THURSDAY, MAY 24, 1906.

ADOLF VON BAEYER'S COLLECTED WORKS.

Adolf von Baeyer's gesammelte Werke. Herausgegeben zur Feier des siebzigsten Geburtstages des Autors von seinen Schülern und Freunden. Erster Band, pp. cxxxii+990. Zweiter Band, pp. 1194. (Brunswick: F. Vieweg und Sohn, 1905.)

AS we examine these two splendid volumes we cannot but feel that no better way of commemorating the seventieth birthday of Adolf von Baeyer could possibly have been found than that of collecting together his researches and publishing them so that they might be studied in their entirety by all students of chemistry.

The publication of the complete researches of an investigator who has had a profound influence on the scientific thought of his time has much to recommend it, since the collected works form not only a memorial to the investigator, but also enable others to gain an insight into the train of thought which preceded the gradual development of each important discovery.

The present volumes have, moreover, a special interest since they have been produced under the personal supervision of Baeyer himself, with the result that the vast amount of work which he has accumulated during the fifty years of his active life is arranged in the manner which he himself wished and thought most suitable.

These volumes contain as frontispiece a strikingly lifelike portrait of Baeyer. The introduction contains a most interesting sketch of Baeyer's life (1835–1905) from his own pen, which enables the reader to form a very vivid idea of the difficulties Baeyer had to encounter in the earlier days of his scientific career. Not only were the schools of chemistry which existed at that time few in number and the appliances even in the best of them only of a very elementary kind, but research in organic chemistry was still quite in its infancy, and therefore every new development was of the nature of pioneer work.

Although in his grandfather's house Baeyer was in his early years brought into contact with Paul Heyse, Geibel, Fontane, and other literary giants of the time, he showed no inclination towards literature, and soon began to develop a love for science by taking a keen interest in chemistry, botany, physics, and mathematics.

In 1856 he decided to devote himself seriously to chemistry, and became a student in Bunsen's laboratory at Heidelberg at a time when Roscoe, Pebal, Lieben, Beilstein, Lothar Meyer, and others were working in the laboratory, and when Bunsen's reputation as a teacher and investigator was at its highest. His first original investigation was a continuation of the work of Bunsen and Roscoe on the combination of hydrogen and chlorine, and this, as well as his next research, on methyl chloride, were suggested by Bunsen. After this Baeyer worked entirely on his own initiative, and gradually laid the foundations upon which the great edifice of his life-work was subsequently raised.

The papers collected together in the two volumes before us have been grouped by Baeyer under the following headings:—(1) The organic arsenic compounds; (2) the uric acid group; (3) indigo; (4) papers arising from the researches on indigo; (5) pyrrol and pyridine bases; (6) experiments on the elimination of water and on condensation; (7) the phthaleins; (8) the chemistry of the hydroaromatic compounds; (9) the terpenes; (10) nitroso-compounds; (11) furfurol; (12) acetylene compounds and the "Spannung's Theorie"; (13) peroxides; (14) the basic properties of oxygen; (15) dibenzalacetone and triphenylmethane; (16) various researches in the aromatic series; (17) various researches in the aliphatic series; (18) nomenclature; (19) diversa.

The titles alone will serve to convey some idea of the immense range of subjects which have claimed the attention of Baeyer, and as we study each of these sections we meet always the same characteristics—great skill in overcoming experimental difficulties (often necessitating the working out of entirely new methods of attack), and great ability in deducing the correct theoretical explanation from the results of experiment.

Within the necessarily limited space of this review it is, of course, impossible to discuss in any detail even the most far-reaching of Baeyer's discoveries or to attempt to follow their historical development.

Attention may, however, be briefly directed to some characteristics of Baeyer's work which will probably strike the reader most as he studies the successive sections into which these researches are divided.

The researches on uric acid, which date from 1860, are marvels of experimental skill, including, as they do, the discovery and characterisation of barbituric acid, violuric acid, and many other new members of this important group, and this at a time when the structure and relationship of the more important members of this section of organic chemistry were little understood. Baeyer was naturally interested in the problem of the synthesis of uric acid, and in 1863 he endeavoured to accomplish this by combining uramil with potassium cyanate, when he obtained pseudo-uric acid, an acid which contains one molecule of water more than uric acid itself. The synthesis was completed in 1895, when E. Fischer and L. Ach showed that pseudo-uric acid is converted into uric acid when it is melted with anhydrous oxalic acid.

Of great interest, not only from a purely scientific, but also from the commercial point of view, are the sections on the phthaleins and on indigo. The researches on the phthaleins must have required exceptional skill, ingenuity and patience, because it must be remembered that this work was absolutely new, and, moreover, the substances belonging to this class are, at the present day, some of the most difficult to deal with experimentally.

The well-known papers on indigo should be read in connection with a most interesting sketch of their historical development (p. xxxviii) which Baeyer himself has contributed.

