THURSDAY, DECEMBER 13, 1906.

THE USE OF PRESERVATIVES.

Preservatives in Food and Food Examination. By Dr. John C. Thresh and Dr. A. E. Porter. Pp. xvi+484. (London: J. and A. Churchill, 1906.) Price 14*s.* net.

THERE is much knowledge enshrined in Parliamentary Blue-books, and doubtless some wisdom. Very often it remains enshrined in them. A better fate, however, has awaited the report of the Departmental Committee appointed by the President of the Local Government Board in 1899 "to inquire into the use of preservatives and colouring-matters in foodstuffs." Messrs. Thresh and Porter have taken this report partly as text, partly as sermon; amplifying it here, compressing it there, and adding, moreover, various allied matters not directly within the purview of the committee, they have produced a volume which will probably be consulted by hygienists when the original Blue-book lies almost forgotten in the archives of the Parliamentary bookseller.

The matter is classified into five parts. In the first section the authors deal with the various methods adopted for preserving foods, and give a general description of preservatives, their pharmacological effects, and the experimental work which has been done upon them. For example, Wiley's investigation into the effects of boron compounds upon the human system is summarised, together with Liebreich's criticism of the results, and due note is made of important experiments by many other workers, including Chittenden, Rideal and Foulerton, Annett, and Tunnicliffe and Rosenheim.

The second part is devoted to the principal foodstuffs into which preservatives enter, namely, milk, cream, butter, alcoholic and temperance beverages, fruits, vegetables, meat, eggs, and fish. Based upon information contained in the Departmental Committee's report, a short account of the substances is given, with figures showing the quantities of preservative used, and notes of the various circumstances affecting its employment.

A perusal of these two sections suggests strongly that the present state of affairs is by no means satisfactory as regards the use of chemical preservatives. Our policy has been a haphazard one. Preservatives of some kind—*e.g.* salt and vinegar—have been employed as far back as the memory of man carries us. The question is asked, Are these long-known substances the best possible for the purpose? Is it not conceivable that modern chemistry might find something better? Quite possibly it may; in fact so far as indicating antiseptics and germicides is concerned, the task is easy. But there is the further question how far any substance which is destructive of microbial and parasitical forms of life may also be inimical to the human organism. It is a question of quantity. On the one hand we have the advocates of various preserving substances—boric acid, formaldehyde, hydrogen peroxide, sodium fluoride; salicylic, benzoic, formic, and sulphurous acids; asaprol, and so on—who argue (1) that by the use of these and other means of preservation food is rendered cheaper; (2) that definite cases of illness or death have rarely or never been conclusively traced to the use of preservatives; and (3) that, on the contrary, during recent years the death-rate has declined, one of the assignable causes of this being the better feeding of the people resulting from cheaper food. On the other hand, it is urged that many cases of illness have, in fact, been indicated as probably due to preservatives. At the best these latter have not been proved harmless, and the most we can admit is that we really do not know what are the physiological effects of small amounts of the foregoing substances. But they are certainly harmful if taken in quantity, and may be so in any dose which would be effective as a germicide. Moreover, even if strong and healthy adults are unharmed by them, there are still children and invalids to consider. Again, it has been pointed out that the uncontrolled employment of preservatives is sometimes liable to great abuse without culpable carelessness on the part of any individual user. Boric acid, for example, may be added to milk first by the farmer, again by the wholesale distributer, then by one or more retailers, and possibly again by the consumer himself; and each may add the maximum allowable quantity. Generally, it may be said that we rarely or never know how much preservative any given food either ought to contain or does actually contain.

The policy of our laws has been to allow food-producers a free hand, subject to the restriction that any preservative added shall not render the food injurious to health. But has this *laissez faire* attitude been a wise one? True, it leaves the food manufacturer free to experiment—which is, so far, good. But it gives him the consumer's living body as *corpus vile*—which is not so good.

Naturally the consumer has some right of objection, and in any case the question of what is "injurious to health" has always to be fought out in the police court—about the worst place in which to decide such a matter. The most diverse decisions have been arrived at, and meanwhile the query whether or not we and our children are being caused unnecessary suffering remains unanswered.

What would be the ideal way of treating such a problem if we could start afresh, and impose decrees *modo tyranni*? Surely it would be to say:—Let your salt, vinegar, and such like, as having by long usage proved themselves comparatively harmless, remain as they are. Let a responsible body be appointed, competent to examine the newer substances; let it hear what is to be said on either side, and let it make whatever experiments may be necessary and practicable to test the evidence. And let no preservative or colouring-matter whatever be added to foodstuffs until it has been at least provisionally approved by this responsible authority.

If this course is not practicable in its entirety now that a number of more or less dubious substances have gained something of a footing, it is at least possible to a very considerable extent. The authors of the volume before us give both sides of the question very fairly—so fairly indeed that we are often reminded of Mr. Facing-both-ways. But the impression left by a

careful perusal of their statements is that a competent and impartial body is required to, and could, draw up a schedule of substances and quantities which, on a review of all the evidence, might provisionally be considered as reasonably safe to use. The presumption should be that nothing ought to be added to food until it has been proved harmless; not, as at present, that a manufacturer may add anything he likes until it has been shown to be injurious.

Coming now to the remainder of the volume: colouring matters and mineral poisons, which may occur in food and drink, are dealt with in the third part, and the following section—a long and important one—is devoted to the study of unsound food. Notes on the principal diseases of animals and upon *post-mortem* appearances are appended, and directions are given for the bacteriological examination of shell-fish and of milk and other dairy produce, as also for the detection of toxins and ptomaines in foodstuffs.

The concluding section is devoted to the chemical examination of foods for preservatives and colouring matters, with a chapter on legal points. For the most part the analytical processes described are well-known methods, conveniently collected here, but otherwise calling for no special comment. In passing, however, it may be remarked that mannitol is easier and cleaner to use than glycerol in the volumetric determination of boric acid.

On the whole the volume is a trustworthy production, and may be accepted as the most useful compendium of the subject yet published. C. SIMMONDS.

MATHEMATICS OF BODILY MOVEMENTS.

Theoretische Grundlagen für eine Mechanik der lebender Körper. By Otto Fischer. Pp. x+372. (Leipzig: B. G. Teubner, 1906.) Price 14 marks.

A FAMILIARITY with the structure of the human body is but rarely combined with a competent knowledge of mathematics. So far as one may judge from published works, Prof. Otto Fischer is the sole representative of this combination of talents in Europe. But his attainments, from their very singularity, carry with them certain disadvantages; although he has diligently applied the methods of the mathematician to the elucidation of the movements of the human body for the last twenty years, he has raised neither rival, disciple, nor critic; his many publications have failed, apparently, to attract the attention of writers of text-books on anatomy and physiology. Prof. Fischer expresses the hope that his book will appeal to mathematicians and physicists on the one hand, and to anatomists and physiologists on the other; he has employed the most intelligible anatomical terms and descriptions for the benefit of the first, and reduced the necessary mathematical formulæ to their simplest expression for the second. Notwithstanding these attempts to form a common ground where mathematicians and anatomists may meet on equal terms, the writer of this notice finds the mathematics of this work difficult and wholly to be taken on trust, and he believes the vast majority of anatomists will experience a similar difficulty. Nor does he believe that the pure mathematician will easily understand the action of such muscles as the "iliacus," "short head of the biceps," or "semimembranosus," nor have a definite conception when he is told that the centre of gravity for the head lies between the "dorsum sellæ" and "posterior perforated lamina."

The initial difficulties which the mathematician and anatomist will experience in studying this book may lead to its great merit being overlooked. In medical text-books the actions of muscles and of joints are described in crude snatches; when the student has finished his study he has no knowledge of the mechanism of the body as a whole. Prof. Fischer's aim is to give a picture of the living, moving body as a complete machine; to estimate the manner in which the muscles work in producing definite movements of the body, and the amount of force expended in the production of these movements. For the purpose of his investigation he has divided the body into fourteen segments or masses, viz. the head, trunk, upper arm, fore arm, hand, thigh, leg, and foot; each of these he treats as a rigid mass; he estimates the centre of gravity for each. The centre of gravity for the trunk he found to be situated near the front of the upper border of the first lumbar vertebra. The mass or weight of each of these parts is estimated—the trunk forming, in the average body, rather more than two-fifths of the whole. The methods applied to the study of machines cannot be used for the human body, where the joints have no fixed axes or fixed points. These difficulties Prof. Fischer seeks to overcome by establishing theoretical fixed axes and fixed points for the various joints; he simplifies his problems, too, by the use of what he terms "mass systems." Although Prof. Fischer has not been altogether successful in reaching the non-mathematical mind, we are certain he has given us in this unique book matter which both physicist and biologist may study with advantage.

GOETHE AS MINERALOGIST AND GEOLOGIST.

Goethes Verhältnis zur Mineralogie und Geognosie. Rede gehalten zur Feier der akademischen Preisverteilung am 16 Juni, 1906. By Dr. G. Linck. Pp. 48. (Jena: G. Fischer, 1906.) Price 2 marks.

THE poetic genius and fascinating personality of Goethe have so dazzled the world that the ordinary reader of "Faust" has never so much as suspected that its author could claim to be a distinguished man of science. Some, perhaps, who have studied the life of the poet may be aware of his discoveries in biology and his speculations in botany; others, again, may have heard of his excursion into the field of optics, and may have marvelled at the amazing aberration of his genius which led him to regard his unhappy attack on the Newtonian theory of colour as the proudest and most valuable achievement of his life; but that he accomplished anything of worth in mineralogy and geology is known to very few.

It is, therefore, well that the professor of mineralogy

and geology at Jena has attempted to do justice to this side of Goethe's activity. Realising the danger of unconsciously misrepresenting Goethe's position by attempting to interpret his work in the light of our present knowledge, Prof. Linck has wisely allowed Goethe to explain himself in extracts from his published writings and correspondence. Goethe appears to have been attracted to the study of mineralogy partly by the reopening of the Ilmenau mines, and partly through the influence of the Freiberg school. Further, his official position brought him into contact with mining and geological problems, and his business instincts led him to take an interest in any discovery likely to be of practical use.

Goethe, in fact, was by nature a realist, and even his muse was happiest when inspired by a striking event or by a beautiful scene. His realistic tendencies led him to become an ardent collector of minerals, rocks, and fossils, which he regarded from a natural history point of view. But he lived in a time when the classification of minerals by their more obvious external characters and by their mode of occurrence was passing away. On the one hand, analytical chemistry was revealing their composition; on the other, crystallography was reducing to order the apparent complexity of the crystal forms. Goethe, however, held by the old system. He realised, it is true, the importance of chemistry—"I cannot get a step further in mineralogy without chemistry"—but it was a study for which he appears to have had but little aptitude. His appreciation of crystallography was smaller still; witness his statement, "Crystallography is not productive—and leads to no results, especially now that so many isomorphous bodies have been discovered of different compositions." Goethe appears, indeed, to have regarded the progress of these sciences with some misgiving, for he says:—"Mineralogy is in danger of being devoured by crystallography, where form is all-important. It is in danger of being devoured by chemistry, which looks only for general laws and is indifferent to form. It may also be in danger of being devoured by geology, for the latter is only concerned with modes of occurrence." As an adherent, then, of a system which had attained practically the fullest development of which it was capable, the field open to him was not extensive, but within its limits he did good work. His description of the Carlsbad felspar twins, for example, was excellent, and we owe many interesting observations to his studies on crystal-genesis and on the occurrence and associations of minerals. Among his collections, those from the neighbourhood of Carlsbad were the most important, but Thuringia, the Harz, and Italy were laid under contribution as well, "for the mineralogist must be like a stag, and browse irrespective of frontiers."

Early in his studies Goethe felt his weakness on the scientific side, and to remedy it caused W. Voigt to be sent to Freiberg. Voigt on his return instructed him in nomenclature, and he began to arrange and label his collections, for "every properly recorded observation is invaluable to posterity." His activity as a collector soon impressed on him the importance of good maps, and the interest thus stimulated led to the preparation of a mineralogical map of the Ilmenau district, subsequently extended to neighbouring regions. It bore further fruit in several practical suggestions as to the best method of printing and colouring such maps. The colour scheme employed to-day is in essentials that proposed by him.

Perhaps Goethe makes his greatest claim to be considered a geologist by his attitude towards the problem of the history of the earth. Living at a time of conflict between Neptunists and Vulcanists, his mind was too well balanced to allow him to become a bigoted partisan or the slave of a hypothesis. The uniformity of nature was his watchword, and he never lost sight of this principle, whether discussing the erratic blocks of Northern Germany or the basalts of Bohemia.

At the conclusion of his review of Goethe's essays in mineralogy and geology, Prof. Linck asks the pertinent question, Are such studies to be put aside with a smile and a shrug of the shoulders as the well-meant efforts of an amateur and nothing more? Prof. Linck thinks not. He points out that many contemporaries well qualified to judge thought highly of the work, and he holds that Goethe is justly entitled to an honourable place among the pioneers in mineralogy and geology. We venture to think that anyone who follows the case presented in his pages will endorse his verdict.

THE CHEMICAL STRUCTURE OF CELLULOSE.

Researches on Cellulose, II. (1900–1905). By C. F. Cross and E. J. Bevan. Pp. xi+184. (London: Longmans, Green and Co.) Price 7*s*. 6*d*. net.

IN the course of their extended researches on the chemistry of cellulose, the authors of this work have gradually become dissatisfied with all the numerous attempts which have from time to time been made to represent the chemical structure of this substance by means of ordinary constitutional formulæ. The fundamental basis for such a representation—the knowledge of the molecular weight—has always been and is still lacking, and in its absence the chemist has perforce limited himself to endeavouring to assign a chemical constitution to some comparatively small unit containing six, or some multiple of six, carbon atoms, and has usually regarded the complete unknown molecule of cellulose as a polymeride of this. A certain measure of success has attended these efforts, particularly as regards the relation of the final products of such processes as nitration or hydrolysis to the original "unit."

The authors, however, consider all such formulæ to be totally inadequate to express the greater number of the chemical changes which cellulose is capable of undergoing. In place of the purely chemical idea of cellulose as a complex polymeride of preformed groups of rigid configuration, they propose to substitute the conception of cellulose as a colloidal aggregate which may be considered to react "as a labile complex of groups of varying dimensions representing a state of matter somewhat analogous

to that of a saline electrolyte—that is, it reacts rather as a solution-aggregate than by a succession of molecular combinations; the masses actually reacting following the stoichiometrical ratios proper to the dimensions of these ultimate groups, and retaining their relationship in the aggregate, which is thus progressively modified by the entrance of the new groups" (p. 7).

Owing to the prevailing ignorance as to the nature of colloids and the relation of this condition of a substance to its chemical character, both the language and the ideas employed by the authors in the development of their thesis are, as they themselves admit, somewhat vague, and it is difficult to realise exactly wherein lies the advantage of the new standpoint over the old view of cellulose as a highly complex molecule, coupled with the recognition of the fact that both the parent substance and many of its derivatives are only known as colloids. There can, however, be no doubt that sufficient attention has not hitherto been paid to this cardinal fact of the colloidal character of cellulose, and the authors do good service by insisting upon it and showing very clearly how this conception may serve to suggest many hopeful lines of investigation on questions of scientific and technical importance.

The first section of the book contains the development of these ideas, together with a general account of the chemistry of cellulose. In the second section are brought together the more important researches on the subject of cellulose which have appeared during the period 1900–5. An impartial abstract of each investigation is given, followed by critical notes on the bearing of the results on the great question of the chemical structure of cellulose. The third and concluding section deals with the progress made on the technical side of the subject during the same period. This book therefore forms a supplement to the two volumes which have preceded it, but it is valuable, not merely as a compendium of the latest researches on cellulose, but much more as a thoughtful and suggestive contribution to our knowledge of the chemical and physical structure of this important natural product. ARTHUR HARDEN.

OUR BOOK SHELF.

Cours d'Astronomie. Première partie: Astronomie Theorique. By H. Andoyer. Pp. 221. (Paris: A. Hermann, 1906.) Price 9 francs.

THERE is no preface to explain the scope of Prof. Andoyer's book, but it appears to consist of the notes of a course of lectures on spherical astronomy. Now, it is characteristic of lecture-notes to offer definitions in place of explanations; also, they have a tendency to disintegrate into a bewildering array of unconnected problems. The book has these defects. But as an exposition of the art of manipulating the very cumbersome formulæ of spherical trigonometry which pervade astronomy, it will fulfil a useful purpose. The mathematical treatment is good and concise; moreover, the problems treated are mostly of a severely practical character. The author has wisely taken as his guide the Connaissance des Temps; he refers to it continually, and there is very little in the book which has not some direct bearing on the use or construction of its tables.

The usual subjects are fully treated, refraction, parallax, aberration, precession, and nutation; there is a brief account of motion in an ellipse. The chapter on the geocentric motions of the planets is not very satisfactory; the student who has followed the lengthy investigations of the preceding chapters might safely have been offered something more advanced and more approximate to the practical problem than the very rudimentary theory here given. The apparent motion of satellites is in like manner inadequately treated. The last chapter, which deals with eclipses, is, perhaps, the best feature of the book; solar eclipses are treated in a very thorough and interesting way. The general accuracy and precision of the book are admirable; the approximations and assumptions made are always clearly stated. Occasionally, however, precision is carried to excess, as, for instance, when the proper motion of Arcturus is given in seconds per *tropical* year (p. 141).

It is a pity that the book is not *printed* in the usual way. It appears to have been reproduced in facsimile from the written manuscript. This is a needless sacrifice of clearness, and must to some extent diminish its value as a book for reference. A. S. E.

Les Révélations de l'Écriture d'après un Contrôle scientifique. By Alfred Binet. Pp. viii+260. (Paris: Félix Alcan, 1906.) Price 5 francs.

