney Sussex. Queens' examined alone, and a week later than the two large groups. As a result of the examination of these thirteen colleges a sum amounting to a little more than 6000*l.* was awarded in scholarships to 108 successful candidates. This total does not include the sum, which amounted to some hundreds of pounds, given in exhibitions, sizarships, and subsizarships, and in certain extra scholarships offered by some of the colleges after the result of the first selection had been published. It is interesting to note the number of scholars and the value of the scholarships given in the different subjects. Out of a little more than 6000*l.* awarded to 108 candidates, classics gained 2850*l.*, divided amongst 49 scholars, mathematics, with 34 scholars, earned 1945*l.*, and the natural sciences divided 990*l.* amongst 20 successful competitors, whilst candidates in history and oriental and modern languages were successful in only five instances, and these 5 divided amongst them 220*l.*

AMONG the papers down for reading at a conference of the National Federation of Head Teachers' Associations, arranged to be held at Cambridge yesterday and to-day, is one by Sir Lauder Brunton, F.R.S., on "The Proposed National League for Physical Education and Improvement."

Science announces that Mr. E. D. Adams has given 10,000*l.* to Columbia University for the foundation of a research fellowship in physical science. The gift is accompanied by a valuable collection of scientific apparatus to be allotted to the electrical, physical, and psychological laboratories of the university.

THE prospectus for 1904–5 of the Colorado School of Mines shows that much importance is attached in the metallurgical courses to visits arranged for the students to works where typical processes in metallurgy can be seen in operation under commercial conditions. Immediately after taking up the study of metallurgy, trips extending throughout the junior and senior years are begun. These excursions, intended to illustrate the lectures, are taken while the particular topics are under discussion, and tend to aid greatly in an appreciation of approved machinery and practice. By means of outlines with which the student is provided, which he is required to fill out, care is taken that all the important points in connection with each plant visited are studied and reported upon.

THE following recent educational appointments are announced:—Dr. Foster P. Boswell assistant in psychology and Mr. Edwin Lee Norton instructor in philosophy at Wisconsin. Miss Florence Fitch associate professor of philosophy in Oberlin College. Prof. F. S. Luther, who occupies the chair of Trinity College, Hertford, Conn., has been elected president of the college. Dr. J. Stebbins has been appointed assistant professor of astronomy, and Mr. A. H. Wilson instructor in mathematics, at Illinois; Dr. H. B. Evans assistant professor of mathematics at Pennsylvania; Mr. C. P. Weston assistant professor of mechanics, Mr. H. R. Willard instructor in mathematics, and Mr. R. K. Morley tutor in mathematics, at Maine; Mr. W. D. Cairns associate professor of mathematics, and Mr. J. R. Luckey assistant in mathematics and physics, at Oberlin; Mr. E. D. Grant associate professor of mathematics at the Michigan College of Mines; Dr. K. Schmidt professor of mathematics and astronomy at Lake City, Florida.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 17, 1904.—"Theory of Amphoteric Electrolytes." Part ii. By Prof. James **Walker**, F.R.S.

In a previous paper (see NATURE, April 7, 1904, vol. lxix. p. 545) it was shown that it is possible to express the concentrations of the ions present in the aqueous solution of an amphoteric electrolyte in terms of the concentration of the un-ionised substance, the dissociation constants of the substance acting as acid and as base respectively, and the ionisation constant of water. In the present paper the values for the aminobenzoic acids have been recalculated, and a closer concordance obtained between theory and experiment than was apparent in the former calculations. As a knowledge of the concentration of the un-ionised proportion of an amphoteric electrolyte in solution is of fundamental importance in the application of the theory, a table is given of the values of this magnitude with varying constants and total concentration. From this table it appears that when the acidic and basic constants approximate in value, dilution has little effect on the total ionisation of an amphoteric electrolyte, although the proportions of the two positive ions, and consequently the molecular conductivity, may vary greatly.