The labour entailed in carrying out these researches must have been very great, and it is instructive to read that, after a certain time, Baeyer became so

wearied with indigo that he was quite unable to continue experimenting on the subject, and had to allow the various problems connected with the commercial development of his discoveries to pass into other hands. In search of fresh fields for investigation, Baeyer commenced an inquiry with the object of discovering whether carbon atoms, uncombined with hydrogen, are capable of uniting to form long chains, and, in order to determine this, he synthesised a number of poly-acetylene compounds, including tetracetylene-dicarboxylic acid

$$CO_2H.C{\equiv}C{-}C{\equiv}C{-}C{\equiv}C{-}C{\equiv}C.CO_2H.$$

This remarkable acid is quite colourless, but is readily blackened by the action of light, and compounds of this type were found to be so explosive that their further investigation had to be abandoned. One of the fruits of the consideration of the properties of these compounds was the enunciation of the well-known "Spannung's Theorie," which has given rise to so much discussion, and proved to be of such value in suggesting new lines for experimental inquiry.

Section viii., which Baeyer has placed directly after the phthaleins, deals with the chemistry of the hydroaromatic compounds and the constitution of benzol. These researches date from the year 1866, when, in conjunction with Graebe, Born, Mohs and others, he first investigated the behaviour of phthalic acid and terephthalic acid towards sodium amalgam.

Baeyer repeatedly returned to this subject in later years, but it was not until 1888 that the epoch-making series of papers "Ueber die Constitution des Benzols" began with the exhaustive study of the products which are formed when terephthalic acid is reduced with sodium amalgam. These researches on the reduction products of the phthalic acids and of benzene itself are well known, but they have perhaps hardly received the close attention which they merit, owing partly, no doubt, to their difficult and intricate nature. The careful study of these papers will, however, more than repay the time spent, and to the young investigator they may well serve as an example of the patience and endurance which he must be prepared to face if he wishes to attempt the solution of a problem of really first-rate importance.

It is perhaps a consequence of the study of these artificially prepared reduction derivatives of benzene that Baeyer was led to investigate that wonderful series of naturally occurring reduced benzene derivatives—the terpenes—the constitution of which has offered one of the most difficult problems to the modern organic chemist. During the course of his experiments on the oxidation of substances which, like the terpenes, contain unsaturated closed chains, Baeyer commenced to experiment with Caro's acid, and, among many other interesting results, showed that this acid was a most valuable reagent for the conversion of ketones into lactones. Further experiments resulted in the discovery of the remarkable series of peroxidised substances of which benzoyl-hyperoxide and diethylperoxide may be taken as types, and led to a development of Collie and Tickle's important work on the tetravalent nature of oxygen and the oxonium theory.

Baeyer's latest publications deal with the vexed question of the relation of colour to constitution, and are concerned especially with the reason for the coloured nature of certain salts derived from dibenzal-acetone and from triphenylcarbinol. One of the most remarkable results of this investigation is the proof that the coloured salts of triphenylcarbinol are in reality esters possessing the properties of salts, and that they cannot be regarded as quinoid compounds.

Baeyer is, at the present time, occupied with the further development of this important matter.

It is impossible to close the volumes before us without marvelling at the immense amount of work which it is possible for one man to carry out, and without a deep impression of the enormous influence which the work of Baeyer has had on the development of modern chemistry. The list of papers published from Baeyer's laboratory occupies no less than sixty-three pages of closely-printed matter, and when we look at the names attached to these papers we are able to form some idea of the magnitude of the school which he has founded, and of the extent to which many of the greatest chemists of the day owe their training in research to Baeyer.

W. H. PERKIN, JUN.

A STANDARD TREATISE ON ELASTICITY.

A Treatise on the Mathematical Theory of Elasticity. By A. E. H. Love. Second edition. Pp. xviii+552. (Cambridge: University Press, 1906.) Price 18*s.* net.

INSTEAD of merely revising his former treatise, Prof. Love has written a new one; the result is that we have two works by the same author, in some ways contrasting, in others complementary. And as in the similar cases of Maxwell's "Electricity," and Thomson and Tait's "Natural Philosophy," the prudent will buy the new book without parting with the old.

Naturally one feature in the new edition is the inclusion of important or interesting results obtained since the appearance of the earlier one. In some branches of mathematics the proportion of English workers is distressingly small; but in elasticity this is happily not the case, and the recent researches of Michell, Filon, Dougall, and others, besides those of veterans that need not be named, receive in these pages their due recognition. So also do those of their Continental *confrères*, more particularly Voigt; but it is hard to avoid the impression that the deaths of Kirchhoff and Hertz have left vacancies which have yet to be worthily filled.

It is interesting to compare the historical introduction in its old form with its successor. The former was in some places controversial, and the author seems to have thought some of the statements too dogmatic, at any rate in form. However this may be, the new introduction is strictly impersonal, and shows clearly enough how recent physical theories and discoveries affect the subject of elasticity. A great deal of the polemic about the number of elastic constants was as illogical as the quarrel about *vis viva*. As an abstract

mathematical theory, the 21-constant hypothesis is as legitimate as its rival and conversely; the question that interests physicists is which of the two, if either, best corresponds to the properties of elastic bodies. Saint-Venant rightly argued that this could not be settled *a priori*, but only by experiment; and at the present day his justification on this point is complete, although he was led to adopt the rari-constant theory by relying upon inconclusive experiments. As Prof. Love points out (pp. 14, 15) our views of the ultimate structure of matter are being profoundly modified, and until they are cleared up it is premature to propose an "atomic" theory of elasticity. Meanwhile we can make a working hypothesis by assuming the existence of a strain-energy-function which is a quadratic function of the components of strain. In all probability the ultimate theory, if we could only reach it, is kinematical; the stresses set up in a strained body being an aspect of a new distribution of kinetic energy in space.