IN this book M. Binet, the well-known experimental psychologist of the Sorbonne, describes an investigation of the art of telling intelligence and character from handwriting. After some preliminary inquiries to ascertain how far "graphologists" are able to recognise sex and age by means of writing, M. Binet submitted to several experts specimens of the handwriting of people of great intellectual eminence, such as Renan, Dumas *fils*, and Claude Bernard, together with others obtained from persons known to be of ordinary intelligence. The general result was to show that, though the experts were more often right than wrong, they were liable to the grossest errors, as in one case in which Renan was judged to be of mediocre and uncultivated intelligence, an opinion into which the expert appears to have been led by the repetition of a word in the sample.

In the estimation of character a similar result was obtained. This was tested by submitting to the graphologists specimens of the handwriting of notorious criminals to be distinguished from the writing of people of good moral reputation. Here again the experts were usually more or less right, but bad mistakes were made, as when a man who had murdered his mother with every circumstance of brutality was judged to be a young girl, "*douce, modeste, et peu coquette.*" In the simple distinction of the two classes of people concerned in the tests, the number of correct answers was distinctly greater than should have been expected from chance, and this preponderance of correct judgments was greater in the estimation of intelligence than in that of character; but it is not clear that clues derived from the subject-matter of the samples of writing were altogether excluded in the former case.

In M. Binet's hands the graphologists themselves became the subjects of investigation, and it may perhaps be regarded as evidence that their art has a scientific basis that some of the experts showed themselves greatly superior to others, under an experimental procedure which deprived them of many of those adventitious aids on which it is probable they usually rely.

The Cyanide Process. By Alfred S. Miller. Second edition, revised and enlarged. Pp. viii+95; with 29 illustrations. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1906.)

THIS little book may be of value in giving general ideas on the cyanide process to those who know nothing about the subject. The possessor of the book may be put in a position to understand what is meant by the various phrases with regard to cyaniding that appear in the technical Press. It is, however, the least practical of manuals, and its statements, sometimes self-contradictory and sometimes mistaken, must be accepted loosely and generally without too close examination. This is the worst that can be said of it, and if it is read cursorily there is no reason for the reader to be misled. On the contrary, he may be enabled to converse intelligently on the subject.

Highways and Byways in Berkshire. By James Edmund Vincent. With illustrations by Frederick L. Griggs. Pp. xiii+430. (London: Macmillan and Co., Ltd., 1906.) Price 6*s*.

ALL readers who are familiar with this attractive series will welcome the most recent addition to it. The style of production, the illustrations and the spirit of the author will together ensure the volume a wide popularity. Mr. Vincent is never dull, and every aspect of the country side with which he is dealing—be it historical, geological, or sociological—is made to contribute something of interest. The book will certainly serve as an invaluable companion to the reader who decides to explore Berkshire for himself, telling him what spots to seek diligently and indicating the districts that may be treated lightly. The indolent man, who eschews travel as troublesome, will be able, without leaving his armchair by the fire, now that he can have the assistance of Messrs. Vincent and Griggs, thoroughly to enjoy Berkshire scenes, make the acquaintance of Berkshire men and women, and learn the importance of the county in English history.

LETTER 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.]*

Geological Survey of Canada.

As one deeply interested in the success of the Geological Survey of Canada, I cannot but regret the letters which have appeared in NATURE concerning the appointment of Mr. Low to the directorship of the survey. As a result of these letters misapprehensions will certainly remain in the minds of the readers of NATURE concerning this appointment, which it would be impossible to dispel without a detailed statement of the full facts of the case. There are, however, two statements contained in the letter which appeared in the number of NATURE dated July 12 (vol. lxxiv., p. 245) which reflect directly on Mr. Low's character and standing, and which, in common justice to that gentleman, should not be allowed to pass unchallenged.

The first of these statements is that "party politics and not geology have been in question in regard to Mr. Low's appointment," and the second is that "Mr. Low is quite unknown in the geological world."

With regard to the first of these statements, I may say that when the Canadian Government—for reasons which it is not my purpose here to discuss—decided that they would not appoint Dr. Bell director of the Geological Survey of Canada, they proceeded to select, quite irrespective of all considerations of party politics, the best man who was available in Canada to fill that position. They accordingly offered the position in question in succession to two geologists holding chairs in leading Canadian universities. Both these gentlemen, however, preferred to retain their university connection, and declined the position. The Government then decided to promote Mr. Low, who was one of the senior field geologists on the Canadian Survey, to the position of director.

Mr. Low received his geological training at McGill University, taking at the time of his graduation honours in geology. He received his geological instruction from Sir William Dawson. After graduation he was at once appointed to a position on the Geological Survey of Canada, and was assigned the task of mapping various areas of the pre-Cambrian rocks of the northern portion of the Dominion of Canada. The work which he carried out in the region of the great lake Mistassini is well known, and he was subsequently sent by Dr. G. M. Dawson to undertake the exploration of that great tract of north-eastern Canada which comprises the Labrador peninsula. While others lost their lives in endeavouring to penetrate into the interior of this great unknown land, Mr. Low traversed it repeatedly from north to south and from east to west, and embodied the results of his work in a series of valuable reports on the geography, geology, and mineral resources of this great region, the final report being accompanied by a large four-sheet map of the whole region showing its geological structure along the various lines of traverse. We owe to Mr. Low practically everything that we know with regard to this great tract of country. His observations on the surface features of this region, which was one of the chief centres of ice dispersion in the Glacial period, are of great importance in connection with our studies of glacial geology.

On the completion of this work in the Labrador peninsula Mr. Low spent a year and a half in the investigation of the iron-ore resources of the region about the southern portion of Hudson's Bay, and more especially on the islands in the Bay, where great bodies of low-grade iron ore occur.

Still later, when the Dominion Government decided to take formal possession of the Hudson Bay region and the islands of the Arctic archipelago, they selected Mr. Low to take charge of the expedition which they sent to the north for that purpose. Mr. Low accordingly, in charge of the ship *Neptune*, pushed his way far north through the Arctic archipelago to the Arctic Sea, taking formal possession of the various Arctic islands in a cruise which lasted for sixteen months, and was accomplished to the satisfaction of the Government in every respect.

For these various northern explorations Mr. Low received the Gill award from the Royal Geographical Society.

The reason that Mr. Low's name is not more widely known in Europe is due chiefly to the fact that his contributions to the various geological magazines and transactions have been comparatively few in number, the results of his work being published chiefly in reports, both voluminous and valuable, which were made to the Geological Survey of Canada, and which are to be found in their annual volumes. These naturally are read chiefly by those particularly interested in the geology of Canada, and consequently do not reach a wide circle of readers.

Mr. Low also, it may be mentioned, is a Fellow of the Geological Society of America, a body composed solely of professional geologists, and one basing its election to fellowship solely on valuable contributions to geological science.

The above facts, I think, afford an adequate answer to the statement that Mr. Low is "quite unknown in the geological world."

In conclusion, it may be safely stated that in appointing Mr. Low to the directorship of the Geological Survey of Canada the Dominion Government has secured the services of a gentleman who has not only a sound geological training and an extensive experience in field geology, but also a gentleman of initiative and administrative ability, in the prime of life, and one whose appointment has been well received both by the geologists of the Dominion and by the representatives of the mining interests with which our Geological Survey is so closely identified.

FRANK D. ADAMS.

McGill University, Montreal, October 31.

NOTES ON ANCIENT BRITISH MONUMENTS.

I.

The Aberdeen Circles. A Letter to Dr. Angus Fraser.

DEAR DR. FRASER,

I told you when leaving Aberdeen that so soon as I had discussed the observations of the stone circles I was enabled to make, thanks to your kindness in placing your motor-car at our disposal, you should be the first to know of the results.

Here is my report. Before I refer to the observations themselves I will just say why I was so anxious to have a look at your circles. During the last year my wife and I had photographed and measured several circles in Cornwall and Devonshire. We found outstanding stones, apparently to indicate certain directions in which observations should be made from the centre of each circle. I studied the chief directions astronomically, and found that they might have been used to observe the rising places of stars and of the sun at different times of the year in each circle, and that practically the same places of star and sun rising were observed in all the circles. This indicated a general use: we were dealing with a system, and not with a chapter of accidents. Each circle might have been a town-clock and farmer's almanac combined, whatever other purpose of utility it may have served.

I gave an account of this work in my book "Stonehenge," and very briefly in a letter to *The Times* (July 30, 1906).

Now before I went to Aberdeen, Mr. A. L. Lewis, a great authority on these ancient monuments, had told me that your circles were different from those in south England. In each of your most perfect circles there is, instead of a *standing* stone outside the circle, a *recumbent* stone inserted between two of the stones of which the circle itself is composed. Not only had I got this information from Mr. Lewis, but I had had the advantage of seeing the many plans prepared for the Gunning fellowship reports by Mr. Coles, the assistant keeper of the Museum of Antiquities at Edinburgh.

The question, then, was, might the *recumbent* stones in the Aberdeen circles play the same part as the *outstanding* stones in Cornwall and Devonshire? If so, of course, they could have been used with the same object, that, namely, of indicating a direction; they would only represent a difference of design, not of purpose.

An inspection of some of the available plans suggested that in the recumbent stone and its supporters we had a special form of "cove," the direction required being indicated by a line *across the circle* perpendicular to the length of the recumbent stone.

If this were so, we should find the Aberdeen *recumbent* stones placed *at right angles* to the chief direction lines to the *outstanding* stones found in S. England; lines used for the star- and sun-places I have detailed in my book "Stonehenge," and therefore dealing with practically the same declinations; latitude and heights of hills being taken into account.

Now to settle this point it was necessary to obtain trustworthy azimuths of these directions, and of the angular height of the horizon in each direction, and it is here that I owe so much to the kindness of friends in Aberdeen which I am most anxious to acknowledge. The University authorities, represented by Prof. Macdonald, lent me a theodolite, you placed your motor-car at our disposal, and Dr. Milne was good enough to suggest circles to examine, and accompanied us to the sites.

The circles examined were Sunhoney, Midmar, Auchquhorties (Fetternear), Raes of Clune, and Old Bourtree Bush.

Friday, September 28.—Sunhoney, lat. N. 57° 8′, az. N. 46° E., horizon 4° high. These numbers are only approximations, for the recumbent stone is curved, and the horizon is covered by trees. Midmar, lat. 57° 8′, az. N. 42° E., horizon 1° 30′ high. The alignment was taken on the stone across the circle, its line of direction being, apparently, at right angles to the front surface of the recumbent stone. The height of horizon is doubtful, in consequence of trees.

Saturday, September 29.—Auchquhorties (Fetternear), lat. N. 57° 16′, az. N. 19° E., horizon 2° 30′ high (assumed half-way up the trees).

Photo. by Mr. Ritchie.

FIG. 1.—The recumbent stone at Auchquhorties, showing supporters and other stones directed to the centre of the circle.

Monday, October 1.—Raes of Clune, lat. N. 57° 5′. No measures were made, as the ground near the recumbent stone had been excavated, and the stone disturbed. Mr. Braid, who had taken much trouble to enable us to find the site, and whom we met near it, promised to make a new survey of this and the other adjoining circles for examination at some future time. Old Bourtree Bush, lat. N. 57° 3′, az. N. 270° W., horizon not measured.

Before I discuss these measurements in detail, let me say that the first result which stares one in the face is very remarkable.

The measurements of the first five circles, which were selected at random, show that two, like the restored Stonehenge, could watch the sunrise at the summer solstice. The direction line of another resembles those of a dozen circles in S. England, built, as I hold, to watch the rise of the clock-star, and the only other one measured is directed to the sunset at the equinoxes.

To enter into details. I take the magnetic variation for 1906 at 18° 30′ W.; this then has to be applied to the compass bearing to get the *true* azimuth. I also give a table of the solstitial azimuths, taking heights of hills into account, for lat. 57° :—

	True Azimuths Summer	Winter
With sea horizon	N. 41° 0′ E.	S. 44° 46′ E.
,, 1° elevation	43 40	42 10
,, 2° ,, ...	46 16	39 30
,, 3° ,, ...	48 20	36 46
,, 4° ,, ...	50 24	33 56

These values apply in a general way to both Sunhoney and Midmar. The difference of azimuth observed arises from the fact that there is, roughly, a difference of 2° in the angular height of the horizon at the two places. I attach greater weight to the measures at Midmar, as the direction was taken to a stone on the other side of the circle. It may be that this way of making the direction line "sicer" was generally taken; the plans suggest but do not prove it.

Let us, then, look at the Midmar result a little more closely. My rough measures gave an azimuth of N. 42° E. According to the above table the azimuth of the solstitial sunrise to-day, with hills 1° 30′ high, is practically N. 45° E. There is a difference of 3°.

Now in your latitude at the solstice, the sun when it rises or sets grazes the horizon for a long time; the direction of its apparent motion is only slightly inclined to the horizon. To-day it is about 27°. A change in the sun's declination due to the change in the obliquity of the ecliptic, which was greater in past times, will therefore produce a great change in the azimuth of sunrise. Thus to give figures ready to my hand, if instead of the present declination of 23° 27′ we take 23° 50′, the declination at B.C. 1000, according to Stockwell's calculations, the present azimuth of N. 44° 58′ E. (with hills 1° 30′ high) becomes N. 43° 57′ E.

Now this is a degree nearer my value of the azimuth; and if that value is not very much out, and if the recumbent stone was arranged in relation to the solstice, it is clear that the Midmar stones were set up more than 3000 years ago.

To carry this inquiry further, observations much more complete than mine, including observations of the sun with accurate time to get the astronomical bearing directly, are required. We want, too, observations in winter when the leaves are off the trees, so that the height of the horizon can be accurately measured.

To such observations *in your high latitude* I attach very great importance, since changes in direction due to the change of obliquity of the ecliptic can be considered under much more favourable conditions than in S. England in the case of circles connected with the sun at a solstice.

I pass to the azimuth N. 19° E. at Auchquhorties. In S. England, as stated in "Stonehenge," the available clock-stars were Arcturus and Capella. But this was for lat. N. 50°. How about lat. N. 57°? I find that for this latitude these two stars were the only ones available for part of the time, and, further, that Castor might have been used at another time.

In the district round Aberdeen, and especially to the westward, the height of the horizon varies greatly. How this affects the star question, and how it is needful for archæologists to take account of it, will be gathered from the accompanying diagram, which Mr. Rolston has been good enough to prepare.

To show the use to be made of it, let us take the observed azimuth at Auchquhorties, N. 19° E. With hills 2° 30′ high, we find that if a star were really in question, it must at the time of circle-building have had a north declination of 33°. This was Capella's declination about B.C. 1640, and Arcturus's about B.C. 600.

There is a difference of a thousand years, and if further inquiries show that either or both of these stars may have been used in connection with these circles, some progress will surely have been made which it seems cannot be made without it.

It will be clear that when *final* observations have been made at Midmar and other circles which may be connected with a solstice, the sun and star dates may be compared, and each may throw light on the other. For instance, if the final values for Midmar come anywhere near my provisional ones, we shall have an argument in favour of Capella as against Arcturus at Auchquhorties, for it is fair to assume that the circles in any one region, whether solar or stellar, were started at *about* the same time; at least, the evidence furnished by the Cornish monuments is in this direction.

The result of such detailed inquiries as these will do much to enable us to form an opinion touching the possibility of astronomical considerations having been taken into account by the builders of the monuments.

I wish to plead for the examination of these circles in the widest possible sense. As I have said, they may have served several purposes, some of them at present undreamt of, and in this connection I protest against the logic of those who hold that because graves have been found in them they were constructed wholly for purposes of burial, and that no other considerations were in the minds of those who set up the stones. It is the same thing as to say that because graves are found in our churches, the churches themselves were not built for the worship of God.

Photo. by Lady Lockyer.

FIG. 2.—The recumbent stone and its supporters at Auchquhorties. View from the back looking across the circle.

While I am writing to you I see in the *Scotsman* (November 8) that recent explorations at Fernworthy Circle, on Dartmoor, have shown that every inch of its area is covered with wood charcoal. "In fact, fires seem to have been kindled all over the circle, for every scoop of the pick and shovel which was removed from the floor displayed charcoal." Now this looks much more like the result of a succession of Beltaine, or other fires, year after year than of burials; and there would be the closest connection between the orientation of the circle which showed when the time of festival had arrived and the fire which proclaimed its advent.

But any way, the more uses were made of the circles the better they are worth investigating.

I have no doubt that connected with your magnificent University (and I do not forget that I am now one of you) there is, or soon will be, a strong School of Archæology, happier than most such schools in that you have a fine field of exploration at your doors, for there are 175 stone circles in your shire alone, shown in the Ordnance maps.

Now let me keep to my own parish and try to point out that a research touching the application of the orientation theory to these circles would certainly be a source of the greatest interest to the researcher.

First he would have to arrange his observations so that he could discuss the value or the futility of the theory taken as a whole; and then if the theory proved valid he would have to hunt down the use of the May, solstitial or equinoctial year and the stars used as clock-stars. The thing bristles with plots for detective stories.

What a time the alumnus of this School who has best studied the methods of Sherlock Holmes will have!

First of all, of course, he must visit the ground, that is, the circles, and among the large number he need consider, in the first instance, only those that have well-marked recumbent stones. On this point he should consult Mr. Ritchie, of Port Elphinstone, who has, I believe, photographed them all (and let me say here how grateful I am to him for the gift of several mounted prints, one of which, with his permission, I have copied above). Next, let him neglect the names, weights, and colours of the riders—I mean the stones—and simply determine the azimuth of the line at right angles to the recumbent stone taken across the circle, and the height of the horizon in that direction. Even the university theodolite is not absolutely necessary; an azimuth compass, and a "clinometer" which can go in the waistcoat pocket, will suffice for a reconnaissance.

Now for "clues."

Are the azimuths all helter-skelter, that is, distributed anyhow, among the four quarters of the circle from 0° to 359°? (If so, the culprits need not be sought among astronomers, and the orientation theory is all moonshine.)