For a series of amphoteric electrolytes with a constant product $k_a k_b$, where k_a is the acidic and k_b the basic constant, it may be shown that the simultaneous alteration of $1/k_a$, k_b, and v in the same ratio has no effect on the total ionisation. From this and the preceding result it may be deduced that in such a series, beginning with an infinitely small value of k_b, the total ionisation falls off as k_a diminishes and k_b increases, the fall being at first rapid, thereafter becoming slower until, through a comparatively long range, it is practically constant at the minimum value, which is actually reached when $k_a = k_b$. At this point the substance is absolutely neutral. As k_a still further diminishes, and k_b correspondingly increases, the ionisation begins to increase, very slowly at first, and the substances considered become more and more basic in character. Finally, the ionisation increases rapidly, and we deal at last with a practically simple base for which k_a is infinitely small.

The theory has been applied to cacodylic acid and to asparagine with satisfactory accordance with the experimental results.

December 1, 1904.—"On Chemical Combination and Toxic Action as exemplified in Hæmolytic Sera." By Prof. Robert **Muir** and Carl H. **Browning**.

This paper deals with the mode of action of complements—those comparatively labile bodies which are present in the serum of normal animals, and which are the active substances in hæmolysis and bacteriolysis. Towards red corpuscles treated with the suitable immune-body (the anti-substance developed by the injection of such corpuscles into an animal of other species) a complement may be regarded as a toxin, and already many points of similarity in the constitution of toxins and complements have been brought forward. The hæmolytic dose of a particular complement varies greatly in the case of different corpuscles, when each variety is treated with the corresponding immune-body, and the question dealt with in this communication is whether such variations in dosage are due to variations in the combining affinities of complements or to variations in their toxic action. For example, the hæmolytic dose of guinea-pig's complement is ten times greater in the case of its own corpuscles than it is in the case of the ox's corpuscles, and the writers show by quantitative methods that in the former case the whole of this large dose of complement enters into combination with the guinea-pig's corpuscles (through the medium of the immune-body); there is no want of combining affinity of complement, but its toxic action is slight. A similar result was obtained with each of three sera investigated—a relative non-sensitiveness of the corpuscles of an animal to its own complement; in one case there was also a deficiency in the combining power of the complement. All the results go to emphasise the importance of distinguishing these two factors in the action of a complement, which correspond with the two chief atom groups designated by Ehrlich "haptophore," or combining, and

"zymotoxic." As bearing on the general biology of the subject, the following may be quoted:—"No one has yet succeeded in producing an anti-substance or immune-body by injecting an animal with its own corpuscles or cells—such a body as with the aid of complement would produce destruction of these cells. This is manifestly a provision against self-poisoning, and Ehrlich has applied to it the term *autotoxicus horror*. The results which we have brought forward, if they were found to hold generally, would go to show that even if some substance should appear which acted as an immune-body, there is a provision whereby the complement of an animal should produce comparatively little harmful effect."

Chemical Society, December 14, 1904.—Prof. W. A. Tilden, F.R.S., president, in the chair.—The following papers were read:—Hydrolysis of ammonium salts: V. H. **Veley.** It is shown that when aqueous solutions of ammonium salts are heated the evolution of ammonia and the concomitant acidity of the solutions are due not to dissociation, but to hydrolysis.—The viscosity of liquid mixtures, part ii.: A. E. **Dunstan.** The author's conclusions, given in a previous paper (Chem. Soc. *Trans.*, 1904, lxxxv., 817), are confirmed by the present series of viscosity-concentration measurements for a number of binary mixtures containing hydroxy-compounds.—The diazo-reaction in the diphenyl series, part ii., ethoxybenzidine: J. C. **Cain.** The author has examined the action of heat on the solution of the diazonium salt prepared from ethoxybenzidine, and has shown that the diazonium group, adjacent to the ethoxy-group, is normally substituted by hydroxyl, whilst the other remains intact.—The sulphate and the phosphate of the dimercurammonium series: P. C. **Ray.** When dimercurammonium nitrite, NHg_2NO_2, is treated with an oxyacid, the dimercurammonium complex remains intact. In this way, the author has succeeded in preparing the sulphate and the phosphate of the series.—A method for the direct production of certain aminoazo-compounds: R. **Meldola** and L. **Eynon.** The authors have found that most diazotised amines when treated in aqueous solutions with a strong solution of sodium dichromate give crystalline precipitates of diazonium chromates. These chromates are more or less explosive when dry, and it is suggested that some of them might find technical application as high explosives.—The combination of mercaptans with olefinic ketonic compounds: S. **Ruhemann.**—Studies in optical superposition, part i.: T. S. **Patterson** and F. **Taylor.** Menthyl acetate, *l*-menthyl *d*-tartrate, and *l*-menthyl diacetyl-*d*-tartrate have been prepared and their rotations examined between 0° and 100°. It is shown to be possible by analogy to trace the separate effects of the different active groups composing menthyl tartrate and its diacetyl derivative.