The results of the theory, as applied to the arts, are, of necessity, only approximate; and great care must be taken to see that, when an approximate solution has been obtained, it is really applicable to the concrete case. An excellent example is given on p. 140, relating to a sphere strained by its own gravitation. If we put in the numerical values of g, r_0, ρ, and any reasonable values for λ, μ, when the sphere in question is the earth, we find that the condition that U/r should be small for $r_0 > r > 0$ cannot be satisfied, although this is one of the assumptions on which U has been calculated. This point was brought out in the previous edition (i. 220); it is a pity that this warning has been suppressed, though another, equally instructive, has been given.

Again, take the condition (or conditions) for rupture taking place (pp. 117 *sqq.*). This cannot be given by the ordinary theory, which is only applicable when the elastic limit is not exceeded. Nevertheless, attempts have been made to express the condition in terms of the components of stress. This is entirely illogical, and hence, as usual, a contest between rival formulæ. It may, of course, happen that one formula, as against the other, may have a wider range of applicability; but it ought to be treated as purely empirical, and not rashly applied to untested cases. On this point the author might have been more dogmatic than he is.

A very interesting section is that on the deformation of plates. This is a famous problem, historically, and even lately gave rise to a controversy, now satisfactorily settled. To get a reasonably simple approximate solution some kinematical assumption must be made, and this must be compatible with the boundary conditions. Prof. Love pointed out that, strictly speaking, a vibrating plate with free edges cannot satisfy the condition that the middle surface is unstretched; Mr. Basset and Prof. Lamb showed that the boundary condition could be satisfied without supposing any considerable stretching except near the edge. An interesting statical illustration due to Lamb is given on p. 521. On p. 506 Prof. Love obtains, by a method of his own, second approximations for stress and strain in a curved shell, agreeing to that order with results of Mr. Basset's.

In this, as in other parts of the book, the analysis is very elegant, and is given in sufficient detail for really competent readers to follow. But the author follows the general tendency now in vogue, of suppressing details of calculation, and emphasising results of practical value, rather than examples of mainly æsthetic interest. In his preface he expresses a hope that his book will be useful to engineers; how far they do so depends, of course, upon them as well as upon him. They will find among the subjects treated the buckling of plates, the collapse of boiler-flues, the whirling of shafts, the stability of slender columns, and other such things; it is to be hoped that they will also appreciate the general theory, as the author presents it. Every student, not an expert, should follow the advice given in the preface of proceeding to chapter v. as soon as possible.

It is a great advantage that the author of this book is a mathematician of wide as well as accurate attainments. As an illustration, it will be enough to refer to p. 306, dealing with the torsion of a rectangular prism; it is at once clear that the author's knowledge of Fourier expansions is quite different from that of the average physicist. Similar examples of rigour free from pedantry may be found throughout the volume.

At the end of the introduction occurs the sentence: "Most of the men by whose researches it [the mathematical theory of elasticity] has been founded and shaped have been more interested in Natural Philosophy than in material progress, in trying to understand the world than in trying to make it more comfortable." It may be added that most of the comfort we enjoy, and most of our civilisation that is worthy of the name, is due to men who have endured discomfort, in pursuance of ideal ends. Apart from the poets and the philosophers, where should we be?

G. B. M.

PROTEID CHEMISTRY.

Chemistry of the Proteids. By Dr. Gustav Mann. Based on Prof. Otto Cohnheim's "Chemie der Eiweisskörper." Pp. xviii+606. (London: Macmillan and Co., Ltd.; New York: The Macmillan Co., 1906.) Price 15*s.* net.

DR. GUSTAV MANN started this work with the modest idea of producing an English translation of Prof. O. Cohnheim's well-known monograph on the chemistry of the albuminous substances. But it has developed into a volume of a much more ambitious nature, and has culminated in a book twice the size of that on which it is founded. The subject in many parts is treated much more fully, and a good deal of new matter introduced. In many places, moreover, Cohnheim's own views are adversely criticised, so that the present volume bears witness to the originality of the English author.

Those who know Dr. Mann best as a histologist may be surprised that he should have the necessary knowledge to write on a subject at first sight so far

removed from the microscope. His previous book on Physiological Histology has, however, shown the connection between the two. The fixing action of preservatives on tissues, the staining reactions of cells and nuclei, are ultimately chemical in nature, and much of macro-chemistry can be learnt from micro-chemistry. Dr. Mann's sympathies are mainly physiological, not anatomical. Physical chemistry also is more than a hobby with him, and the sections relating to speculations of a physico-chemical nature form pleasant oases in what as a rule is rather solid reading. His histological proclivities have led him in some cases to devote a good deal of space to subjects which some might regard as of secondary importance—for instance, his lengthy description of the interactions of proteids with mercury compounds evidently springs from the extensive use he has made of corrosive sublimate as a fixative.