Is an azimuth, say between N. 10° and 25° E., pretty common or quite exceptional? (If pretty common, this will strengthen the view that we are dealing with observations of a clock-star and that blind chance has nothing to do with the inquiry.)

Is there any relation between the azimuths and the amount of squaring of the stones? (If so, as the non-squared stones are most probably the oldest, if the azimuths decrease as the squaring gets more pronounced we are dealing with Capella; see diagram.)

Is there another group of azimuths between N. 40° and 48° E.? (If so, as this is the solstitial alignment, it will strengthen the astronomical view.)

Are there any azimuths about N. 58° E.? The rising place of the sun at the beginning of May at the Beltaine feast? (If not, we have an argument against great age, as the oldest sun alignments in Cornwall and along the west coast deal with the May-year.)

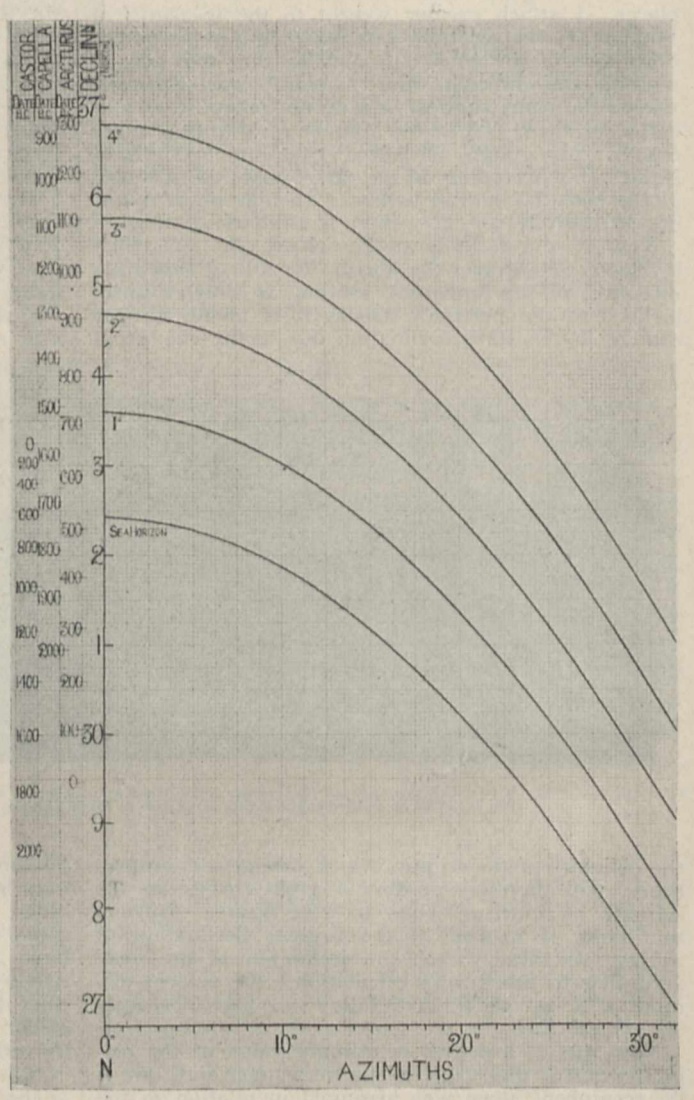

FIG. 3.—Showing the dates at which the stars Arcturus, Capella and Castor rose at the azimuths indicated, the heights of the horizon being taken into account.

Is the Aberdeen form found anywhere else? (If so, the other regions in Europe or elsewhere to which it is common may be regarded as in some way connected with the form.)

Is it a general rule that the heights of the stones decrease from the recumbent stone to the opposite side of the circle? (If so, the relation of this to the naos at Stonehenge must be considered.)

I hope I have succeeded in showing you that there are many points of great interest connected with

your Aberdeen stone monuments which are well worth investigation.

I hope, also, that Aberdonians will see that the necessary work is done. How I wish I could be with you to help in it, and renew the pleasures you allowed my wife and myself to feel, going about among the relics of a long bygone past in your most modern motor car.

Always sincerely yours,

NORMAN LOCKYER.

APPLICATIONS OF THE MICROPHONE PRINCIPLE.

AN interesting booklet upon applications of the microphone principle has been written by Messrs. Jensen and Sieveking, of the physical laboratories in Hamburg and Karlsruhe.[1] By the term "microphone principle" the authors mean all those phenomena which are due to the change of ohmic resistance between loose contacts. The memoir contains a very exhaustive collection of what is to be found scattered in scientific literature from the time of Munck of Rosenschoeld, to the present day. The explanation that in loose contacts the nearer approach of the particles resulting from the application of pressure is the cause of the diminished resistance observed, is ascribed to du Moncel and Beetz, who gave it almost simultaneously, though independently. Among the early practical applications of this property of loose contacts was Hughes's induction balance, which is so well known that no lengthy reference need be given here. A less known though also interesting application may, however, be mentioned, namely, the demonstration of nodes and antinodes in acoustic waves in cylindrical vessels. By lowering a small microphone into the cylinder, Fossati succeeded in locating the position of the nodes and antinodes by means of a telephone receiver connected with the microphone. The sound waves impinging against the loose contacts produce a rasping sound in the telephone, which vanishes when the microphone reaches the position of a node. In a darkened room minute sparks may be seen between the microphone plates when the microphone is in the position of an antinode.

Another acoustic application of the microphone made quite recently by Hebb is the determination of the velocity of sound. He uses two parabolic mirrors facing each other, and placed on the same axis. The one is fixed, and the other can be moved to a greater or lesser distance. In the focus of the first or fixed mirror is placed a tuning fork and a microphone, in the focus of the movable mirror a second microphone. The secondary of an induction coil having two primary windings is connected to a telephone. The primary windings are connected each with a battery and one of the microphones. The sound waves of the tuning fork act directly on the microphone next to it, and the reflected sound waves on the microphone in the movable mirror. It is easy to see that the loudness of the tone given out by the telephone depends on the frequency of the tuning fork, the distance between the two mirrors, and the velocity of sound. If both microphones receive antinodes at the same time, the tone is loudest, and if there is a phase difference of half a period between them the tone is weakest. Now the phase difference depends on the distance between the mirrors, the length of the acoustic wave, and the frequency. By first carefully determining the latter, and then finding the position of strongest and weakest sound, Hebb was able to determine with great accuracy the velocity of sound. He found it to be 331.29 metres, the probable mean error being only 0.04 m.

The attempts to use the microphone in seismography do not seem to have led to any practical or trustworthy result. Rossi, in 1887, used a microphone consisting of a silver plate and pointed lever in his underground observatory near Rome, and noticed that the telephone gave out sounds which were unmistakably the effect of seismic movements, and when afterwards the apparatus was tranferred to Vesuvius and came under Palmieri's observation, a general agreement between the sounds in the telephone and the records of the seismograph was observed, but the difficulty of separating sounds due to other causes seems to have stood in the way of further developments. Nevertheless, the authors think that the microphone may be made a seismographic instrument of great sensitiveness.

An ingenious application of the microphone for the detection of fire-damp has been made in France by Hardy. If the sound waves of two pipes of equal pitch impinge on microphones connected in series with a telephone a clear note is heard, but if one of the pipes emits a but slightly different note there will be beats heard in the telephone. Now if one pipe is on the bank and the other underground, the latter, if there be fire-damp, will be blown with air of a different density and emit a different note. The telephone, by sounding beats, will then give warning of the presence of fire-damp. The apparatus when tested with coal gas showed great sensitiveness. An admixture of but 0.1 per cent. gave three beats in twenty seconds, and an admixture of 1 per cent. gave thirty beats in twenty seconds.

The memoir deals very fully with the use of the microphone in telephony, including the production of graphic records such as are given by the instruments of Nernst, Lieben, Poulsen, and others. Also the use of the microphone in wireless telephony is touched upon. The most directly useful part of the memoir is, however, a very full account of the work done by a large number of experimenters in order to ascertain the best composition of the material forming the loose contact of the microphone, its mass, area of contact, specific pressure, and other determining factors as regards strength and clearness of sound.

The connection between the microphone and wireless telegraphy is not obvious, and the authors deal with this part of their subject very briefly. One sentence is, however, so interesting that it may, in conclusion of this short review, be quoted verbatim. The authors say:—"Already in 1879 Hughes has used the influence of spark discharges on microphonic resistances for wireless telegraphy over a distance of 400 meters."

GISBERT KAPP.

[1] "Anwendungen des Mikrophonprinzips." By Chr. Jensen and H. Sieveking. (Hamburg: Graefe and Sille.)

SIR EDWARD J. REED, K.C.B., F.R.S.

THE death of Sir Edward James Reed on November 30 brought a long, useful, and highly distinguished career to a close. He was in his seventy-seventh year—full of activity, with mind as vigorous, and interests in life and work as keen, as ever. He was an active worker to the end. For the greater part of the last half-century he was the most prominent naval architect of his time. His influence during that long and important period in the progress of naval construction was one of the most potent forces that shaped its development and improvement. That influence was exerted, not only by his work and teaching, but also by constant and earnest efforts from his earliest days to promote the scientific education and training of young men

for the pursuits of naval architecture and marine engineering, and to raise the scientific standard and professional status of those important branches of engineering.

Edward James Reed was born at Sheerness in September, 1830. He received a thorough practical training in the Royal Dockyard there, and was afterwards a student of the School of Mathematics and Naval Construction in Portsmouth Dockyard, where he received the highest education in the science of naval architecture that was obtainable in this country. On passing out of the Portsmouth school he was given a subordinate appointment in Sheerness Dockyard, but he resigned this in 1852, and went out into the world to seek his fortune. He became editor of the *Mechanics' Magazine*, and soon began to play an active part in literary and scientific circles. One of his greatest services to the cause of naval science was rendered in connection with the foundation of the Institution of Naval Architects in January, 1860. This would hardly have been practicable, at that time, but for the devotion and ability with which Mr. Reed performed the onerous duties of honorary secretary during the period of organisation, and those of secretary for three years after.

Mr. E. J. Reed was appointed Chief Constructor of the Navy in July, 1863. This appointment followed upon proposals he had made some time before for improving the design of ironclad ships. The earliest ironclads of the *Warrior*, *Minotaur*, and other classes were found to be imperfect and unsatisfactory, and Mr. Reed proposed a radical change of design by limiting the armoured portion of the hull to what was merely sufficient for the proper protection of its vital parts—such as the compartments containing the boilers, machinery and magazines, the gun battery, the rudder head and steering gear, and the waterline area before and abaft the gun battery. This became famous as the "belt and battery" system, and it is, in principle, the system adopted in the design of battleships and armoured cruisers to-day. It enables the thickness of armour to be increased to a maximum upon a given size of ship, and admits of the application of thick armour to ships of smaller dimensions than would otherwise be requisite. The wooden ships *Enterprise*, *Favourite*, and *Research* were ordered by the Admiralty to be converted in accordance with Mr. Reed's proposals in 1862, and the design of the *Bellerophon* followed immediately after he took office in 1863. The last-named was the first of a continually progressive series of historical ships that led in direct line to the last of our armourclads which fought their guns upon the broadside; while the *Devastation*, the last battleship designed at the Admiralty by Sir Edward Reed, is the first in the series of sea-going battleships, the heaviest guns of which are placed in turrets on deck, which now reaches its latest development in the *Dreadnought*. In these typical designs the lines which future progress in battleship design would take are clearly indicated. The design of the structure of the hull in the *Bellerophon* was novel and ingenious. It has been followed in all subsequent battleships and cruisers for the British Navy, and adopted all over the world. An important factor in Mr. Reed's success at the Admiralty, which the writer frequently heard him mention, was that he had as his principal assistants Messrs. Barnaby (his successor for fifteen years as Chief Constructor of the Navy), Barnes, and Crossland, the best of his old fellow-students at the Portsmouth school. He always said that without the aid of men of the highest scientific and technical training, as they were, his achievements would have been impossible. The value of their scientific knowledge and ability in dealing with the new and difficult problems in naval construction that were then continually presenting themselves for solution was so manifest as to furnish one of the strongest proofs to the Board of Admiralty of the necessity of maintaining an efficient school of naval architecture.

Space will not admit of detailed reference to Mr. Reed's work at the Admiralty during the seven years 1863–1870, but evidence of his great activity and energy there, and of the scientific value of his work, may be found in the Transactions of the Institution of Naval Architects for those years. He left the Admiralty in July, 1870—as the result of the non-acceptance of his views respecting the height of freeboard requisite for sailing ironclads the principal guns of which were placed in turrets on deck—and practised as a naval architect from that time almost to the last day of his life. Almost immediately after he left office the correctness of his views with regard to low-freeboard sailing ships was proved in a tragic manner by the loss of the *Captain*. He was held in high repute all over the world, and designed famous warships for the German, Japanese, Chilian, and other foreign Governments. The last of these with which the long-familiar name of Sir E. J. Reed is connected are the *Libertad* and *Constitucion*, built for the Chilian Government by the Elswick and Vickers firms respectively, which now form part of our own navy under the names *Triumph* and *Swiftsure*. These ships have attracted much attention in naval circles because of the high speed and great fighting power they possess upon comparatively moderate dimensions, and they have proved most successful on service. Sir Edward Reed was also naval architect for the Indian Government and the Government of the Crown Colonies, and designed many successful ships of various classes for those Governments.

Sir Edward Reed was a strenuous advocate, as we have said, of scientific and technical education. The School of Naval Construction at Portsmouth, at which he was educated, was abolished by the Admiralty in 1853, but he joined with other leading members of the Institution of Naval Architects in 1863 to urge upon the Admiralty the necessity for establishing another school for the scientific training of young naval architects and marine engineers for the Admiralty service, and also for the mercantile shipyards of the country. This action resulted in the foundation of the Royal School of Naval Architecture and Marine Engineering at South Kensington in 1864, to which most of the leading naval architects and marine engineers of to-day owe their scientific training. Mr. Reed, as Chief Constructor of the Navy, never failed to promote the interests of this school. He was one of its best and most popular lecturers; and those who passed through the school at that time owe to him their first appointments to responsible posts, in which their qualities could be tested, and their early professional advancement.

In 1873 Sir Edward (then Mr.) Reed contested unsuccessfully the Borough of Hull at a Parliamentary election. He was returned for the Pembroke Boroughs in 1874 and for Cardiff in 1880, and sat continuously in the House of Commons from 1874 to 1895, and from 1900 until last year, when he retired from Parliamentary life. He was made a C.B. in 1868 and K.C.B. in 1880, and served as member, and sometimes as chairman, of many important committees. He was chairman of the Load-line Committee of 1884, which first made legislation for regulating the depth of loading of ships successful in practice, and of the Manning of Ships Committee of 1894. He was also the Government Commissioner

who investigated the cause of capsizing of the *Daphne* in the Clyde in 1883. Sir Edward was one of the Lords of the Treasury in Mr. Gladstone's Government of 1886.

Sir Edward Reed was elected F.R.S. in 1876. He sat upon the council of the Institution of Naval Architects from 1863, when he retired from the secretaryship, until his death, and upon the council of the Institution of Civil Engineers from 1883 to 1896. He was the recipient of very high Russian, Austrian, Japanese, and Turkish honours and decorations. Among the works published by him are:—"Shipbuilding in Iron and Steel," 1869; "Our Ironclad Ships," 1870; "Letters from Russia in 1873"; "Japan," 1880; "The Stability of Ships," 1884; "Modern Ships of War" (in collaboration with Admiral Simpson), 1885; "Fort Minster, M.P.," a novel, 1885; "Corona and other Poems," 1857; and "Poems," 1902. He was also the author of numerous papers in the Transactions of the Institution of Naval Architects and other professional institutions, and of two important papers, "On the Relation of Form and Dimensions to Weight and Material in the Construction of Ironclad Ships," which were communicated to the Royal Society by the late Sir George Stokes, and are published in the Philosophical Transactions of 1868 and 1871. He was also the proprietor and editor of the quarterly magazine *Naval Science* from 1872 to 1875, and contributed many articles to its pages.

The subject of this imperfect memoir was not merely a great naval architect, but a man richly endowed by nature with many and varied gifts. He was cheerful and sanguine in disposition, with an attractive and impressive personality, and unusual force and independence of character. He was lucid, graceful, and fluent of speech, and one of the ablest and most effective speakers and controversialists of his time. He long commanded public attention as man of science, politician, orator, and author, and in the last-named capacity he had the unique distinction of earning laurels in fields so far removed from those of his severe professional labours as poetry and romance. No one was more popular or more genuinely admired among his professional brethren and children for his great abilities and accomplishments, and his genial and sociable nature, than the late Sir Edward Reed. FRANCIS ELGAR.

NOTES.

A REUTER message from Stockholm states that the formal distribution of the Nobel prizes took place on Monday evening. Prof. Moissan, Prof. Thomson, Prof. Golgi, and Prof. Ramon y Cajal each received the prize diploma and a gold medal from the King of Sweden in person. Each prize this year amounts to 7659*l*. Prof. Thomson's prize is awarded to him for his researches extending over many years into the nature of electricity, and Prof. Moissan's for his experiments in the isolation of fluorine, his researches regarding the nature of that element, and for the application of the electric furnace to the service of science. Profs. Ramon y Cajal and Golgi are bracketed for the medicine prize on account of their works dealing with the anatomy of the nervous system.

THE Government geologist of South Australia reports that the discovery of corundum in the Farina district is likely to be one of considerable value. The corundum occurs in metamorphic schist, the proportion in the rock amounting in places to 10 per cent. to 25 per cent.

THE American mail brings the announcement of the death, on November 23, of Dr. William H. Chandler, emeritus professor of chemistry at Lehigh University, at the age of sixty-five years. Dr. Chandler taught for many years in the Columbia School of Mines, and was the author of several important works.

IN an article in the *Pall Mall Gazette* (December 10) with the somewhat sensational title of "The Approaching Conquest of Cancer," Dr. Saleeby states that several cases of cancer have been cured or much improved by injections of trypsin, one of the pancreatic ferments, a method of treatment suggested by Dr. Beard, of Edinburgh. Even if this be correct, however, it by no means follows that cancer is to be conquered in the near future, and the premature publication of such details as these in the public Press serves no useful purpose.