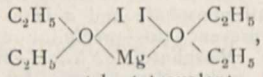
Linnean Society, December 15, 1904.—Prof. W. A. Herdman, F.R.S., president, in the chair.—The ecology of woodland plants in the neighbourhood of Huddersfield: Dr. T. W. **Woodhead.** The plant-associations of this portion of west Yorkshire having been dealt with on broad lines by Smith and Moss, the author has endeavoured to carry the study a stage further by paying special attention to a very limited area. A small wood (Birks Wood, near Huddersfield) was examined in great detail, and the main factors determining the distribution of the more important plants of the undergrowth studied, such as soil, shade produced by the dominant tree, moisture, exposure, and wind. The results thus obtained were then tested by an examination of the woodlands in an area of 66 square miles to the south and west of Huddersfield; special attention was also paid to the distribution of these species beyond the limits of the woodlands.—Experimental studies in heredity in rabbits: C. C. **Hurst.** The studies were based on breeding between a Belgian "hare" and an albino Angora; the second generation showed but little outward variation from the Belgian parent, but the third generation displayed great diversity of colour—albino, grey, black, and variegated. These experiments tallied in a very close degree with the numbers expected according to the Mendelian laws.

Faraday Society, December 19, 1904.—Mr. J. Swinburne, vice-president, in the chair.—The electric furnace: its origin, transformations, and applications, part ii.: M. Adolphe **Minet.**—Electrolytic analysis of cobalt and nickel: Dr. F. Mollwo **Perkin** and W. C. **Prebble.** *Cobalt.*—The aim of the experiments was to obtain bright deposits of the metal that should be quantitatively accurate. The most satisfactory results were obtained with a solution containing an alkali phosphate and a little phosphoric acid, the latter to prevent the precipitation of the double sodium cobalt phosphate. *Nickel.*—Similar solutions were tried for nickel deposition. In this case good results were obtained with a borate solution, while a phosphate solution, which gave good figures in the case of cobalt, was not at all satisfactory.—(1) The electrolytic preparation of tin paste; (2) note on the electrolytic recovery of tin: F. **Gelstharp.** The electrolytic process is less costly than other processes in spite of the low current efficiency (50 per cent.), and it can be worked continuously. The process consists in dissolving anodes of tin, roughly cast from commercial ingots, in dilute hydrochloric acid, and depositing the metal in the form of sponge on kathodes of block tin or tinned iron. In the second note an experiment is described that has some bearing on the conditions necessary for electrolytically stripping tin plate.

PARIS.