Cohnheim's book in the original state cannot be described as an ideal one. It lacks the imaginative faculty, and reflects the stolid, plodding German worker, anxious to omit no reference to literature that can possibly be dragged into a footnote. To some investigators this is of course advantageous; they will profit by the diligence of the author, and easily be able to consult the memoirs quoted in reference to any special point they are interested in. But to the student who desires to obtain a general insight and a wide outlook on the general relationships of the subject, this compression of material is a distinct hindrance; he will be apt to lose sight of the wood on account of the trees.

Dr. Mann follows on very much the same lines, and though it is impossible to restrain one's admiration for his labours in hunting up literature, quoting authorities as far back and as far forward as possible, one cannot but regret that the text does not as a consequence run easily, and most of it will form stiff reading even for advanced students. In some places the pages abound with chemical formulæ without a sufficient guidance in words. Here, again, anyone but an accomplished organic chemist will have difficulty in finding his way along.

Dr. Mann also has certain mannerisms of style, but one does not complain of these unduly, for they stamp the pages with the author's individuality; but there is one of these faults which many will find annoying and even confusing, and that is a looseness and inexactitude in the use of terms. For instance, on the title-page we find the word "proteid" used as a general expression for all the albuminous substances; within the pages of the book "proteid" is employed only for a certain group of these materials. Albumin also is sometimes used as a generic term, and at other times applied to a specific group; sometimes it is used as opposed to globulin, sometimes it includes the globulins, and sometimes it includes everything. In one place we read that lactalbumin is one of the few true albumins; on another page it is alluded to as a hypothetical substance. The author has dedicated his work to his father, and in the dedication tells us something of his father's life-work. It would be interesting to know something more about his ancestry—whether, for instance, he has any Irish blood in him. The use of the expressions "true pseudo-acid" and "true pseudo-base" is distinctly Hibernian.

The same kind of carelessness is shown in the spelling. Albumin is sometimes spelt with an *i*, sometimes with an *e*. The nomenclature committee of the Chemical Society tried to introduce uniformity into spelling, and assigned certain meanings to certain terminations. A word ending in *ine*, for instance, means an alkaloidal material; a word ending in *in* does not; similarly, the terminations *ol* and *ole* have a distinct chemical significance. But Dr. Mann has paid no attention to such rules. "Vitellin," for example, is sometimes spelt with, sometimes without, a final *e*. "Gelatine" and "cholin" are spelt as just printed in direct contravention of the rules of the Chemical Society. The names of investigators are also often mis-spelt; Waymouth Reid, Curtius, Claude Bernard, and Lane-Claypon are among the sufferers.

The whole question of nomenclature in chemistry is very difficult, especially in translations. It is hopeless to try to reconcile English with German usages, but there ought to be an attempt on the part of English writers to adopt some sort of uniformity. This difficulty is accentuated in relation to proteid nomenclature, and one can only hope that the joint committee of the Physiological and Chemical Societies now sitting on this very subject may put forward some practicable suggestions. Dr. Mann is therefore not wholly to blame for his misdeeds.

In spite of the blemishes to which I have devoted so much space, I believe the book will have a useful career in front of it. Its many excellences can be discovered by reading it and using it, and Dr. Mann is to be congratulated in having produced such a valuable addition to scientific literature.

W. D H

STATISTICAL SEISMOLOGY.

Les tremblements de terre. Géographie Séismologique. By Comte F. de Montessus de Ballore; with a preface by Prof. A. de Lapparent. Pp. v+475. (Paris: Armand Colin, 1906.) Price 12 francs.

WITH the growth of their science seismologists have become more and more specialised, and devoted themselves to the cultivation of a limited portion of their domain, but none have marked out for themselves a more clearly defined plot, or cultivated it with greater assiduity, than the Comte de Montessus de Ballore. Leaving to others the study of the nature and effect of earthquakes, he has confined himself to the consideration of their cause, and attacked the problem by the statistical way, believing that a detailed study of the distribution of earthquakes in time and space will most conclusively indicate their cause. By no means the first cataloguer of earthquakes in point of time, for the great lists of Mallet and Perrey are well known, to say nothing of the numerous local catalogues compiled by others, our author stands preeminent in the number of earth-

quakes which he has tabulated, and the work before us deals with the records of 171,434 distinct shocks. The labour involved in this compilation would have formed no light task for any man, and when we remember that, besides being a specialist in seismological statistics, the author is an officer on the active list of the French Army, the result seems almost miraculous.

In summing up the results of all this compilation the author holds that he has conclusively established the independence of earthquakes and volcanoes, and the greater prevalence of the former along those tracts where the surface relief shows the steepest and longest gradients. Both these conclusions had been reached by Prof. Milne while working in Japan, and the second of them is only an empirical, and not invariable, way of expressing the general principle that earthquakes are most abundant where the crust-movements have been greatest and most recent, while they become rarer as these movements are older and have more or less completely died out; but we must remark that earthquakes seem to be more particularly associated with the changes resulting from, or accompanied by, compression, for the dropped valleys of the Jordan, the Red Sea, and of Central Africa are not specially affected by earthquakes.