MR. W. R. BUTTENSHAW, who has been scientific assistant on the staff of the Imperial Department of Agriculture for the West Indies during the last four years, has been offered the post of botanist in the Agricultural Department of India. He will vacate his present post as soon as his successor has been appointed.

THE annual conversazione and exhibition of new apparatus arranged by the British Electrotherapeutic Society will be held in the small Queen's Hall on Friday, December 14, from 7.30 p.m. to 10.30 p.m. The exhibition will be open from mid-day.

WE learn from the *Chemist and Druggist* that a wealthy landed proprietor named M. Audrac, who died recently at Le Luc, near Draguignan, has left the Pasteur Institute the whole of his fortune, valued at the equivalent of 50,000*l*. at least. Interviewed on the subject, Dr. Roux, the distinguished director of the institute, stated that he had received a visit from a lawyer, who informed him that a will had been found bequeathing the whole of the property to the institute. The reserve, however, was made that another document might possibly come to light making various bequests or otherwise disposing of part or whole of the property; consequently, Dr. Roux says that some time must elapse before the Pasteur Institute can know definitely how it stands with regard to the inheritance.

BY the death of Mr. John Ward, of Longton, Staffs, British geology has lost one of those quiet, earnest workers who, in the midst of their other duties, achieve so much for science. Mr. Ward was an original member of the North Staffordshire Field Club, and one of the most regular and valued contributors to its Transactions. In 1874 he was elected a Fellow of the Geological Society of London, and in 1898 he was the recipient of an award for his work upon the fossil fauna and flora of the North Staffordshire Coalfield. As a collector, Mr. Ward was the happy possessor of a splendid enthusiasm tempered with sound knowledge; a large part of his collection of Coal-measure fishes is now in the British Museum (Natural History). While attending to the conduct of his business and devoting his spare time to geology, Mr. Ward yet found it possible to take a prominent part in the duties of citizenship. He will be missed greatly by students of Carboniferous faunas, not in this country alone, but by his numerous friends abroad.

THE following telegram, dated Bombay, November 29, has appeared in the public Press:—"Dr. von Lecoq, a scientific emissary of the Prussian Government, has arrived safely at Srinagar after a journey through the most remote parts of Central Asia. He has brought with him a quantity of highly interesting paintings on stucco, the backgrounds in many cases being of gold leaf as in Italian

work, and a number of manuscripts in ten different languages and one wholly unknown tongue. Dr. Lecoq's discoveries probably constitute the greatest archæological find since the days of Layard and Rawlinson." Dr. von Lecoq will probably not be over-pleased with the last sentence of this telegram, for the wording of which he of course is not responsible. He had been sent to explore sites in Chinese Turkestan like those discovered by Dr. Stein some years ago; Dr. Stein published his discoveries in his well-known book "Sand-buried Cities of Khotan" (reviewed in NATURE of July 21, 1904, vol. lxx., p. 275). Dr. von Lecoq has evidently trodden successfully in Dr. Stein's footsteps, and has, judging by the description in this telegram, found antiquities of the same type as those brought back by the earlier explorer, and now exhibited in the British Museum. To compare with the epoch-making discoveries of Rawlinson and Layard the work even of the pioneer of the archæology of Turkestan, Dr. Stein, would show great want of a sense of proportion. Such comparisons are always odious, and often, as in this particular instance, simply silly.

THE eighteenth annual dinner of the Institution of Electrical Engineers was held on December 4. The president, Dr. R. T. Glazebrook, F.R.S., presided over a distinguished company. Mr. H. Babington Smith, who proposed the toast of "The Institution of Electrical Engineers," pointed out the good which has been done by the visit of foreign friends in the summer, one of the results of which was the establishment of the International Commission for the Standardisation of Electrical Nomenclature and the Rating of Electrical Machinery under the auspices of the Institution of Electrical Engineers. The recent growth of wireless telegraphy was then compared with that of what might be called ordinary telegraphy. In 1825 a telegraph line was laid for a distance of about eight miles, and this might be regarded as the starting point of ordinary telegraphy. Little advance was made during the next ten years, and it was more than forty years before telegraphy across the Atlantic became practicable. Wireless telegraphy, on the other hand, was put into practical application in less than ten years from its beginnings, and the crossing of the Atlantic will probably be satisfactorily accomplished in less than forty years. The president, in replying, referred to the tablet recently unveiled by Lord Kelvin in memory of Michael Faraday in the building (formerly a chapel in which Faraday worshipped) of the National Telephone Company at Barnsbury, London, N. It is seventy-five years since Faraday first published a description of his original magneto-electric machine. Progress has indeed been great since then, especially during the last few years. The basis upon which the subject rests has been firmly established by Faraday's disciples, Kelvin, Maxwell, and others, and the progress has been great because the efforts of scientific and practical men have been combined in due proportions. Lord Justice Buckley proposed "Science and Industries." Sir Arthur Rücker, in responding, said that science and industry are mutually supplementary. The general view, no doubt, is that industry follows rather from science, and the corresponding view is that science follows from industry. There is an element of truth in both views. Very frequently, indeed, great scientific discoveries follow from the efforts of those who are interested in industry. The two things are best closely combined.

IN No. 1496 of the Proceedings of the U.S. National Museum (vol. xxxi., pp. 569–591) Mr. M. Ward Lyon points out that the great anteater inhabiting Central America, for which he proposes the name *Myrmecophaga centralis*, is readily distinguishable from the typical *M. tridactyla* (or *jubata*) of Brazil by skull-characters. As shown in the plate accompanying his paper, the most distinctive difference between the skulls of the two forms is to be found in the degree to which the frontals interpenetrate the nasals, the dissimilarity in this respect being very great. It was only to be expected that detailed examination would reveal local differences in a type ranging from Guatemala to Brazil.

No. 1495 (vol. xxxi., pp. 539–568) of the Proceedings of the U.S. National Museum is devoted to a detailed description, by Mr. A. Hrdlička, of a collection of twenty-six skulls of the orang-utan obtained by Dr. Abbott in western Borneo, twenty-four of these coming from the Sakaiam River district in Landak. Some difficulty was experienced in determining which specimens belonged to fully adult animals, the dentition affording no trustworthy evidence. The best test, in the case of males, appears to be the fusion of the temporal ridges to form a sagittal crest. After recording measurements of a number of the specimens, the author refers to various dental abnormalities, such as the presence of supernumerary cheek-teeth and the diminution in the size of the hinder molars in some female specimens.

TWO papers in the *American Anthropologist* (vol. viii., No. 2, April–June), the one by Dr. J. C. Merriam and the other by Prof. F. W. Putnam (to whom we are indebted for separate copies of both), deal with recent cave-exploration in California, and the evidence thereby afforded in favour of the existence of Pleistocene man in that State. The mammalian fauna of Mercer's, Potter Creek, and Samwel Caves (which appear to be the most important of the group) has been described in various papers by Messrs. E. L. Furlong and W. J. Sinclair, who have recorded remains of the ground-sloth Megalonyx and of two remarkable new genera of ruminants, Preptoceras and Euceratherium, which seem to show evidence of affinity both with the musk-ox and with the Himalayan and Tibetan takin (Budorcas). In some of these caves it appears to have been the custom of the natives to throw in the bodies of their deceased relatives, and the bones remaining from these appear to be younger than those of the ground-sloth fauna. The most important evidence of the coexistence of man with the latter is afforded by certain polished and pointed bones, a small percentage of which are perforated. Many of these bones recall those found in the shell-mounds, although they are less rough, and some may be portions of Euceratherium skeletons. Stone-payments showing unmistakable evidence of man's handiwork occur in the caves, and in Prof. Putnam's opinion these are probably of Pleistocene age. According to the same authority, two perforated bones figured in his paper "are sufficiently important to warrant the belief that man inhabited the vicinity of the caves at least as early as the latter part of the Quaternary period."

PROF. KELLOGG, of the Stanford University, gives in *Science* of November 23 a short account of a preliminary investigation conducted by Miss L. Ramsay under his direction as to assortative mating, in nature, between individuals of different varieties of the lady-bird *Hippodamia convergens*. The investigation was interrupted by the great earthquake, but from sixty cases noted it is concluded that the matings are "wholly non-selective; they are chancé matings." This conclusion is not, however, quite in accordance with the numbers given in the text,

which, so far as they go, indicate a certain degree of homogamy, and it is to be hoped that the investigation will be taken up again next year with the view of obtaining sufficient observations to warrant a more confident conclusion.

A PRELIMINARY notice of the Ramie Growing Association, formed with the object of fostering the industry in this fibre, has been received from the honorary secretary, Mr. D. Edwards-Radclyffe.

THE list of seeds of hardy herbaceous plants and of trees and shrubs available from Kew for exchange with botanic gardens has been published as the first appendix to the *Kew Bulletin* for 1907.

IN view of the fact that there is an import trade of sugar into India exceeding a quarter of a million of tons per annum, it is difficult to realise that nearly one-fifth of the world's output of sugar is produced in the Indian Empire chiefly from the sugar-cane and also from certain palms. In the course of an article on the subject in *Tropical Life* (November), the annual production in India is roughly computed at three million tons, and if more efficient methods of extraction were adopted this amount could be largely increased. Among various references to rubber in the journal, a note on block rubber indicates the advantages attending this method of preparation over the previously belauded biscuit, and an article on Ceara rubber refers to the hopeful expectations of establishing the tree in various parts of southern India. A short account of Mr. W. Fawcett's efficient work in Jamaica accompanies his photograph that is presented in this number.

A FLORA of the State of Washington, prepared by Mr. C. V. Piper, forms vol. xi. of the Contributions from the United States National Herbarium. Partly owing to the seaboard position of the State, the flora presents numerous ecological features of interest that are described at some length and lavishly illustrated. Six important zones are distinguished, the upper Sonoran area coextensive with the sagebrush, *Artemisia tridentata*, the humid transition where the red fir, *Pseudotsuga mucronata*, is dominant, the arid transition area characterised by prairies of *Agropyron spicatum* or forests of *Pinus ponderosa*, a Canadian zone where *Pinus monticola* grows, a Hudsonian or zone of *Abies lasiocarpa*, and an Alpine region. The systematic enumeration shows a preponderance of Compositæ, in which order Senecio is an important genus; among other large orders, Castilleja, belonging to the Scrophulariaceæ, Lupinus and Phaca, to the Leguminosæ, are characterised by a considerable proportion of endemic species.

THE current issue of the Records of the Geological Survey of India (vol. xxxiv., part ii.) contains the statistics of the mineral production of India during 1905, by Mr. T. D. La Touche. The total value is given as 5,707,956*l*., which is 350,116*l*. in excess of that for 1904. Nearly every item shows an increase. Gold, with a value of 2,416,966*l*., takes the first place, and coal, with a value of 1,436,951*l*., the second. The output of coal, 8,417,739 tons, has again exceeded all previous records. Other minerals for which returns of production are given are, in order of importance, petroleum, salt, saltpetre, manganese ore, mica, rubies, jadestone, graphite, iron ore, tin ore, chromite, diamonds, magnesite, and amber. Incomplete returns are given for alum, arsenic ore, bauxite, borax, building stone, clay, copper ore, cornelian, corundum, garnet, gypsum, limestone, marble, slate, steatite, and tourmaline. In the same issue Mr. E. Vredenburg gives a detailed account of *Nummulites Douvillei*, an undescribed species from Kachh, named in honour of the geologist whose researches on the Foraminifera have thrown so much light on the classification of the Tertiary system. The paper concludes with a summary of the zonal distribution of Indian Nummulites. Mr. J. Malcolm Maclaren gives a detailed description of some auriferous tracts in southern India, in territory under British administration or within the Nizam's dominions. The paper is accompanied by a coloured geological map of the Gadag auriferous belt, Dharwar district. In this goldfield the extensive old workings are of great interest. Numerous small vertical shafts, 4 feet square, were sunk by the ancient workers to the dip of the veins, often not cutting the vein until the shafts were 80 feet in depth. The veins were then followed on the underlie with great assiduity to a depth of at least 300 feet. Abundant relics of mills for crushing quartz exist. Those of most frequent occurrence were essentially rock-breakers, in which the quartz was broken to the size of a walnut. They are depressions 6 inches wide and 4 inches deep in hard rock. Into these mortars there fitted rude stone pestles 9 inches long, and sufficiently thick to be grasped in the hand. The Gadag goldfield is exceptionally well situated for economic working, and is of special geological interest in the occurrence of its gold-quartz veins in argillites. In the last paper Mr. R. R. Simpson records the abandonment of the collieries worked by the Government of India at Warora, Central Provinces, in consequence of a serious subsidence that took place on March 28.

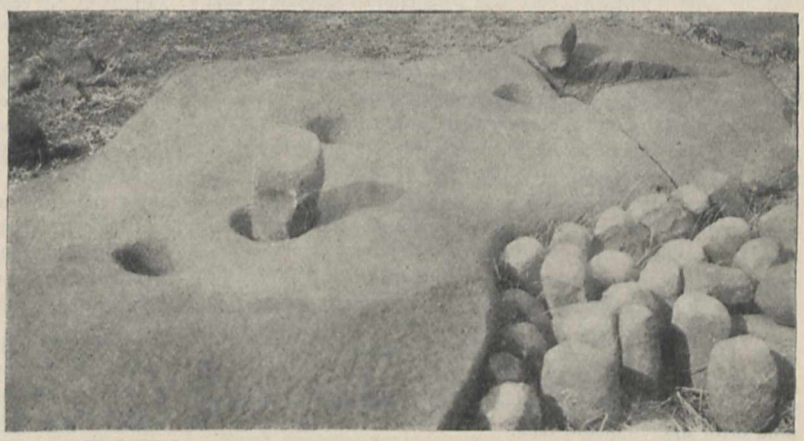

Photo. J. M. Maclaren.

Ancient Rock Mortars, with Pestles, near Sangli Mines, Gadag.

FATHER GUTIÉRREZ-LANZA, S.J., assistant director of the Belén Observatory, Havana, writes taking exception to the statement in these Notes, in NATURE of October 25 (vol. lxxiv., p. 642), that the great hurricane of October 17 had burst over Cuba "apparently with little or no warning." The note was based on the cabled reports, which stated that Father Laurent Gangoiti had telephoned to Columbia Camp an hour before the storm burst, announcing its

approach. From the information now supplied by Father Gutiérrez-Lanza, it is clear that both in the local newspapers and in messages to the U.S. Weather Bureau at Washington, Father Gangoiti had on October 12 announced the existence of a cyclonic disturbance south of Barbados; on October 16 that it was about 500 miles south of Havana; at 6 a.m., October 17, that it was approaching western Cuba and moving towards Florida; and at 3 p.m. of the same day that the cyclone was nearing Havana province. The storm reached the city of Havana at 10 p.m. The word "apparently" in the note was intended to cover any possible imperfections in the hurried early reports of the calamity. With the information bearing upon the predictions of the approach of the recent hurricane towards Havana, Father Gutiérrez-Lanza has forwarded an interesting brochure on "The Pioneer Forecasters of Hurricanes," by the Rev. Walter M. Drum, S.J., of Georgetown University.

In *Engineering* (vol. lxxxii., No. 2135, December 1) Mr. H. Burcharts gives illustrations of the sand-blast apparatus used for testing building materials at Gross-Lichterfelde Institute. Some results of tests are given showing that the new method gives useful information with regard to the power of resistance to wear in practical use, and to the quality of road and floor materials. The duration of the exposure to the sand-blast has, after many experiments, been fixed at two minutes, the steam-gauge indicating a pressure of two atmospheres. This short time suffices to give a good indication of the structure of the materials tested and their resisting qualities. The sand used is a natural quartz sand of fine and nearly round grains, procured by washing and drying the original sand and passing it through a sieve with 120 meshes per square centimetre, or about 774 meshes per square inch. It is the waste from the German standard sand used for testing Portland cement, the grains of which pass the sieve of sixty meshes, and are retained on the sieve with 120 meshes per square inch. Granite from Malmö lost 0·09 cub. cm. per square cm., blast-furnace slag, Bochum, 0·12, red pine 0·10, and linoleum 0·02.

Signor Guido Bordoni-Uffreduzi gives a summary of sanitary progress in Milan, accompanied by diagrams of statistics of death-rates, particularly from infectious diseases, during the past thirty years. The paper is published in the Lombardy *Rendiconti*, xxxix., 14.

Prof. Temistocle Calzecchi-Onesti, writing in the *Rendiconti* of the Lombardy Institution, xxxix., 14, regarding the discovery of the coherer, directs attention to his experiments made in 1884, before Branly had worked on the subject. He further points out the important part played by Righi in the discovery of wireless telegraphy.

In the *American Journal of Mathematics*, xxviii., 3, Mr. F. J. B. Cordeira discusses the analogy between gyroscopes and cyclones. The author considers that the oscillations of a gyroscope have a close analogy in the motions of cyclones about a position of equilibrium. It is also suggested that the frictional couple due to cyclones tends to accelerate the earth's rotation, and that the effect is cumulative, though it should be noticed that the only possible result is the transference of angular momentum between the atmosphere and earth, and that the total angular momentum of both cannot be altered.

In the Proceedings of the Royal Philosophical Society of Glasgow, under the title "Solution of Physical Problems," Prof. Andrew Gray, F.R.S., discusses two problems in the theory of attractions. The first is the determination of the attractive force between the two halves of a sphere of gravitating matter, the surfaces of equal density being concentric spheres. The problem for the case of uniform density was solved by Prof. Tait in a very simple way by considering the hydrostatic pressure on the supposition that the sphere was fluid. In the present paper three methods are considered, namely, the hydrostatic method, a method based on Gauss's well-known theorem of the flux of force over a closed surface, and a third based on a simple theorem according to which the attraction between two concentric hemispherical shells is the same as if the mass of the inner shell were concentrated at the centre. The second part of the paper consists in a re-discussion of the problem of the attractions of ellipsoids, with some historical notes and alternative methods of treatment.