Academy of Sciences, December 26, 1904.—M. Mascart, in the chair.—On the theorem of areas and conservative systems: Paul **Painlevé.**—Groups of negative bands in the air spectrum with a strong dispersion: H. **Deslandres.** A detailed examination under high dispersion of the ultra-violet band λ 3914. This band is intense round the negative pole in vacuum tubes filled with air or nitrogen, and it constitutes nearly exclusively the kathode light of gases; it is found in the aurora borealis and in the radium light.—On the constitution of the sodium salts of certain methenic and methinic acids: A. **Haller** and P. Th. **Muller.** A differential optical method has been employed in this work, comparing the molecular refraction of the sodium salt with its corresponding acid, so far as possible in the same solvent and at equal concentrations. The substances studied included cyanacetic ester, propionyl-cyanacetic ester, malonic and cyanomalonic esters, malonitrile, and cyanocamphor. The results indicate that all the sodium salts examined have a different constitution from that of the generating acid, and hence that the latter should be classed as pseudo-acids.—On some new geological discoveries in the Soudan: A. **de Lapparent.** The fossils found present a fresh proof of the existence of an arm of the sea penetrating into the Soudan.—On the new Giacobini comet: M. **Giacobini.** Observations, the elements and ephemeris of the new comet, discovered on December 17, 1904, at the Observatory of Nice.—The provisional elements of the Giacobini comet (December 17, 1904): G. **Fayet** and E. **Maubant.**—Observations of the Tempel comet (1873, 2) made at the Observatory of Algiers with the bent equatorial of 31·8 cm. aperture: MM. **Rambaud** and **Sy.**—On the stability of aërostats fitted with steering apparatus: G. A. **Crocco.**—On the fragility of certain steels: A. **Perot** and Henri Michel **Levy.** A study of the effect of shock on notched test-pieces, a photographic method of recording the results being adopted.—On the kathode rays and the laws of electromagnetism: P. **Villard.** Diagrams are given showing the comparison of the theoretical curves with those actually obtained, and it was found that none of the experimental results present anomalies requiring the assumption of a magnetic friction.—On the thermoelectricity of the aluminium alloys: Hector **Pécheux.** Alloys of aluminium with tin, lead, bismuth, magnesium, antimony, and zinc were studied at 100°, 180°, and 380° C.—On the theory of magnetism: P. **Langevin.** An application of the hypothesis of electrons to the explanation of the phenomena of para- and dia-magnetism.—On a phenomenon of retinal adaptation relating to visual perception of faintly illuminated colours: A. **Polack.**—On the reduction by amorphous boron of the oxides of manganese, and on the preparation of a new boride of manganese: Binet **du Jassonneix.** The composition of the new boride studied is represented by the formula MnB. It fits into the series of well defined and crystallised borides FeB, NiB, and CoB prepared by M. Moissan by means of the electric furnace.—On quadri-

valent oxygen: E. E. **Blaise.** Ethyl ether and magnesium iodide form a well defined, crystalline compound from which the ether is only driven off when heated to temperatures approaching 190° C. Its probable constitution is given as