Comte de Montessus attempts to carry his conclusions still further, and finds that earthquakes are almost confined to certain bands which correspond with the secondary geosynclinals of Haug, and are said to lie along two great circles, making an angle of 67° with each other. We have had the curiosity to plot these bands, as shown on the map accompanying the book, upon a globe, and have failed to find any correspondence between them and the great circles as defined, or, indeed, with any other great circles; approximately, they seem to form a network of arcs of great circles, joining up in groups of three and four, an interpretation which is more probable than the other, though the departures in detail render the correctness of either view doubtful. However this may be, the fact remains that nine-tenths of the shocks recorded have originated in regions which cannot cover more than one or two per cent. of the globe and are almost all distributed along certain lines, of which the most important are the great girdle of the Pacific, the line which runs up from the Sunda Islands, through Arracan, the Himalayas, Caucasus, and Alps to the western Mediterranean, and another which runs up from the Caucasus through the mountains of Central Asia to Lake Baikal, possibly continuing to somewhere in the neighbourhood of the Bering Straits.

Though, in the main, the distribution of the more violently shaken regions shows no change from that drawn by Mallet in 1858, there is a radical difference in the character of the two maps. In Mallet's the frequency of earthquakes was indicated by the depth of tint, and the dark patches shaded off gradually into the white; de Montessus, believing that it is a mistake to treat an essentially discontinuous phenomenon as a continuous one, has made the limited areas, where destructive earthquakes are known to originate, black, and left the rest of the map blank. This abrupt boundary between the regions classed as seismic and the much more extensive ones classed as peneseismic or aseismic, is held to be a better representation of what is actually the case than any gradual shading of the one into the other. The difference between the two maps is, in fact, one of principle; Mallet's was meant to indicate the frequency with which earthquakes were felt, that of de Montessus the frequency with which they originate. Each of these facts is interesting in itself, but their delineation must necessarily differ, apart from any question of increasing perfection of the data.

We have indicated some of the conclusions drawn in this book, which do not seem to be so fully established as its author suggests, but this must not be taken in derogation of the value of his work in statistical seismology. We welcome this summary of his researches, and regret that he should have followed the custom, so common in France, of omitting a subject index.

OUR BOOK SHELF.

Notes on Shipbuilding and Nautical Terms of Old in the North. By E. Magnusson. Pp. 62. (London: A. Moring, Limited, 1906.) Price 1s. net.

THIS small volume reproduces a paper read before the Viking Club Society, and its appearance will be welcomed by all who are interested in the history and development of shipbuilding. Although it deals chiefly with Scandinavian records and discoveries, it contains an excellent summary of Greek and Latin references to ancient ships, and does not leave unnoticed much older Egyptian types. In short it is a scholarly performance, and the writer has a full appreciation of technical developments which have accompanied progress in shipbuilding. Wide reading and research must have been undertaken to provide the materials; they have been dealt with in a terse but clear style, and the result is of permanent value as a book of reference and a bibliography of the subject. An excellent glossarial index is appended. The only regret one feels is that there are no illustrations. The rock-carvings of ancient ships found in Egypt, Sweden, and Norway are described and compared; but simple illustrations would have emphasised the deductions made by the author. Again, the details of methods of construction which Mr. Magnusson gives are readily understood by experts in shipbuilding, but would be grasped by general readers also if diagrams of a simple nature had been given. The ancient ships found in Scandinavia and preserved in museums might also have been pictured with great advantage. Of course size and cost would be increased if this were done, but that action is well worth the consideration of both author and publisher, as the permanent value of the book would be greatly increased thereby, and its place in the libraries of all interested in shipbuilding would be assured.

A book so condensed in form and substance must be read to be understood. Mr. Magnusson does not claim originality in discovery or treatment. He starts with the log and raft of the stone age, passes to the canoe hollowed from a single log by the use of fire and flint implements; traces the development of the coracle and other hide-covered vessels, with internal framework; shows how these "skins" were replaced by wood planks, first fastened by thongs or withes,

and later on by iron nails; and so he arrives at methods of building which persisted, with trifling variations, until wood gave place to iron in the last century. As regards propulsion a similar advance is traced from the single oar, to the rowing boat, and the galley with its banks of oars, coming at last to the use of masts and sails, as navigation took a wider and over-sea range. The special provisions made in vessels used for purposes of war are described, including that most ancient method of attack—the ram-bow. Altogether the book is an excellent piece of work.

W. H. W.

A First German Course for Science Students. By Prof. H. G. Fiedler and F. E. Sandbach. Pp. x+99. (London: A. Moring, Ltd., 1906.) Price 2*s.* 6*d.* net.

IT is essential that students who intend to devote serious attention to science should be able to read scientific works in French and German, and, if possible, also in Italian. By the use of the present book a working knowledge of the German language can be obtained through lessons based upon work in elementary physics and chemistry. The book consists of a series of reading lessons describing simple experiments and principles such as are included in the rudimentary courses of schools. The words and phrases used in the various reading-passages are graded in such a way that the principal rules and grammatical forms are illustrated by the text. A short outline of grammar essential for the purpose in view follows the series of lessons, and there is a full vocabulary.