The number of the Journal of the Chemical Society published on November 29 contains abstracts of several mineralogical papers. One of these (F. Zambonini) describes crystals of galena deposited by sublimation on the scoria at the edge of the crater formed as a result of the eruption of Vesuvius in April. This galena appears to owe its origin to the action of hydrogen chloride on the vapours of lead chloride. An abstract (E. Hussak) describes the bean-shaped pebbles, considered to be a good indication of the presence of diamonds, in the alluvial gravels at Diamantina, Brazil. They include two new mineral species, and consist of barium aluminium phosphate, named gorceixite; strontium aluminium sulphato-phosphate, named harttite; and lead aluminium phosphate, probably identical with plumbogummite. An abstract of a paper by Mr. A. Pauly describes a new mineral of the zeolite group from Hainburg, Lower Austria, and another (G. d'Achiardi) deals with a similar mineral from Elba.

Messrs. W. Heffer and Sons, Cambridge, have purchased the mathematical library of the late Prof. Joly, of Dublin, and the botanical library of the late Prof. Marshall Ward, of Cambridge. Catalogues of the libraries are in preparation.

We have received a copy of an important contribution to the *American Anthropologist* (vol. viii., No. 3, July–September), which has been published separately. The paper, which was presented by the American Anthropological Association to the International Congress of Americanists held at Quebec this year, deals with recent progress in American anthropology, and is a review of the activities of institutions and individuals from 1902 to 1906.

Every attempt to increase the number of people with an intelligent interest in science deserves encouragement. Our contemporary *Knowledge and Illustrated Scientific News* continues its efforts in this direction, and presents its readers month by month with accurate and interesting accounts of modern scientific work prepared by writers in close touch with knowledge in the making. In addition to illustrated articles, each issue of the magazine includes sections in which the progress made in the various branches of science is noted in correct though popular and easily understood language.

The issue of "Who's Who" for 1907 is even more complete than the edition of a year ago. Its size has been increased by nearly a hundred pages, and there are now 1958 pages of short autobiographies of persons of import-

ance in the world of work and the world of society. Prominence is given to men of science who have added to knowledge, and many foreign investigators are recognised equally with those of our own country. There is, however, a striking disparity in the amount of detail provided in the various life-histories; while in the case of some American scientific workers details are provided of each step in their careers and of their individual papers, many Fellows of the Royal Society supply the reader with next to nothing about themselves; but as a whole "Who's Who" is an indispensable work of reference, and the editor is to be congratulated upon its completeness. The tables which were formerly included with the biographies, and were, in fact, the nucleus of the book, are published separately in an extended form under the title "Who's Who Year-book, 1907."

OUR ASTRONOMICAL COLUMN.

COMET 1906g (THIELE).—A new set of elements and an ephemeris for this comet, computed by Dr. E. Strömgren, appear in No. 4138 of the *Astronomische Nachrichten*. The following is an extract from the ephemeris:—

Ephemeris 12h. M.T. Berlin.

1906	α (true) h. m.	δ (true) ° ′	1906	α (true) h. m.	δ (true) ° ′
Dec. 14 ...	12 59 ...	+53 6·4	Dec. 26 ...	14 35 ...	+58 24·6
18 ...	13 32 ...	+55 29·2	30 ...	15 2 ...	+59 13·3
22 ...	14 5 ...	+57 12·7			

On the last-named date the brightness of the comet will be about half that at the time of discovery (mag. = 8·5).

The results of a number of observations of this object appear in No. 4137 of the same journal.

COMET 1906h (METCALF).—Numerous observations of this comet are recorded in No. 4138 of the *Astronomische Nachrichten*, and an ephemeris and set of elements, calculated by Herr M. Ebell, are also given.

Observing this object with the large equatorial of the Bordeaux Observatory on November 22, M. E. Esclangon perceived two nebulosities near to his comparison star B.D. −3°·696. These objects were easily visible, and differed in shape, the first being elongated, with a length of about 30″, and the second being circular, with a diameter of about 20″. Taking α and δ as the equatorial coordinates of the star B.D. −3°·696, the coordinates of the respective centres of the nebulosities at 11h. 30m. (M.T. Bordeaux) on November 22 were

$$\alpha - 6{\cdot}4\text{s.}, \quad \delta + 6'', \quad \text{and} \quad \alpha - 5{\cdot}3\text{s.}, \quad \delta - 2'\,20'',$$

but the various settings on the second object appeared to show an hourly movement of $\alpha = +0{\cdot}7\text{s.}$, $\delta = -7''$. On November 23 M. Esclangon was unable to re-discover these nebulosities.

On receiving the news of this observation it occurred to Prof. Kreutz that the nebulosities might be companions to comet 1906h, and he therefore asked for observations of B.D. −3°·696 from several other observatories. Prof. Millosevich replied that he could find no appendices to this star, which was, however, unfavourably placed for observation, whilst at the time of publication no other observers had been able to make the desired observations.

A METEORITE IN THE ATLANTIC (OCTOBER 17).—The owners of the Prince line of steamers have received a letter, published in the *Liverpool Journal of Commerce* (November 27), from Mr. C. B. Anderson, captain of the *African Prince*, describing the fall of a meteorite observed by him on October 17. Captain Anderson says, in the course of his letter:—"On the evening of October 17 I was on the bridge with the second officer, when suddenly the dark night was as light as day, and an immense meteor shot comparatively slowly at first, because the direction was so very perpendicular to our position, then more rapidly towards the earth. Its train of light was an immense broad electric-coloured band, gradually turning to orange, and then to the colour of molten metal. When the meteor came into the denser atmosphere close to the earth, it appeared, as nearly as it is possible to describe it, like a molten mass of metal being poured out. It entered the water with a hissing noise close to the ship."

SOME REMARKABLE SMALL NEBULÆ.—In No. 4136 of the *Astronomische Nachrichten* Prof. Barnard describes, and gives diagrams of, several remarkable groups of small nebulæ which he has discovered since 1888.

In the first group there are six nebulæ, two of which were probably originally discovered by Stephan, in a circular field of 16′ diameter. The second group also contains six, two of which are remarkably small and are elongated, and several other nebulæ were suspected in the same field. From the frequency with which these groups occur associated in isolated, compact clusters, Prof. Barnard thinks there can be no doubt but that the members of each group are physically connected. Both the above groups, and two others, found in 1889 and 1890 respectively, were discovered with the 12-inch refractor of the Lick Observatory.

Another nebula, which from its remarkable shape Prof. Barnard has named the "Bug Nebula," was discovered by him, with a 5-inch refractor, in 1880. This object, as seen in the 36-inch refractor, is a triple nebula having streamers running in a north-preceding direction from the two preceding components, and two nebulous arches springing from the following component, thus giving the whole the appearance of a ghostly beetle of some kind. In the N.G.C. it is designated by the number 6302.

THE PERIOD OF β CEPHEI.—Finding that the observations of the interesting spectroscopic binary β Cephei, made during 1901 and 1902, were insufficient to fix the period with certainty, although they showed that in all probability it was exceptionally short, Prof. Frost made arrangements to obtain several spectrograms on each observing night during the past summer, and now publishes a preliminary account of the results in No. 4, vol. xxiv., of the *Astrophysical Journal*.

As many as twenty two-prism plates, with an average exposure of twenty minutes, were secured in one night, and the preliminary discussion of the total shows that the period of the star's radial velocity is probably very near to 4h. 34m. 11s. The provisional measures also indicate a range of velocity of about 34 km., from about +12 km. to −22 km.

Some speculations as to the radius of the orbital motion of the bright component and the inclination of the orbit to the line of sight suggest that the bright body must be near to the centre of gravity of the system, and they also raise the question as to whether the two components must not be nearly in contact. Indications of the second-component spectrum suggest that the difference between the magnitudes of the two bodies may be small.

If these preliminary measures are confirmed, the period of β Cephei is by far the shortest yet discovered for a spectroscopic binary star.

NEW VARIABLE STARS.—By the method of superimposing a negative upon a positive of the same region taken on a different date, Miss Leavitt has discovered twenty-eight new variable stars in the region of the Southern Cross and the "Coal-sack." Two others were discovered on a plate having the Orion nebula at its centre, and one on a plate having the Pleiades central. Prof. Pickering remarks on the paucity of variable stars in the vicinity of the Pleiades, and states that the conditions in that region seem to favour unusual constancy in light. The position and the range of variability of each of these thirty-one variables are given in Circular No. 120 of the Harvard College Observatory.

OBSERVATIONS OF PHŒBE IN 1906.—From Circular No. 119 of the Harvard College Observatory we learn that nine additional photographs of Saturn showing images of Phœbe were obtained with the 24-inch Bruce telescope at Arequipa during August and September last. These photographs have been measured, and the resultant positions of the satellite in respect to Saturn are given in the Circular.

AMERICAN GOOSEBERRY MILDEW.

MR. E. S. Salmon, the mycologist to the South-Eastern Agricultural College at Wye, Kent, is the active leader of an agitation against a mildew affecting gooseberries known as *Sphaerotheca mors uvae*. The fungus in question is of American extraction, and somehow it was introduced into Ireland about the year 1900; it has since spread, has already effected much mischief, and will undoubtedly cause more.

In Sweden it has, we believe, been very destructive, and quite recently its presence has been detected in England. Curiously enough, its introduction into Britain has been associated with the yellow-flowering currant *Ribes aureum*. This is a Californian shrub that has long been cultivated for ornamental purposes in this country, and, up to this time, we have not heard of its being subject to the attacks of mildew.

It now appears that Continental growers of gooseberries make use of *Ribes aureum* as a "stock" whereon to graft the common gooseberry. Standard gooseberries are by no means in general cultivation in this country, and we are informed that the use of *Ribes aureum* is being discontinued owing to the circumstance that it produces objectionable suckers. We do not know what object cultivators had in using *Ribes aureum* as a stock, and indeed we were not aware that it was so used until recently, but from the circumstance already mentioned that the golden-flowered currant has long been cultivated here without detriment to neighbouring gooseberry bushes, we may acquit it of anything but indirect participation in the spread of the mildew.

Still, in whatever way the pest may have been introduced, we cannot but look upon it as a serious matter. The trade in ripe gooseberries is no doubt relatively of little importance, but the prices obtained in the market for "green gooseberries" early in the season are often very high, and the market-gardener who was deprived of this source of income would suffer seriously. In face of these facts it is recommended that the importation of all gooseberry bushes, especially of those "worked on" *Ribes aureum*, be prohibited, and that all bushes known to be affected should forthwith be destroyed by fire.

It is evident that such measures could never be efficiently carried out by individuals. If one grower in any district proved negligent, all the careful ones would suffer from his default. No system of Government inspection would be sufficient to keep out the intruder. Not the keenest mycologist in the world could guarantee that no fungus spores were introduced even if the importation of gooseberry bushes were prohibited. Not the most experienced microscopist could guarantee that all the fungus spores in a particular plantation were destroyed by the cremation of the affected bushes. The spread of the Phylloxera throughout the vine-growing countries, despite the most elaborate precautions, shows how ineffective those precautions were. At the same time they caused much inconvenience and loss to the traders and others—a loss which was all the more serious, as, except in the case of vines, it was wholly unnecessary.

It is to be hoped that if legislation on the lines proposed by Mr. Salmon be carried out it will be administered with due discretion, otherwise the remedy may prove more injurious to the interests of the cultivator than the mildew itself. In the meantime the Board of Agriculture has issued a circular giving a description of the fungus and of its mode of life, directing the attention of growers to the imminence of the danger, and recommending that every precaution be taken in the purchase of the bushes, especially those from Ireland and the Continent, that all affected shrubs be forthwith burnt, and that, as a measure of precaution, spraying with Bordeaux mixture be carried out during the winter in the case of plants in any way open to suspicion. The Board states that there is at present no law dealing with the eradication of the pests of fruit trees, and that it depends very largely on the action of the dealers and of the growers whether or not the further development of the pest can be prevented.

Since writing the foregoing remarks we notice in the *Times* of December 8 that Mr. Massee has, at the request of the Board of Agriculture, visited the neighbourhood of Evesham, where he was told that the disease had existed for thirty years, "and had not affected the fruit," so that there is absolutely "no necessity for panic." Panic and discretion are at opposite poles. If we might offer advice to the gooseberry growers it would be that they should practise watchfulness and act with discretion.

RECENT PROGRESS IN MAGNETO-OPTICS.[1]

Rotation of the Plane of Polarisation close to an Absorption Band.[2]

FARADAY'S rotation of the plane of polarisation is extremely small in all gases, also in sodium vapour. Only within a very narrow range close to the sodium lines the rotation is positive and very great, a fact discovered by Macaluso and Corbino.[3] In a recent extremely interesting paper Prof. Wood has given measurements of observed rotation of four complete revolutions.[4] This, however, was in rather dense vapour, at least dense in comparison with the vapour used in the experiments now to be described, in which vapour containing about one-millionth gram of sodium per cm.[3] was used.

The magnitude of the rotation close to the sodium lines is illustrated by measurements made by Dr. Hallo in the Amsterdam laboratory. It is clear that on both sides of an absorption line the rotation is in the same direction. We may attenuate the vapour still further so that the doublet in the direction of the lines of force becomes visible. What is the rotation, then, between the components of the doublet?

It is easily deduced from Prof. Voigt's theory that in very diluted vapours the rotation must occur, in a sense, opposite to that outside the components, and therefore negatively, and also that it must be very great. In the case of sodium vapour I had the pleasure to confirm this theoretical result, and to observe rotations of $-400°$.

In these experiments interference fringes in the spectrum were used, established by means of a system of Fresnel quartz wedges (a method used by Voigt, Corbino, and others in similar cases). I will project these fringes on the screen.

If a plate of quartz, which rotates the plane of polarisation, is held in the ray, you will notice a displacement of the fringes. A plate of glass has no influence, of course. I have here a quartz plate which rotates the plane of polarisation through 90°, and you will notice a displacement of half the distance between two fringes. A displacement of the entire distance between two fringes corresponds to a rotation of half a revolution.

Analysing the light by means of a Rowland grating, we can produce such a system of fringes for all wave-lengths, and can consider the rotation for wave-lengths close to the controlling absorption bands. On the screen I will first project the fringes close to the sodium lines with the field off. The dark vertical lines are the sodium lines. They are broad, because the vapour is rather dense. The horizontal bands are the interference fringes. With the magnetic field on, the image now projected is seen.

You see how fast the rotation increases in the vicinity of the absorption lines, becoming more than 180° closer to the bands. In the interior of the bands only a hazy fringe is seen. A remarkable equation, first deduced by Becquerel,[5] gives the law of the rotation. The phenomenon is more beautiful as soon as the vapour is so thin that the doublet is seen (Fig. 5).

Outside the components of the doublet the fringe rises *upwards*, but inside the components the fringe has moved *downwards*; the rotation is negative there. The rotation is $-90°$ for D_1, nearly $-180°$ for D_2. It is very interesting to watch the movement of the fringes in the spectroscope as the field is increased or the density of the vapour changed.

[1] Discourse delivered at the Royal Institution on Friday, March 30, by Prof. P Zeeman. Continued from p. 140.

[2] Zeeman, Proc. Ac. Sciences, Amsterdam, May, 1902. Hallo, Thesis, Amsterdam, 1902, Archiv Néerl., ser. 2, T. 10, p. 148, 1905.

[3] Macaluso and Corbino, *Comptes rendus*, cxxvii., p. 548, 1898.

[4] Wood, *Phil. Mag.*, October, 1905.

[5] Becquerel, *C.R.*, cxxv., p. 679, 1897. *Cf.* also Schuster, "The Theory of Optics," pp. 291–294, 1904. Siertsema, Proc. Ak. Amsterdam, xii., p. 499, 1903.

Double Refraction and Resolution of the Absorption Lines.

In the second place, we will now consider the *double refraction* which occurs whenever light traverses a vapour at right angles to the magnetic field. A plane wave with vibrations parallel to the field has a velocity different from that of a wave with vibrations at right angles to the field. It is only close to the absorption band that the difference becomes perceptible. Sodium vapour in a magnetic field behaves as a double refracting crystal for light close to the sodium lines. This result of Voigt's theory was verified by him in conjunction with Wiechert in the case of dense vapours, and commented upon by Becquerel and Cotton.

With great density, and using the same system of interference bands, the phenomenon assumes the appearance now projected. Whereas the rotation of the plane of polarisation was symmetrical on both sides of the absorption band, you see that the double refraction is not. On one side of the absorption line sodium vapour behaves like a positive crystal, on the other side like a negative one. With very dilute sodium vapour, and with a magnetic field strong enough to resolve the sodium lines, the theory must be extended. There is no difficulty here. The observations made by Mr. Geest, as well as by myself, concerning the details of this double refraction, have fully confirmed Voigt's theory.[1]

The slides shown always refer to *one* of the yellow sodium lines, and hence the structure seen is almost entirely confined to the extremely small region between the components of one line. The line D_2 splits up into three components in a moderate field. The theoretical course of

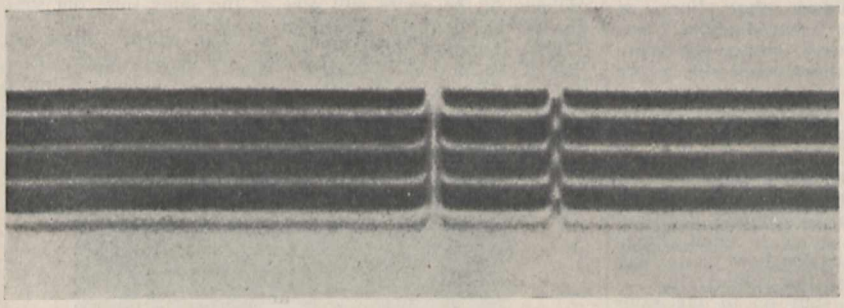

FIG. 5.

double refraction is given in a diagram; next to it the result of observations is given (Figs. 6 and 7). On a somewhat larger scale the appearance is as now shown; with greater density the characteristic sinuous line undergoes transformation. The line D_1 splits up into a quartet. Besides the concave parts, you will now notice a line with a point of inflexion in the theoretical and in the observed curves.