in which the oxygen must be tetravalent. If this substance is treated with an ether containing an alkyl group of higher molecular weight, as amyl ether, the latter replaces the ethyl ether, and a vigorous reaction ensues.—On the reduction of the anhydrides of the dibasic acids: G. **Blanc.** The anhydrides of pyrotartaric, αα-dimethylsuccinic, αα-dimethylglutaric, ββ-dimethylglutaric, and camphoric acids, when reduced with sodium and absolute alcohol, give good yields of the corresponding lactones.—A general method for the synthesis of aldehydes with the aid of substituted glycidic acids: Georges **Darzens.** A mixture of monochloracetic ester with any ketone is treated with sodium ethylate in powder. The acid formed by this condensation is unstable, and splits up easily into carbon dioxide and an aldehyde of the type RR′CH—CHO, where the original ketone was RR′ : CO. The reaction has been applied to a considerable number of ketones and found to be quite general.—On the diastatic coagulation of starch: A. **Fernbach** and J. **Wolff.** It is shown that the diastatic coagulation of starch is only possible if it is in a state of liquefaction, this being produced either by a liquefying diastase or artificially.—On the combustion of sulphur in the calorimetric bomb: H. **Giran.** The heat of combustion of sulphur has been determined in the Berthelot bomb at pressures varying between 2·5 and 45 atmospheres, with the unexpected result that the heat of formation of sulphur dioxide increases with the pressure. This result is regarded as being possibly due to the formation of the persulphuric anhydride of Berthelot.—On the electrical conductivity of colloidal solutions: G. **Malfitano.** In order to eliminate the effect possibly produced by the presence of minute traces of electrolytes in solution, the conductivity of the colloidal solutions was taken both before and after filtration through a thin film of collodion, it having been shown by preliminary experiments that solutions of pure electrolytes undergo no appreciable change after such filtration. It was found that the conductivity due to the fine particles in suspension was practically nil.—On the comparative production of alcohol and carbonic acid during fermentation: M. **Lindet** and P. **Marsais.** The ratio of alcohol to carbonic acid has been followed throughout the whole course of a fermentation, the effect of varying temperature being also studied.—Study of calcium carbide used as an explosive in mining work: Marcel P. S. **Guédras.** The cartridge used consisted of a charge of calcium carbide separated by an insulating membrane from water. The membrane is broken by a cap controlled electrically, and after five minutes the explosive mixture is fired also by electrical means. The explosion takes place in a manner well adapted for mining work.—On the histology of the myocardium in the primitive molluscs: P. **Vigier** and Fr. **Vles.**—Intranuclear fat in the suprarenal capsules of mammals: P. **Mulon.**—On the migration of glucosides in plants: W. **Russell.**—On the destruction of the winter egg of Phylloxera by lysol: G. **Cantin.** An account of experiments demonstrating the practical efficacy of a 1 per cent. solution of lysol against the disease.—On the mineral species of arable earth: A. **Delage** and H. **Lagatu.**—The geology of Sahel, Algeria: General **de Lamothe.**—The culture of the parasite of dysentery of warm countries: A. **Lesage.**—On infectious anæmia of the horse: MM. **Carré** and **Vallée.**

DIARY OF SOCIETIES

THURSDAY, JANUARY 5.

RÖNTGEN SOCIETY, at 8.15.—Description of an Automatic Vacuum Pump: C. E. S. Phillips. (The apparatus will be shown at work.)—Exhibition of a Method by which Strongly Adherent Films of Aluminium may be applied to Glass.—A Note on the Coloration of Glass by Radium Radiation.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—Thames Barrage: James Casey.

FRIDAY, JANUARY 6.

INCORPORATED SOCIETY OF MEDICAL OFFICERS OF HEALTH, at 7.30.—The Report of the Inter-Departmental Committee on Physical Degeneration: Sir Lauder Brunton, F.R.S.

GEOLOGISTS' ASSOCIATION, at 8.—The Third Issue of the British Association Geological Photographs: Dr. C. G. Cullis.

ROYAL GEOGRAPHICAL SOCIETY, at 3.30.—National Antarctic Expedition: Capt. R. F. Scott. (Lecture to Young People.)

MONDAY, JANUARY 9.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Some Chemical Aspects of the St. Louis Exhibition: Walter F. Reid.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Mr. Reginald Enock's Journeys in Peru: the President.

TUESDAY, JANUARY 10.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Recent Visit to the United States and Canada: Sir William Henry White, K.C.B. (The Address will be repeated on the following day at 3.30 p.m.)

WEDNESDAY, JANUARY 11.

SOCIETY OF PUBLIC ANALYSTS, at 8.—Brandy: Otto Hehner.

THURSDAY, JANUARY 12.

MATHEMATICAL SOCIETY, at 5.30.—Generational Relations for the Abstract Group simply Isomorphic with the Abstract Group LF [2, *pn*]; Dr. W. Bussey.—On a Class of Expansions in Oscillating Functions: Prof. A. C. Dixon.—Isogonal Transformation and the Diameter Transformation: H. L. Trachtenberg.—A Generalisation of the Legendre Polynomial: H. Bateman.—Current Flow in Rectangular Conductors: H. Fletcher Moulton.—Basic Generalisations of some well known Analytic Functions: Rev. F. H. Jackson.

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