The book is printed in English characters, but the text and illustrations have a decidedly German appearance, as is appropriate in this case. Though the course covered by the lessons is similar in substance to that taken as introductory science in many schools, no doubt most teachers will prefer to follow English text-books for the actual work of the class-room and laboratory, and to use this book as an auxiliary aid or an incentive to the study of German. For pupils who are familiar with the experiments described, the book will be found very useful, and it will make them acquainted with the German equivalent of many technical terms not to be found in the ordinary reading books of the language. As an attempt to coordinate the teaching of modern languages and science, it will no doubt be appreciated, and for the finer feeling of literature pupils may still read extracts from the works of standard authors.

Personal Hygiene Designed for Undergraduates. By Dr. A. A. Woodhall. Pp. vii+221. (London: Chapman and Hall, Ltd., 1906; New York: John Wiley and Sons.) Price 4*s.* 6*d.* net.

PERSONAL hygiene is an important branch of hygiene which does not receive its full measure of treatment in any text-book, but this small work does not pretend to offer to its readers more than a clear and elementary statement upon the hygienic needs of the body. It is intended for undergraduate students, and it consists of the substance of lectures upon personal hygiene delivered by the author during the past few years. Exercise, food, clothing, habits, and similar matters of daily individual concern, are here dealt with in language as free from technical terms as possible. We are told in the preface that the constant aim of the writer has been to present actual conditions in the simplest language, and it must be said that he has achieved this object. We may add that the work is free from "Americanisms"—either of wording or spelling.

Only such elementary facts of anatomy and physiology as are necessary to the reasonable understanding of the subject are introduced, and some hints as to "first aid" are here and there given in the text, but this subject is otherwise omitted.

The chapters on alcohol, tobacco, and exercise are particularly good. They are discussed in tolerant language and with much sound common-sense. After reading the following opinion (p. 157) the reader will think twice before he refuses an offer of confectionery. "Where the taste has not been vitiated, in a degree by tobacco but chiefly by alcohol, sugar is as acceptable to the normal civilised man as it is to savages, and his disposition toward candy is no bad test of his drinking habits."

The following criticism of our national game of cricket will scarcely meet with approval in this country:—"Cricket, an exotic that has never taken wide root on our soil, lacks many of the qualities of a good game, chiefly because of the long waits before going to the bat and the limited number actively engaged." But though the author does not write in his usually well-informed manner upon this particular item, the following statement (p. 88) will serve to acquit him of the charge of bias towards *every thing* American:—"The misnamed nasal twang with which some Americans are justly charged is due partly to chronic catarrh, blocking the nasal passages, and partly to that curious and unconscious imitation by which in youth we acquire the tone most commonly heard. Unfortunately, as a people all our voices are too sharp and rasping. . . . We are so accustomed to strident voices that we fail to recognise their inherent infirmity."

Life and Matter. A Criticism of Prof. Haeckel's "Riddle of the Universe." By Sir Oliver Lodge. Pp. ix+200. (London: Williams and Norgate, 1905.) Price 2*s.* 6*d.* net.

IT is difficult to pardon Prof. Haeckel for his dogmatism and his over-statements, and no less for his having furnished the peg on which have been hung many dull books and reviews. Forgiveness becomes easier when his work evokes a first-rate criticism like that in the volume before us. Sir Oliver Lodge contests chiefly (*a*) the right by which the name of Monism is arrogated to the Haeckelian philosophy; (*b*) Haeckel's statement of the "Law of Substance," the true account of which, according to the critic, is that "anything which actually exists must be in some way or other perpetual"; (*c*) Haeckel's account of the development of life, and particularly the theory which endows the atoms of matter with life, will, and consciousness.

The later chapters of the book state with great clearness Sir Oliver Lodge's own constructive views. He regards it as possible that life is a basal form of existence, as fundamental an entity as matter and energy. "It can neither generate nor directly exert force, yet it can cause matter to exert force on matter, and so can exercise guidance and control." His view occupies a middle position between the so-called monistic one and that, for example, of Prof. James Ward, who argues that the laws of physics are only approximate and untrustworthy.

The author, who understands well that effective illustration is half the difficulty, and that the "analogy of experience" is one of the soundest of philosophic principles, develops a fascinating comparison between life and magnetism. If we understand his views aright they imply that possibly mind can exist apart from terrestrial brains, and life apart from living creatures or plants as we know them—that is, that the phenomena of life and consciousness

which surround us are due to the interaction of something material and something spiritual, or (to express it otherwise) to the fact that something spiritual uses the material as its instrument or organ. This seems to imply a dualism, but he also holds it possible that "there may be some intimate and necessary connection between a generalised form of matter and some lofty variety of mind."

The arrangement of the various topics is not always the best possible. This is partly caused by the inclusion of reprints from well-known journals—a practice which is open to criticism. But apart from these slight defects the book deserves hearty commendation.

The Fox. By T. F. Dale. (Fur, Feather, and Fin Series.) Pp. xiii+238; illustrated. (London: Longmans, Green and Co., 1906.) Price 5*s*.