The same phenomenon is again illustrated by the next slide, where also the change which occurs with greater density is manifest. In a very strong field the line D_2 is resolved into a sextet. The inverse sextet can be readily seen with the means at our disposal, but the phenomena occurring between these narrow-spaced components could only be seen with difficulty. Only in very favourable circumstances Mr. Geest observed the image now projected.

All the described phenomena are qualitatively in excellent accordance with Voigt's theory. It is certainly very interesting that the theory is able to explain the complicated course of double refraction by the difference between the velocities of propagation of vibrations at right angles and parallel to the field.

Magnetic Resolution and Intensity of Field.

Let me again refer to our first subject, the magnetic separation of the lines. The magnitude of this separation is proportional to the intensity of the field in which the source is placed. We may, therefore, deduce the intensity of the field from the magnitude of the magnetic separation. We have only to measure the distance of the components of a suitable line. It is not generally known that

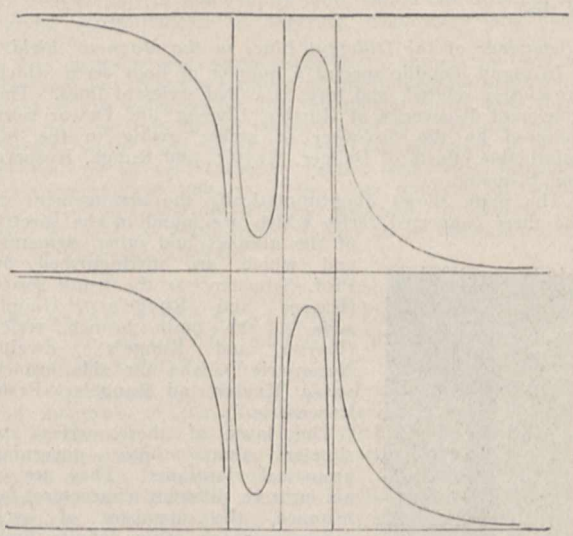

FIG. 6.

this distance can be measured with great accuracy (with an error of considerably less than 1 per cent.). It is, therefore, far easier, if a relatively high degree of accuracy is necessary, to compare the intensities of field by measurements of the distance between the components than by direct magnetic measurements.

All methods used for the measurement of magnetic fields give us the intensity in a point. On the other hand, the magnetic resolution of spectroscopic lines can give us the intensity *in all points belonging to a line*. Moreover, in this manner we make direct use of a property of the atom.

You see here a vacuum tube with some mercury. We heat the tube and excite it with the coil. You notice the brilliant light, which is, however, greatly increased when the tube is placed in a magnetic field.[1] For a given density of the vapour there is a definite intensity of field for which the luminosity is a maximum. You can see this when we put on the current in the electromagnet; the intensity of the field then rises gradually.

We project an image of the tube on the slit of a spectroscope. This spectroscope must be so arranged that to every point of the slit there corresponds a point of the image. The blue line of mercury (4359) resolves into a sextet. Using this line, the field of a du Bois electromagnet with a pole distance of 4 mm. is mapped out in the spindle-shaped optical magnetograms now shown (Fig. 8). We may, of course, extinguish the light of the inner components. In some cases a triplet will give more accurate results. The method sketched will, of course, only be applied in difficult cases. So long as our spectroscopes of great resolving power are rather cumbersome there is no practical application for the method. By means of this method we may also study some questions as to the way in which certain phenomena which accompany the resolution depend on intensity of field.

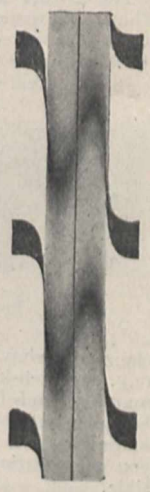

FIG. 7.

[1] Zeeman and Geest, Proc. Acad. of Sciences, Amsterdam, May, 1903, December, 1904. Geest, Thesis, Amsterdam, 1904, Archiv Néerl, sér. 2, T. 10, p. 291, 1905.

[1] Paschen, "Physik. Zeitschr.," I. S., 478, 1900.

We have no time, however, to discuss this further, because I should like to refer to the important subject of the

Behaviour of the Different Lines in the Magnetic Field.

In many metallic spectra a number of lines occur which are closely related, and form so-called series of lines. The important discoveries of Hartley, Liveing, and Dewar were followed by the discovery of series, owing to the indefatigable efforts of Balmer, Kayser and Runge, Rydberg and Schuster.

The plate shows diagrammatically the arrangement of the three connected series which are found in the spectra of the alkalies and other elements, and which are distinguished by Prof. Schuster[1] as the trunk series (Kayser and Runge's "Hauptserie"), the main branch series (Kayser and Runge's "Zweite Nebenserie"), and the side branch series (Kayser and Runge's "Erste Nebenserie").

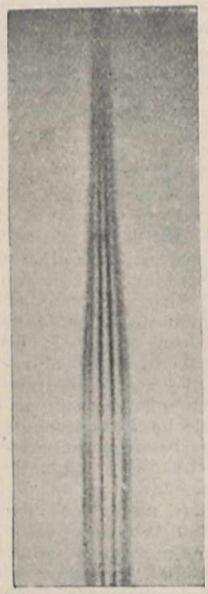

FIG. 8.

The laws of these series are simpler than those governing acoustical vibrations. They are of an entirely different character; for instance, the members of each series approach some definite limit of frequency, whereas the number of acoustical vibrations may increase indefinitely.

My first measurements already made it evident that lines of different series behaved entirely unlike each other.[2] Hence the ratio of charge to mass could not be the same for all vibrating electrons.

Runge and Paschen have proved in a most beautiful and systematic investigation[3] that all the lines of a trunk or of a branch behave in the same manner. This result was first announced by Thomas Preston,[4] but it is not stated to what degree of accuracy and for how many lines he investigated the subject.

All lines of the same series are split up in the same manner, *e.g.* all lines are resolved into triplets or all into nonets. Moreover, not only the general type of subdivision is the same, but even the amount of separation when measured in oscillation frequency.

The second law discovered by these physicists is this: That corresponding series of *different* elements show the same type of resolution, and the amount of separation is the same when measured on the frequency scale.

In the alkalies each line of the trunk series is double, and we may speak of a twin trunk. The yellow sodium lines are a typical example. The type of resolution of the two lines is shown in the diagram (Fig. 9). Here we have again our old sodium lines in the field. The same division occurs in all cases when twin trunks exist. Substances so different in chemical behaviour as sodium, copper, silver, and calcium (*e.g.* the well-known lines H and K), split up in the same manner; and I think that even Sir William Crookes will be surprised to hear that his thallium lines are in the magnetic field only counterfeit sodium lines. I can show you the splitting up of these beautiful thallium lines in the slide.

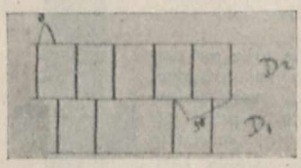

FIG. 9.

1 Schuster, "The Theory of Optics," p. 282, 1904.
2 "Zeeman, Verslagen Ak. v. Wetenschappen, Amsterdam, December, 1897. *Phil. Mag.*, February, 1898.
3 Runge and Paschen, Berl. Akad. Abhandlungen, Anhang, 1902. Sitzberichte, Berlin, p. 380, p. 720, 1902. Runge, "Physik. Zeitschr.," 3. Jahrgang, S. 441. Kayser, Spektroscopie, Band 2, Kapitel ix., 1902.
4 Preston, Dublin Trans. (2) 7, pp. 7–22, 1899.

With zinc, cadmium, mercury, and calcium, there are *three* main branches associated with each other. The amount of separation is the same in each of these branches. The type of resolution is shown in the diagram (Fig. 10). I can show you further lines of mercury, the triplet, the sextet, the nonet. Another example of the same sextet is given by a zinc line. The next slide refers to some beautiful magnesium lines exhibiting the same three types of resolution (Fig. 11).

We see that in these cases the simple image of an oscillating electron does not apply. I regret to say that the electronic theory cannot yet give us the explanation of the more complicated resolutions; even for the quartet we are yet in want of a model.

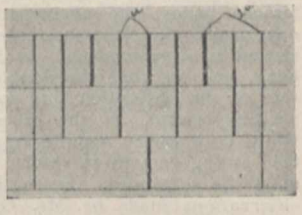

FIG. 10.

The laws discovered, however, seem to point to the conclusion that all the lines of a series are emitted by one oscillating system, that there are, therefore, as many series in the spectrum of a substance as oscillating systems in its atom; moreover, that the oscillating mechanism is the same in different elements. We are reminded here of the view advocated by Sir Norman Lockyer that the different elements have something in common. The relation between these spectral series and resolution in the magnetic field is so close that we may expect that the solution of the problem of the series will give at the same time the solution of the magnetic separation problem.

That Lorentz's theory is on the right track even in the case of the more complicated magnetic effects appears from the polarisation of the nonet shown in the slide. Three groups of vibrating lines here correspond to the three lines of the triplet. The circular polarisation corresponds also

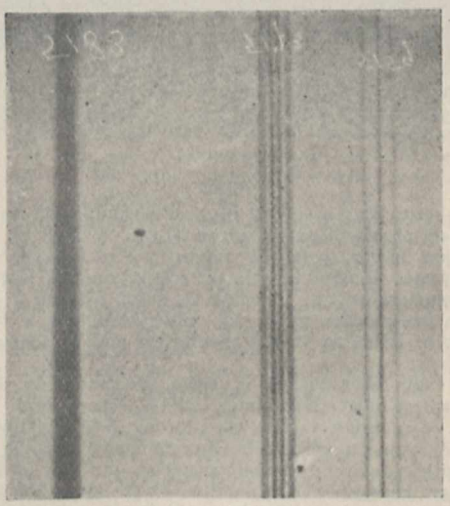

FIG. 11.

to that of the doublet, indicating that it is always the negative electron which executes the vibrations. There is yet room enough for experimental work in extending these investigations in different directions and to other elements.

Much light on our present subject will be thrown undoubtedly by the activity in adjacent chapters of physics. I can only mention in this relation the extremely interesting experiments by Lenard and Stark on the centres of emission of different spectral series, and the important theoretical work by Drude[1] on the optical properties and electronic theory. Maxwell has said, "an intelligent student armed with the calculus and the spectroscope can

1 Drude, *Annalen der Physik*, pp. 677, 936. Bd. 14, 1904.

hardly fail to discover some important fact about the interior structure of a molecule." I think this statement remains as true now as it was thirty-two years ago. There can be no doubt, I think, that spectrum analysis, and especially the magnetisation of the spectral lines, will give us a clue to the inner structure of the atom. I hope that I have succeeded in imparting to you this, my conviction.

THE ERUPTION OF VESUVIUS IN APRIL, 1906.

THE most complete published account of the eruption of Vesuvius in April last is due to the enlightened liberality of the French Government, which commissioned Prof. Lacroix to study and report upon the eruption, and it is gratifying to find that this, as all other detailed accounts by qualified scientific observers of the eruption of Vesuvius, confirms in every respect the description which we were able to disentangle from contemporary newspaper reports and publish in our issues of April 12 and 19. As a result of Prof. Lacroix's researches he has, in addition to more detailed memoirs published or to come, communicated to the *Revue générale des Sciences* of October 30 and November 15 an interesting account of the result of his observations and deductions, some of which are sufficiently interesting to deserve notice, in extension of what we have already published.

The earlier stage of the eruption was of the Strombolian type, that is to say, the material ejected from the crater was formed by the breaking up of molten lava; it was consequently red hot, and Prof. Mercalli, who was watching the eruption from Torre Annunziata, noticed that the mountain became covered, for from 200 metres to 300 metres from its summit, with a continuous sheet of glowing material, from which blocks incessantly rolled down to lower levels. At 0h. 31m. and again at 2h. 40m. a.m. on April 8 violent earthquakes were felt, corresponding to the most violent paroxysms of the eruption, accompanied by a lowering of the height of the cone and a change from the Strombolian to the Vulcanian type of eruption. From this time onward the ejected material was less and less composed of fresh lava, and less and less incandescent, being composed, in increasing degree, of the old solidified lavas and tuffs of the cone.

For several days after April 8 the summit was hidden by a thick cloud of ashes, and when this cleared away the mountain was found to have changed its form, from a pointed to a truncated cone, like that left after the eruption of 1822, though not so low or with so large a crater. When it became possible to ascend the cone it was found that the new crater was a true caldera, almost circular, of 640 metres to 650 metres in diameter, surrounded by walls almost vertical, except at the top, where a steep talus reached up to the crest, and at the bottom, where a funnel-shaped talus sloped down into a cloud of vapour escaping from the fumeroles. The rim was irregular in height and generally sharp-crested, but cut by a deep gap on the north-east, where, for some 80 metres, the crest was not only lower, but comparatively flat-topped; this gap faces the crest of Somma in the direction of Ottajano, where scoriæ and ashes fell in quantity sufficient to crush in the roofs of houses, while the observatory, less than half as far from the crater in the opposite direction, received but a very small quantity of these same ejections. Prof. Lacroix rejects the explanation that this difference was solely due to wind, and considers that he has established a case of oblique eruption, the average direction of projection being, not vertical, but inclined at a considerable angle towards the north-east.

The greater part of the material blown out from the crater fell on the slopes of the cone, which was covered many yards deep with a loose deposit of fine dust, ashes, and blocks of all sizes. Even before the eruption ceased the surface of this deposit began to be broken by dry avalanches, which crashed down on every side, leaving the cone deeply scored by a series of radiating valleys, separated by steep-sided, sharp-crested ridges. Later on, rain-water sinking into and saturating these loose deposits set them in motion as the well-known mud lavas, the mode of flow of which resembles closely that of the molten lava, and still later the rain-water, flowing off the surface, formed torrents of more liquid mud, which cut through the earlier accumulations of the dry avalanches and mud lavas.

The eruption was accompanied by a change in level of the land, but this was confined to the immediate neighbourhood of the volcano, for the tide-gauge shows that there was no alteration in the relative level of land and sea at Naples, while Prof. Mercalli found an elevation of from 30 cm. to 48 cm. between Portici and Vico Equense. Of mineralogical interest is the new mineral, of which the first published description appeared in NATURE of May 31, and the discovery of galena as an addition to the list of Vesuvian minerals.

RUSSIAN OBSERVATIONS OF THE SOLAR ECLIPSE, AUGUST 30, 1905.

CONSIDERING the unfavourable weather conditions experienced by many of the eclipse parties last year, the members of the Russian expedition, in charge of M. A. Hansky, are to be congratulated on the results they obtained, which have been recently circulated as a publication of the Pulkowa Observatory. The observers were stationed at Alcocebre, on the Mediterranean coast near Valencia. The central line of totality passed almost exactly through the station, and various local conveniences combined to render the choice of site favourable to efficient observation. On August 15 all the instruments were received in good condition, and after observations had been made for determining the azimuth of the sun's rising point, the various pillars and stands for the apparatus were erected.

Photographs of the corona were taken on two scales:—small pictures with the Bredikhine double photographic telescope, furnished with a Zeiss objective of 170 mm. aperture and 800 mm. focal length, giving a field of 12°·4 in R.A. and 8°·8 in declination; large pictures, for the delineation of fine detail in the coronal streamers, with an objective of 5 inches aperture and 13·28 m. focal length, the light being supplied from a cœlostat 30 cm. in diameter. Spectroscopic observations of the corona and prominences were made with a direct-vision spectroscope without slit, and the polariscopic phenomena examined by the aid of a Savart polariscope. Measurements of the solar radiation were taken with an actinometer and actinograph of Crova's pattern.

Near the time of eclipse the sky became clouded over, but about a minute before totality the sun was seen in clear sky. The corona was seen five or six seconds before totality, and the last ray of sunlight was visible for some two seconds, probably through a deep valley in the moon's limb. This feature is also shown very clearly in the photograph of the chromosphere accompanying the report, which is divided up into a series of bead-like masses at that particular place. Visually the corona was seen of a brilliant, silver-white colour, its brightness increasing rapidly towards the moon's limb. The longest rays seen extended about one and a half lunar diameters, and were situated near the poles of the sun, one at the north and two very fine ones at the south pole. The sky had a green colour, similar to that often seen about half an hour before sunrise. Careful examination of the spectrum of the corona during one of the forty-seconds' exposures showed that the continuous spectrum was especially strong in the green, yellow, and red, the latter region being so brilliant that it suggested the possibility of photographing the corona in ordinary daylight by means of suitably prepared colour screens.

With the polariscope the coronal light was seen to be strongly polarised, and the conditions were such that the dark bands were not visible on the sky surrounding the corona. The bands were much stronger when tangential to the sun's limb than when radial. There appeared to be a rotation of about 2½° of the plane of polarisation, which may possibly be ascribed to the action of a magnetic field round the sun.

Eight photographs of the corona were obtained with the long-focus telescope, the exposures varying from 40–45

seconds. The longest were somewhat over-exposed near the limb, and showed structure to about three-quarters the lunar diameter. Six photographs were taken with the Bredikhine coronagraph, the first of which only was successful, most of the others being much over-exposed. On the good plate the star ρ Leonis was photographed, thereby giving an accurate means of orienting the plates for determining the position angles of the prominences and coronal streamers. These values are tabulated for the more important streamers. M. Hansky considers that the results obtained confirm the idea that the corona varies, not only in form, but in brightness and spectrum, with the sun-spot period. During this last eclipse the brightness was probably ten times that of the full moon, while at epochs of minimum spots the corona has only been about as bright as the full moon. Owing to the sky being frequently clouded over, the actinometric observations are of only small importance, but the character of the record obtained indicates that Crova's instrument is very convenient for such investigations.

Shadow bands were observed before the commencement of totality, the direction of their displacement on the ground being from west to east. They were badly defined at their edges, but became more definite as totality approached. They appeared of a brownish colour, and moved with a velocity of 2–3 metres per second, the motion being apparently oscillatory, and not translatory. Their distance apart was not more than 25 centimetres. Other observations made at Amposta showed the bands to be 5–7 cm. wide and 10–15 cm. apart, the displacement being from north-west to south-east. At the end of totality the corona disappeared immediately, and no shadow bands were seen. The sunlight appeared to return suddenly, without any gradual change such as was observed before totality.

CHARLES P. BUTLER.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The following examiners have been appointed:—In zoology, Dr. J. W. Jenkinson, Exeter College; in preliminary physics, R. E. Baynes, Christ Church; in preliminary chemistry, H. B. Hartley, Balliol College; in preliminary animal physiology, Prof. F. Gotch, Magdalen College; in preliminary zoology, R. W. T. Günther, Magdalen College; in medicine, Dr. A. E. Garrod, Christ Church; in organic chemistry, N. V. Sidgwick, Lincoln College; in materia medica, Dr. R. Stockman; in anatomy, Prof. A. Thomson, Exeter College; in physiology, Dr. H. M. Vernon, Magdalen College; in pathology, Prof. G. Sims-Woodhead; in forensic medicine, Dr. H. H. Littlejohn; in surgery, D'Arcy Power, Exeter College; in obstetrics, J. S. Fairbairn, Magdalen College.

Dr. J. W. Jenkinson, Exeter College, has been appointed lecturer in comparative and experimental embryology.

T. Lindsay, Glasgow University, has been elected to a Brakenbury scholarship in natural science at Balliol College.

An examination for a Radcliffe travelling fellowship of the annual value of 200*l.*, tenable for three years, will commence on February 26, 1907. Intending candidates should send their names to the regius professor of medicine by February 9.

CAMBRIDGE.—Mr. A. G. Tansley, assistant professor of botany at University College, London, has been appointed lecturer in botany in succession to Mr. A. C. Seward, who has succeeded the late Prof. Marshall Ward in the chair of botany.

The Vice-Chancellor has published a further list of donations to the benefaction fund, which has now reached a sum of 96,400*l.*

Mr. T. G. Bedford, of Sidney Sussex College, has been appointed assistant demonstrator at the Cavendish Laboratory to hold office from January 1, 1907, to September 30, 1911.

Prof. B. Hopkinson has been appointed chairman of the examiners for the mechanical sciences tripos, 1907.

The Arnold Gerstenberg studentship (1906) has been awarded to A. E. Baker, Trinity College, for an essay entitled "A Critical Examination of Descartes' Philosophy of Nature."

The special board for biology and geology has adjudged the Walsingham medal for 1906 to W. E. Agar, for his essay on "Researches into the Embryology of the Dipnoi," and W. L. Balls, for his essay entitled "Studies of Egyptian Cotton."

It is proposed that, in accordance with a recommendation of the general board of studies, a university lecturer in hygiene be appointed for a period of five years, in connection with the special board for medicine, and with an annual stipend of 100*l.* payable out of the funds in the hands of the State Medicine Syndicate.

The authorities of Gonville and Caius College, having decided to close their chemical laboratory at the end of the present academic year, a syndicate was appointed on November 8 to consider the assignment of a site for the extension of the chemical laboratory. The conclusion arrived at is that, of the sites available, the one site which is not liable to considerable objection lies between the chemical laboratory and the new medical schools, with a frontage next Pembroke Street.

The antiquarian committee recommends that it be authorised to hire an old malting house at Newnham for a period of five years in which to store some of the collections under its charge. The need for a new museum of ethnology and archæology is indeed becoming pressing. The University has assigned a site for such a building, and a building fund has been started by Baron von Hügel, curator of the museum, but until that fund is very considerably augmented the University will be compelled to store away many of its treasures in a building inaccessible to students, and quite unworthy of the treasures it contains. The committee also recommends that the numerous small sums which it receives from the financial board for the upkeep of the museum be consolidated, and that an annual grant of 420*l.* be placed at its disposal for each of the five years 1907 to 1911.

THE fourth annual prize distribution of the Sir John Cass Technical Institute was held on December 4, when Sir William Ramsay, K.C.B., F.R.S., delivered an address and distributed the prizes. The chair was taken by Sir Owen Roberts, chairman of Sir John Cass's foundation. In reviewing the work of the institute, Sir William Ramsay dwelt upon the scope and aims of those who follow the study of science with the view of making discoveries, whose main object is to extend the boundaries of science and to gain knowledge, in contrast with those who, on the one hand, restrict their work to duties of a more mechanical character, involving less responsibility, and are satisfied with the discharge of their daily task, and with those, on the other, who find their work and interest in the direction and guidance of business concerns and in the control of their fellow-men. The comparative rewards and the nature of the successes of these various classes of workers were contrasted, and the possibilities of the institute in training students to fill one or more of these different spheres of activity were outlined. Turning to the awards made on the work of the past session, Sir William Ramsay advised students not to aim at prizes; if prizes come, well and good, but they should not be the object of work. The chief aim, he said, should be to get on with the work in hand, to do it as well as possible, even if the labour brings no immediate reward, and to seek for knowledge; for the great thing in life generally is to be, and not to get. Previous to the distribution, Mr. George Baker, chairman of the institute committee, made a short statement of the work of the institute, in which he pointed out that its relation to the industries of East London is beginning to be known and appreciated by manufacturers, and expressed the hope that it would in the course of time prove a real and progressive help to the trades and industries of the district.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 28.—"The Pharmacology of Ethyl Chloride." By Dr. E. H. **Embley.**

Four years ago Dr. Embley published the result of an investigation into the pharmacology of chloroform which he had carried out in the physiological laboratory of the University of Melbourne,[1] primarily with the view of elucidating the cause of those sudden misadventures which occur in chloroform administration, and more particularly during the early period of the induction of the anæsthetic.

Dr. Embley's work, however, covered the whole subject of the physiological action of chloroform in a very thorough manner, and perhaps one of the most striking merits which it possessed was due to the fact that the experiments were conducted throughout with definitely known percentages of chloroform in the air respired.

The present work on ethyl chloride is conducted in the same quantitative manner, and with the same command of physiological technique, as shown by the excellent graphic records which illustrate the paper.

Ethyl chloride was first used as a general anæsthetic in 1848 by Heyfelder. It subsequently fell into disuse, but was revived in 1895. Its position is intermediate between nitrous oxide and chloroform or ether.

According to Embley, blood absorbs more than twice as much of the gas as water under similar conditions, so that ethyl chloride, like chloroform, evidently enters into loose chemical union with the blood.

The first point ascertained was the direct effect of ethyl chloride upon the mammalian heart.

Isolation of the heart was obtained by ligation close to the aorta of all the systemic arteries, except the subclavian. By this procedure the circulation was confined to the heart, lungs, and one limb; the nervous system being cut off from its blood supply is instantly put out of action. The pressure in this miniature circulation was recorded by a manometer connected with one carotid artery.

The effect of ethyl chloride upon heart muscle, as is the case with chloroform, and in contrast to ether, was paralytic, but the quantity of ethyl chloride vapour in the air required was nineteen times as great as that of chloroform to produce comparable results.

The direct influence of ethyl chloride upon the arterioles was demonstrated by driving an artificial circulation first through the isolated lungs and then through the isolated intestine of an animal, and measuring the outflow before, during, and after the admixture of definite percentages of ethyl chloride in the air rhythmically pumped into the lungs.

The administration of air containing 20 per cent. to 30 per cent. of ethyl chloride was found directly to paralyse the arterioles. The effect upon the vasomotor system in the intact animal was studied by taking simultaneous records of the arterial blood pressure and of the volume of various organs. These experiments showed that with 20 per cent. to 30 per cent. ethyl chloride in the air respired, a considerable degree of paralysis of the vasomotor system occurred.

Vagus inhibition of the heart was found readily to occur when above 9 per cent. of ethyl chloride vapour was present in air. Between 10 per cent. and 20 per cent. inhibition caused sudden fall of blood pressure and cessation of circulation. These effects upon the heart were due to stimuli passing down the vagi from the central nervous system, for on cutting these nerves the circulation was instantly resumed. This sudden inhibition of the heart was not, however, nearly so dangerous as the same effect easily produced by chloroform, for the direct paralytic effect of ethyl chloride upon the heart muscle is comparatively insignificant, so that in the majority of cases recovery of the circulation readily occurred if the administration were suspended.

The effect of ethyl chloride upon the respiration is also dealt with. Ethyl chloride gradually reduces the rate and extent of the respiratory movements, and if pushed in sufficient concentration will ultimately lead to their cessation. The same interdependence between respiratory activity and blood pressure was brought out, as had been shown by Leonard Hill and the author, to obtain in chloroform poisoning. Provided the circulation were maintained, it was found nearly impossible to produce cessation of respiration, but directly serious fall of blood pressure occurred, owing to inhibition of the heart, the respiration immediately became very shallow or ceased, but returned again directly the circulation recovered.

The primary danger in the administration of ethyl chloride to dogs, as in the case of chloroform, is syncope from inhibition of the heart, brought about by the stimulating action of these drugs upon the cardiac-inhibitory centre in the medulla. As it is a stimulating action, it is more prone to occur in the early stages of administration before these nerve centres are themselves narcotised by the drug.

"Refractive Indices of Water and Sea-water." By J. W. **Gifford.** Communicated by W. A. Shenstone, F.R.S.

Reference is made to previous papers (Roy. Soc. Proc., February 13, 1902, and March 3, 1904). The same special method of observation has been adopted. Measurements of the refractive index of water for twenty-six wave-lengths and of sea-water for twelve wave-lengths are contained in the paper. Those of sea-water were made for the purpose of computing an under-water lens, since successfully constructed for submarine use. The measurements were made at an approximate temperature of 15° C., but were also corrected by means of temperature refraction coefficients.

The error is estimated as in no case exceeding 0·000025, and in most cases not exceeding 0·000015. The index of water for line D, reduced to 20° C. by the temperature coefficient, is 1·333032. Dufet ("Recueil de Données numériques," vol. i., p. 83) gives 1·33303 as the mean of the measurements of twenty-nine different observers for that line and temperature. The measurements were made on the goniometer used before (*loc. cit.*), but have been checked by critical work on a much larger instrument.

The distilled water was prepared in platinum vessels by Mr. Bousfield; the sea-water was taken five miles from shore by Lieut. E. R. G. Evans, R.N.

November 8.—"On a Compensated Micromanometer." By B. J. P. **Roberts.** Communicated by Sir John I. Thornycroft, F.R.S.

The principle of the gauge is similar to that of Sir W. Siemens's bathymeter. The instrument described consists of a U tube having the limbs connected by a tube of small bore, the motion of the fluid in this small-bore tube being rendered visible by means of an air-bubble index. The sensitiveness depends on the ratio between the bores of the limbs and the connecting tube, and also partly on the nature of the fluid employed. The fluid should have a low surface tension, and the bore of the connecting tube should preferably not exceed 1·5 millimetres. The length of the bubble should be made equal to the distance between the centres of the upright limbs—the readings will then be practically unaffected by changes of level; the readings are also indifferent to vibration or similar disturbing causes. No fluid will pass the bubble provided certain precautions are observed—of these the most important is keeping the rate of movement of the bubble from exceeding certain limits. An attachment for preventing loss of fluid by evaporation is suggested in some cases.

"The Composition of Thorianite and the Relative Radioactivity of its Constituents." By Dr. E. H. **Büchner.** Communicated by Sir W. Ramsay.

Various investigations on residues from the mineral thorianite, carried out in the laboratory of Sir William Ramsay, made it desirable to analyse a large amount of this mineral, and to determine how its radio-activity is distributed over its constituents. About 24 grams were dissolved in boiling nitric acid, and left only a small residue behind, which was then fused with hydrogen potassium sulphate. The fused mass dissolved almost completely in water. The solutions obtained were then treated in the ordinary way and separated in the various groups. Pb, Cu, Sn, Sb, Fe, Al, Ur, Th, Ce, Zr, Ti, Ca, He, CO_2, and water were quantitatively determined; the greater part of these elements are present in very small quantities.

[1] "The Causation of Death during the Administration of Chloroform" (*British Medical Journal*, April 5, 12 and 19, 1902).

The determination of the more important ones gave the following results:—PbO, 2·42 per cent.; Fe_2O_3, 3·35 per cent.; Ur_3O_8, 13·12 per cent., ThO_2, 70·96 per cent.; Ce_2O_3, 1·96 per cent. From 1 gram of the mineral 8·2 c.c. of helium were obtained. The original mineral possesses 83·3 per cent. of the activity of standard uranium oxide. The greater part of the constituents proved to be radio-active, though some only in a very slight degree. Nearly 60 per cent. of the activity of the mineral is allied to the thoria, about 9 per cent. to the uranium. The strong activity of the iron appears to be due to the presence of Hahn's radio-thorium. The activity of several precipitates increased during the time between two measurements, while others showed a decreasing activity, which sometimes even disappeared. It may be assumed that these precipitates are so-called X-substances; one of them resembles in its chemical behaviour a platinum metal.

Zoological Society, November 13.—Mr. Howard Saunders, vice-president, in the chair.—A very young embryo of the okapi (*Okapia johnstoni*) obtained by Dr. T. David from a specimen shot in the Semliki Forest: Prof. R. **Burckhardt**. The object not being well preserved and in an early stage, it could only be stated that all the particulars ascertainable were specially ungulate in character.—Description of a new species of turbellarian obtained during Dr. W. A. Cunnington's expedition to Lake Tanganyika: F. F. **Laidlaw**.—List of a second collection of mammals made in Western Australia for Mr. W. E. Balston, with field-notes by the collector, Mr. G. C. Shortridge: Oldfield **Thomas**. This second collection was made in the Avon watershed, and consisted of about 350 specimens, of which a fine series had been presented to the National Museum by Mr. Balston. In all, forty-two species were enumerated, and of these Mr. Shortridge gave notes on the distribution and comparative rarity at the present time, such notes being of particular value in the case of a disappearing fauna like that of Australia. An appendix dealt with a small series obtained on Bunier Island, Shark's Bay, on the north-west coast of Australia.—Sixth instalment of the results of the Rudd exploration of South Africa: Oldfield **Thomas** and H. **Schwann**. This contained an account of the mammals obtained by Mr. C. H. B. Grant in the eastern Transvaal. Twenty-one species were represented in the collection, of which one was new.—The Mollusca of the Persian Gulf, Gulf of Oman, and Arabian Sea, as evidenced mainly through the collections of Mr. F. W. Townsend, 1903–5, with descriptions of new species, part ii., Pelecypoda: J. Cosmo **Melvill** and R. **Standen**. A continuation of the enumeration of the Mollusca of the above-named seas published in the Proc. Zool. Soc., vol. ii., 1901, and completing the catalogue, the total number embraced being nearly sixteen hundred species, many of these being found to be new to science. Among the Pelecypoda, Tellina holds the premier place; most orders and families are, however, represented, and the result is a very refined and varied molluscan fauna. Some interesting forms occur among the Lardiacea, while the Pectinidæ show alliance and, in some cases, specific identity with the Erythræan fauna, monographed by Dr. Sturany.

November 27.—Mr. Howard Saunders, vice-president, in the chair.—Notes on the habits of the lesser horseshoe bat, *Rhinolophus hipposiderus*: T. A. **Coward**. This bat usually occupies different retreats in summer and winter, and during the earlier period of occupation of the winter retreat sleep is not profound. The bats feed probably in the caves or retreats, and the food is at times, if not always, consumed when the animal is at rest and not on the wing. When feeding it does not—probably could not—make use of the interfemoral membrane, after the manner of the Vespertilionidæ, but, as a substitute, the interbrachial membrane is employed. These facts suggest that the hibernation of this species, and probably of other cave-haunting bats, is not really a profound winter sleep.—An account of four species of Solenidæ contained in the collections made by Mr. Cyril Crossland in Zanzibar and British East Africa in 1901–2: E. A. **Smith** and H. H. **Bloomer**.—Attempt to explain the existence of the so-called "renal-portal" system: W. **Woodland**.—The anatomy of *Centrophorus calceus*: W. **Woodland**. The author described in particular the anatomy of the alimentary tract, which differs in several respects from that of most Selachians and, as regards the length of the bile-duct, from most vertebrates.—Mammals collected in Korea and Quelpart Island by Mr. Malcolm P. Anderson for the Duke of Bedford's exploration of Eastern Asia: Oldfield **Thomas**. The collection consisted of about 130 specimens, belonging to nine species, of which four were described as new. Quelpart Island proved to contain a very poor mammal fauna, and the only specimens obtained there were a Putorius and a Micromys, both identical with forms found on the Korean Peninsula.

Linnean Society, November 15.—Prof. A. W. Herdman, F.R.S., president, in the chair.—A series of twenty-one specimens of *Polygala amarella*, Crantz, selected to show its wide range of form under various conditions: J. **Cryer**.—The Fjærlands Fjord, Norway: H. W. **Monckton**. During the past summer the author spent a fortnight at Mundal, on the Fjærlands Fjord, and he had paid short visits to the same place in previous years. The fjord is a long arm running from the Sogne Fjord in a north-easterly direction, and snow-fields lie near the fjord on both sides, though at a considerable altitude above it. Mundal is about ninety miles from the open sea, but Fucus grows well on the rocks and foreshore, and Mytilus and Cardium flourish. The author considered, among other subjects, the question to what extent the snow-fields and glaciers of Norway can be looked upon as relics of the Glacial period.