"THE fox," writes the author in his opening paragraph, "is at home in Europe, Asia, including India, a great part of Africa, the whole of North America, and a distinct but allied species, *Canis virginianus*—known as the grey fox in the United States—is found in South America." If he had tried to compress as many errors as possible into a single sentence, he could scarcely have succeeded better. The fox is unknown in India proper, it inhabits only the northern fringe of Africa, and the grey fox (*Urocyon cinereoargenteus*) is a native of North and not of South America. This is one of those numerous instances where authors of works on popular natural history will go out of their way to refer to subjects which they do not understand, and which do not concern them. Had Mr. Dale kept within his proper limits, we should have had nothing but commendation to bestow upon his work, in which the fox is discussed from the point of view of the sportsman and the farmer in a very thorough manner. The eight illustrations by Messrs. Thorburn and Giles are all that can be desired, although one of them follows somewhat closely on the lines of a well-known sketch by the late Mr. Wolf.

R. L.

Oologia universalis palæarctica. By Georg Kause. Part i. (Stuttgart: Fritz Lehmann, Verlag; London: Williams and Norgate.)

THIS is the first part of a beautiful egg book, printed entirely on separate sheets of cardboard, two sheets being devoted to each species—one of coloured figures of the eggs, the other of letterpress, backed with references to the specimens figured. The text is in German and English, and comprises a large number of synonyms and local names, and a short description of the range of the bird, its breeding habits, nest, eggs, &c. The four species treated of in the first part are the golden eagle, quail, song thrush, and raven, as many as sixteen (odd) eggs of the last-named bird (from different localities) being figured. In the case of the song thrush we have five "clutches," and in that of the golden eagle a clutch of two eggs and three single ones. The colour printing has been very successful, and admirers of eggs will welcome the excellent selection of varieties which has been figured, of each of which the "data" are given. We cannot extend the same praise to the English version of the letterpress, which is crude, too literal, and disfigured by unfamiliar words and expressions. However, it is possible to understand what is meant, although the remark on the quail that "the ♀ only breeds, the male is polygamons," reads strangely until we substitute broods for breeds and correct the misprint.

The work is to be complete in 150 parts, and Messrs. Williams and Norgate point out that on the publication of Part ii. the price per part will be raised from fifteen to eighteen pence.

LETTERS TO THE EDITOR.

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

Osmotic Pressure.

IN the concluding sentence of his most interesting letter on this subject in your issue of May 17 (p. 54) Mr. Whetham states that "The theory of ionic dissociation rests upon electrical evidence, and by such evidence it must be tried." It is unnecessary to dwell on the importance of the pronouncement.

Will Mr. Whetham kindly tell us *how* we *know* all the things which—in the final paragraph of his letter—he so confidently asserts that we know; in fact, what *precisely* the *electrical evidence* is upon which the theory of ionic dissociation *now rests*. He is a recognised master of lucid exposition and will be able, I am sure, as counsel of the whilom advocates of the doctrine of molecular suicide in solution, to state the case fully and fairly on their behalf. When we have this statement it will perhaps be possible to consider the validity of his modest contention and whether electricians alone have the right to pronounce judgment. A plaintiff is usually sure of his case before his cross-examination takes place.

This request is preferred in no adverse i(r)onical spirit, simply because I feel that it really is necessary that we should be informed where we are exactly. Our friends the ionic dissociationists are incorrigible squatters and seem to think that they have acquired the right of preemption over their adversaries' property; it is difficult to know, as they object to stock-taking, whether they have given anything in exchange for that they have lifted and what they have jettisoned of their original property; and until the electricians' title-deeds are shown and submitted to careful scrutiny, chemists can scarcely be expected to admit that they are ousted from possession.

As a chemist and a friend of the poor molecules, I feel that the aspersion of immorality should not be allowed to rest upon them for ever unless the evidence be really condemnatory beyond question. In any case, it is important that we should discover the true nature of the crime committed in solution; to cloak the inquiry by restricting it to thermodynamic reasoning—a favourite manœuvre of the mathematically minded—is akin to using court influence in abrogation of full and complete investigation; such a course may satisfy the physicist but is repulsive to the chemist, who, although able, perhaps, to imagine the existence of a frictionless piston, yet desires, in the first place, to get nearer to a knowledge of what happens to the real tangible piston of practice.

HENRY E. ARMSTRONG.

MR. WHETHAM'S letter in NATURE of May 17 (p. 54) raises clearly the whole question of the applicability of thermodynamic reasoning to osmotic phenomena. As my views as to the value of thermodynamic reasoning appear to be somewhat heterodox, may I indicate some criticisms of his remarks?

All thermodynamic proofs assume the truth of the "second law." Now the machinations of Maxwell's demon have shown clearly that the meaning of this law, when interpreted in terms of the molecular theory, is merely that, in the processes considered, no differential treatment is applied to the molecules in virtue of their different velocities. The law may or may not be true in any particular case. It cannot be said that there is any *a priori* support for it, or that a proof of its validity for one small branch of phenomena would justify its application to a totally different branch.