Anthropological Institute, November 20.—Prof. W. Gowland, president, in the chair.—A visit to the Hopi Indians at Oraibi: W. **Crewdson**. The visit took place in November, 1905, when it was late to travel across the plains of Arizona; but by starting from Canyon Diablo, on the Santa Fe route, with relays of horses, the seventy miles to Oraibi was accomplished in one day. Oraibi is the most conservative of Indian towns, practically unaltered by Western civilisation, and shows examples of primitive life in our own days, several of the implements used being still of stone; the bows and arrows and boomerangs are also used for killing game. One of the most striking characteristics of the Hopi men is their marvellous power of running; for this they are trained as children by one of the chief men, who stands on one of the Mesas and sees the young men take a twenty-mile run before commencing the day's work. The necessity for this was owing to their fields being many miles distant from their homes. The result is that a Hopi will sometimes run forty miles to his fields, cultivate them, and then run home again, all within the twenty-four hours. In the house, which is built by the woman, she rules absolutely; the children take the mother's name; the men weave the garments for both themselves and their wives, and are at any time liable to be definitely turned out of their homes, possibly after a forty-mile run, by the wife who has grown tired of her husband. These Indians are intensely religious, most of their ceremonies, which often last for days, being really prayers for rain. Their pottery is interesting, being decorated to a large extent with cloud symbols, and many pieces have a break in the design to allow the spirit which is supposed to be imprisoned in the design free ingress and egress. This idea bears a curious resemblance to the idea, once prevalent in England and elsewhere, that if a circle was drawn round a witch she could not escape unless someone cut the circle for her from outside. The celebrated snake-dance, which has been so often described, takes place in August, and it is becoming more and more probable that these Indians are really acquainted with a cure for snake-bite. In November, however, the dance of the year, only second to the snake-dance, and called the basket-dance, takes place. The lecturer was present at this, having previously been admitted to the Kiwa, or underground chamber, where the preparatory rites in connection with the ceremony take place.—The relative stature of the dolichocephalic, mesaticephalic, and brachycephalic inhabitants of East Yorkshire: J. R. **Mortimer**. The inhabitants are divided into two classes, those of the Neolithic and Bronze period,

and those of the Early Iron period. Of those in the first class, the dolichocephals are found to have the greatest stature and the mesaticephals the smallest stature, while in the second class the mesaticephals have the greatest stature and the brachycephals the shortest stature. There is, therefore, no simple relation between stature and skull length. The number of skulls examined was 151.

Geological Society, November 21.—Sir Archibald Geikie, Sec.R.S., president, in the chair.—The Kimeridge Clay and Corallian rocks of the neighbourhood of Brill (Buckinghamshire): A. M. **Davies.** The paper contains two principal divisions:—(1) an account of the section of Rid's Hill, Brill; (2) the rock of Studley and Arngrove, described by Phillips as an argillaceous chert, is shown to be mainly composed of the globate spicules of the tetractinellid sponge Rhaxella. Palæontological notes are given on certain species of Lamellibranchia and Annelida, chiefly from the Lower Kimeridge Clay.—The skull and greater portion of the skeleton of *Goniopholis crassidens* from the Wealden Shales of Atherfield (Isle of Wight): R. W. **Hooley.** In the late autumn of 1904, at a place locally called "Tie Pits," near Atherfield Point, a huge mass of the cliff, comprising many thousand tons of the Wealden Shales, subsided, pushing its foot across the beach until below low-water line. As the sea washed away the base, the mass continued to sink, and fresh horizons were denuded. In 1905 a series of heavy "ground-seas" cast up blocks of limestone and ironstone, containing crocodile bones, which were discovered on the sand between high- and low-water marks. The skull came ashore in six pieces. Fragments of bones and scutes were constantly picked up. The specimens were derived from a horizon 80 feet to 90 feet below the top of the Wealden Shales.

Entomological Society. November 21.—Mr. F. Merrifield, president, in the chair.—*Exhibitions*: H. W. **Andrews**: Specimens of *Odontomyia angulata*, Pz., from the Norfolk Broads, of which species few captures have been recorded of recent years, and *Icterica westermanni*, Mg., a rare Trypetid, taken in the New Forest.—Dr. F. A. **Dixey**: Specimens of South African Pierinæ demonstrating that the wet-season form of *Teracolus regina*, Trim., is in mimetic association with an undescribed species of Belenois, intermediate between *B. calypso* and *B. thysa*.—H. and F. **Campion**: A male specimen of *Sympetrum vulgatum* taken in Epping Forest on September 4 last, of which species there are recorded only three other authentic British specimens.—R. **Adkin**: A short series of *Tortrix pronubana*, Hb., including both sexes, reared from larvæ and pupæ collected from euonymus at Eastbourne in September. The only previous records for the species in Britain are single male examples captured at Eastbourne and at Bognor.—Dr. T. A. **Chapman**: A long series of *Coenonympha mathewi*, Tutt, from different places in the north-west corner of Spain (Galicia), and from which it was concluded that *C. mathewi* is a geographical or subspecific variety of *C. dorus*, and not a fully established species.—*Papers*.—A permanent record of British moths in their natural attitudes of rest, and Further notes on the choice of a resting site by *Pieris rapae*: A. H. **Hamm.**—Studies of the Blattidæ: R. **Shelford.**—Notes on the life-history of *Sesia andrenaeformis*, Lasp.: Hon. N. Charles **Rothschild.**—Notes on an unusual emergence of *Chrysophanus salustius* in New Zealand: H. W. **Simmonds.**

PARIS.

Academy of Sciences, December 3.—M. H. Poincaré in the chair.—A new and rapid method for the determination of the errors of division of a meridian circle: M. **Lœwy.** A continuation of previous papers on the same subject. The method is modified to allow of the direct determination of the correction of the twenty standard points.—The specific adjuvants of experimental parthenogenesis: Yves **Delage.** It has been found that the addition of certain salts to the solution usually employed in parthenogenesis (common salt, sea water, and distilled water) considerably augments the power of the latter as a parthenogenetic agent. Such substances are the chlorides of manganese, cobalt, and nickel, the last-named being the most active. This result is unexpected, and no satisfactory explanation has as yet been found. Different eggs, even from the same ovary (of the sea-urchin), present considerable differences, differences which neither the superficial nor histological examination offer any assistance in explaining.—Concerning the expedition organised for the study of sleeping sickness: A. **Laveran.**—Pulmonary physiological anthracosis of intestinal origin: MM. **Calmette, Vansteenberghe,** and **Grysez.** A repetition and extension of previous experiments in answer to the objections raised by other workers on the same subject, especially Küss and Lobstein. The authors conclude, in confirmation of their previous work, that besides anthracosis of respiratory and pure mechanical origin, the existence of which they have never denied, it is necessary to admit the existence of physiological anthracosis of intestinal origin.—Observations of the comet 1906*h* made with the large equatorial of the Observatory of Bordeaux: Ernest **Esclangon.** The observations were made on November 22 and 23, and give the apparent positions of the comet and mean positions of the comparison stars. The comet appeared as a uniform nebulosity 30″ in diameter, and without apparent nucleus.—Observations of the Thiele and Metcalf comets (1906*g* and 1906*h*) made at the Observatory of Algiers: MM. **Rambaud** and **Sy.** The observations were made on November 13, 14, 16, 19, and 20, the last night furnishing the best results. On November 20 the comet 1906*h* appeared as an irregular nebulosity, the lustre being comparable with that of a star of the twelfth magnitude.—Observation of the Metcalf comet (1906*h*) made at the Observatory of Lyons: J. **Guillaume.** A single observation on November 20. The comet had the appearance of a circular nebulosity of about 30″ diameter, with a central condensation and a small nucleus. Its lustre was about the eleventh magnitude.—Certain transcendental numbers: Edmond **Maillet.**—The critical points of inverse functions: A. **Hurwitz.**—Periodic functions: P. **Cousin.**—The diffusion of solutions of copper sulphate in gelatin: M. **Yegounow.** Copper sulphate appears to enter into combination with gelatin, but its movement rigorously follows Stefan's law.—Potential equalisers: M. **Moulin.** The combustion of filter paper impregnated with quantities of lead nitrate varying from 2 per cent. to 5 per cent., according to the conditions of wind, has given accurate results. The use of flames or radium salts requiring many precautions has been found less practical.—Researches on gravitation: N. **Crémieu.**—A theoretical explanation of the magneto-optic phenomena observed in a crystal: Jean **Becquerel.**—An apparatus for compensating the inertia of selenium: A. **Korn.** A device for overcoming the inertia of the selenium cell in telephotography.—Positive charge at a distance in an electric field under the influence of ultra-violet light: Mme. **Baudeuf.**—The reduction of oxide of chromium by boron: Binet **du Jassonneix.** The reduction of oxide of chromium by boron in magnesia crucibles at the temperature of the electric furnace gives ingots attackable by hydrofluoric, hydrochloric, and sulphuric acids. These may contain from 5 per cent. to 17 per cent. of combined boron. If boron is present in higher proportions it exists as the carbide of boron. The boride CrB constitutes the limit of saturation of chromium by boron.—An extremely sensitive method for the precipitation of zinc: Gabriel **Bertrand** and Maurice **Javillier.** The method is based on the production of a crystallised, insoluble calcium zincate. Quantitative determinations of zinc can be made in this way in solutions containing only two parts of zinc in a million. Even at ten times this dilution the zinc can be qualitatively detected with certainty.—Nitriles and carbamines: P. **Lemoult.** Determinations of the heats of combustion and formation of methyl and ethyl carbamines. From thermochemical data hydrocyanic acid is considered to be a carbamine, and not a nitrile.—The action of reagents on ethyl glyoxylate: L. J. **Simon** and G. **Chavanne.** The ethyl glyoxylate was prepared by the electrolysis of ethyl oxalate, and its reaction with phenylhydrazine, hydroxylamine, and semicarbazide studied.—The esterification of arsenious anhydride by alcohols and phenol: V. **Auger.** A limited amount of alkyl ester is produced by heating together arsenious anhydride and the anhydrous alcohol. If the experiment is arranged so that the water produced in the reaction is removed (with

calcium carbide), a good yield of the arsenite is produced. The physical properties of propyl, normal butyl, and iso-butyl arsenites are given.—The orthosubstituted azo-acids and their transformation into *c*-oxyindazylic derivatives: P. **Freundler.**—The condensation of oxalacetic ester with cyanacetic ester in presence of piperidine: Ch. **Schmitt.** The condensation can take place in two ways, giving rise to isomeric substances possessing different properties.—The replacement of hydroxyl of some carbinols by the radical —$CH_2.CO_2H$: R. **Fosse.**—The constitution of hordenine: E. **Léger.** The regulated oxidation of acetyl-hordenine with potassium permanganate gives acetyl-para-oxybenzoic acid. This fixes the orientation of the hydroxyl group in hordenine, which is thus found to be para-oxyphenylethyl-dimethylamine.—The volcanic rocks of the peninsula of Cape Verde (Senegal): Jean **Chautard.**—The presence of galena amongst the minerals produced by the fumerolles of the last eruption of Vesuvius: Ferruccio **Zambonini.** Referring to a recent paper by M. Lacroix on this subject, the author mentions that he contributed a paper on the same subject to the Accademia dei Lincei in August last.—The intracellular inclusions of the leaf of *Rhamnus cathartica*: Wladimir **Tichomirow.**—The evolution of the metachromatic corpuscles of seeds during germination: J. **Beauverie.**—The histological modifications produced in the flowers of *Teucrium Chamaedrys* and of *Teucrium montanum* by the larvæ of Copium: C. **Houard.**—The coral formations of the island of San-Thomé, Gulf of Guinea: Ch. **Gravier.**—A respiratory calorimetric room: M. **Letulle** and Mlle. **Pompilian.** A diagram is given of the apparatus, which allows of simultaneously measuring the respiratory exchanges and heat evolved by a man over a long period. The heat is determined by reading the inlet and outlet temperatures of a measured flow of water, the regulation of the temperature of the calorimeter being made automatically at any desired point between 12° C. and 24° C. The apparatus was standardised electrically with a possible error of 0·5 per cent.—The *rôle* of the chromotropic phenomena in the study of biological and psychophysiological problems: Romuald **Minkiewicz.**—The prophylaxy of glandular cancer of the prostate: A. **Guépin.**—The production in medicine of static effects by high frequency resonators: H. **Guilleminot.**

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 13.

ROYAL SOCIETY, at 4.30.—The Relation between Breaking Stress and Extension in Tensile Tests of Steel: A. Mallock, F.R.S.—On the Intensity of Light Reflected from Transparent Substances: Prof. R. C. Maclaurin.—Contributions to our Knowledge of the Poison Plants of Western Australia, Part ii., *Oxylobium parviflorum*, Lobine: E. A. Mann and Dr. W. H. Ince.—Experiments on the Length of the Kathode Dark Space with Varying Current Densities and Pressures in Different Gases: F. W. Aston.—An Examination of the Lighter Constituents of Air: J. E. Coates.—The Velocity of the Negative Ions in Flames: E. Gold.—The Electric or Magnetic Polarisation of a Thin Cylinder of Finite Length by a Uniform Field of Force: Dr. T. H. Havelock.—Further Observations on the Effects produced on Rats by the Trypanosomata of Gambia Fever and of Sleeping Sickness: H. G. Plimmer.

SOCIETY OF ARTS, at 4.30.—The Indian Mohammedans: their Past, Present, and Future: A. Yusuf Ali.

LONDON INSTITUTION, at 6.—Tadpoles—a Study in Embryology: D. J. W. Jenkinson.

MATHEMATICAL SOCIETY, at 5.30.—On the Form of the Surface of a Search-light Reflector: C. S. Jackson.—The Potential Equation and Others with Function given on the Boundary: L. F. Richardson.—On the Limits of Real Variants: J. Mercer.—The Asymptotic Expansion of Integral Functions defined by Generalised Hypergeometric Series: Rev. E. W. Barnes.—The Diophantine Equation $x^n - Ny^n = z$: Major P. A. MacMahon.—The Uniform Convergence of Fourier's Series: Dr. E. W. Hobson.

FRIDAY, DECEMBER 14.

PHYSICAL SOCIETY, 7 p.m. to 10 p.m.—Second Annual Exhibition of Electrical, Optical, and other Physical Apparatus.

ROYAL ASTRONOMICAL SOCIETY, at 5.—(1) Observations of Comet *c*, 1905, and Comets *a* and *b*, 1906, from Photographs taken with the 30-inch Reflector of the Thompson Equatorial: (2) Pogson's Observations of U Geminorum, edited by H. H. Turner: Royal Observatory, Greenwich.—Hansteen's Eclipse at Stiklastad, 1030 August 31: P. H. Cowell.—The Proper Motion of Castor: A. C. D. Crommelin.—Note on some Proper Motions derived from a Comparison of Carrington's Catalogue, 1855: W. G. Thackeray.—Note on the Approaching Return of Halley's Comet: A. C. D. Crommelin.—On the Accidental Production of Temporary Errors of Division on a Graduated Circle: W. M. Witchell.—*Probable Papers*: (1) Note on Silicon in the Chromosphere; (2) The Enhanced Lines of Iron in the Region C to F: A. Fowler.—Estimate of the Number of Stars within Certain Limits of Proper Motion: W. G. Thackeray.—Discussion (*time permitting*): Possibility of Improving the Places of Reference Stars for the Astrographic Catalogue: H. H. Turner.—Solar Parallax Papers, No. 5, Photographic Places of Stars in the Paris *Eros* Circular: A. R. Hinks.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Mechanical Improvements in the Drainage of the Bedford Level: A. Carmichael.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—*Discussion*: Steam as a Motive Power for Public Service Vehicles: T. Clarkson.—*Probable Paper*: Lighting of Railway Premises; Indoor and Outdoor: H. Fowler.

MALACOLOGICAL SOCIETY, at 8.—Description of *Latirus* (*Peristernia*) *Sowerbyi*, sp.n.: J. Cosmo Melvill.—On the Anatomy of *Tagelus gibbus* and *T. divisus*: H. H. Bloomer.—Descriptions of two New Helicoid Forms from German New Guinea: J. H. Ponsonby.

MONDAY, DECEMBER 17.

SOCIOLOGICAL SOCIETY, at 8.—Sociology as a Province of Biology: M. Maxweiler.

SOCIETY OF ARTS, at 8.—Artificial Fertilisers: Potassic Fertilisers: A. D. Hall.

INSTITUTE OF ACTUARIES, at 5.—On the Error introduced into Mortality Tables by Summation Formulas of Graduation: G. King.

TUESDAY, DECEMBER 18.

ROYAL STATISTICAL SOCIETY, at 5.

SOCIETY OF ARTS, at 8.—Basket Making: Thomas Okey.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Mechanical Considerations in the Design of High-tension Switch-gear: H. W. E. Le Fanu.

WEDNESDAY, DECEMBER 19.

SOCIETY OF ARTS, at 8.—Modern Developments of Flour-milling: A. E. Humphries.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—The Guildford Storm of August 2, 1906: Admiral J. P. Maclear.—The Metric System in Meteorology: R. Inwards.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Exhibition of Slides from the Collection presented to the Society by Mr. Jas. Hilton.

THURSDAY, DECEMBER 20.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Track Circuit as Installed on Steam Railways: H. G. Brown.

LINNEAN SOCIETY, at 8.—Botanical Results of the Third Tanganyika Expedition, 1904-5: Dr. A. B. Rendle and others.—Fossil Foraminifera of Victoria; the Balcombian Deposits of Port Phillip: F. Chapman.—*Exhibition*: Albino Woodlice: Wilfred Mark Webb.

CHEMICAL SOCIETY, at 8.30.—A New Laboratory Method for the preparation of Hydrogen Sulphide: F. R. L. Wilson.—The Reaction of Acids with Methyl Orange: V. H. Veley.—(1) Contributions to the Study of the Calcium Phosphates, I., The Hydrates of the Calcium Hydrogen Orthophosphates: (2) Contributions to the Study of the Calcium Phosphates, II., The Action of Ammonia Gas on the Calcium Hydrogen Orthophosphates: H. Bassett, jun.

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