In all treatises with which I am acquainted, when the law has been stated, the only reasons alleged for believing it to be true are those derived from our inability to construct a heat engine which will work without equalising temperature. A few pages, before or after, will be found the statement that we cannot construct a reversible heat engine; but it is not pointed out that the irreversibility of all actual engines would mask the effect of a violation of the second law, unless that violation were very complete and the separ-

ation of the molecules into high and low velocity groups very nearly perfect. A demon might be slaving with the most commendable energy, but all his exertions would be rendered inoperative by the imperfections of our apparatus. To my mind, the evidence for the second law, even applied to the best actual heat engines, is extremely slight.

But even if the evidence were overwhelming, there would be no justification for applying the law to a process of such an entirely different nature as osmosis, where, moreover, there is some presumption that it is not true. No actual membrane is perfectly semi-permeable; some molecules of the solute pass through; it is not wildly improbable that these molecules possess velocities within some narrow range. But if this is so, Maxwell's demon is at work, the second law is not applicable, and thermodynamic reasoning is absurd. Definite experimental proof must be offered before the validity of the law for osmosis can be considered even probable. Some progress might be made by examining the same membrane at different temperatures; if its "degree of imperfection" did not vary rapidly with the temperature, the existence of such a separation as has been suggested would be rendered less probable.

Mr. Whetham has offered some proof already. He points out that there are five assumptions involved, and asserts that the truth of all of them is proved by the agreement between theory and experiment. But he ignores the possibility that two or more of the assumptions may be incorrect and that the errors thus introduced may cancel each other. He offers a particular solution of an equation containing five variables, and assumes that it is the only solution possible.

It must be remembered that there is not perfect agreement between theory and experiment. The errors are larger than those involved in the direct measurement of the pressure and the other quantities involved; there is a systematic error. But this is due, say the thermodynamicists, to the imperfection of the membrane. Exactly so; but that imperfection may invalidate the whole proof; in order to support their proof they may be denying one of their fundamental assumptions.

Mr. Whetham says that to reject the theory because there is no perfect membrane would be as absurd as to reject all thermodynamics because there is no reversible engine. I agree; but then I am such a heretic that I reject both. Our inability to construct a perfectly reversible engine is connected with the impossibility of handling individual molecules; friction and the rest would vanish if we could replace the material cylinder by a swarm of trained demons. When we have constructed a perfectly reversible engine we shall be possessed of the powers of those demons, and we shall be no longer bound by the second law, which merely asserts that we do not possess those powers. So far as physicists are concerned, reversible thermodynamics *is* "a vain thing."

Neither am I convinced of the perfection of Mr. Whetham's two perfect membranes. They are doubtless perfect so far as the solute is concerned, but his assumption (2) may be violated by the molecules of the solvent. It is quite possible that it is the swifter molecules which escape in the vapour and the slower which escape into the solid, and that, if our experimental devices were sufficiently delicate, we could use the separation thus effected to perform useful work. At any rate, proof is required to the contrary before thermodynamic deductions can be made with accuracy.

So far as I can see, thermodynamic reasoning applied to osmotic phenomena, as to most others, proves nothing but that the sum of the errors introduced by the various rather doubtful assumptions is not very different from zero—a result that does not seem to me worth the labour that has been expended in obtaining it

NORMAN R. CAMPBELL.

Trinity College, Cambridge, May 20.

The Oscillation of Flame Cones.

PROF. GALLOWAY (NATURE, April 19, p. 584) considers that my explanation of the phenomenon described by Mr. Temple in his letter (March 29, p. 512) is inadequate, and he offers a different explanation. With the view of deciding the question some experiments have been made here by Mr. C. E. Whiteley. I may perhaps repeat that the phenomenon in question is the continued descent and re-ascent of the inner cone of a coal-gas and air flame when a suitable mixture of the two is ignited at the end of a glass tube fixed so as to form a prolongation of the metal tube of a Bunsen burner.

The following results were obtained by Mr. Whiteley:—(1) The continued oscillation of the inner cone could not be established with a forced supply of both gas and air, but only when the air was sucked in by the injector action of a gas jet, as in the ordinary Bunsen burner. (Mr. Temple informs me that this was also his method of working.) (2) The continued oscillation of the inner cone could be maintained when the apparatus was tilted even to horizontality or beyond. (3) When the inner cone began to descend a back pressure was immediately produced in the ascending current of gas and air.

I think the determining influence is clear from these observations. When the cone begins to descend and causes a back pressure this will momentarily check the indraught of air without materially checking the supply of gas. A stratum of mixture containing less air is thus produced; its rate of inflammation is less than its upward velocity, and so the cone is carried to the top of the tube. Soon the normal air supply is re-established, a mixture with a higher rate of inflammation is restored, and the cone again descends.

A confirmation of this explanation is afforded by two further observations:—(4) a shortening of the glass tube increases the rapidity of oscillation in conformity with the shorter distance to be traversed by the altered stratum; (5) a "capacity" in the form of a globe at the bottom of the glass tube stops the oscillation. Such an arrangement would both damp the back-pressure impulse and obliterate stratification.

Observations (2) and (5) show, I think, that the chimney-like action suggested by Prof. Galloway cannot be the determining cause, and indeed this could hardly be expected, inasmuch as such action would increase the aspiration of air and produce a mixture having a higher rate of inflammation, a condition which would oppose the other effect, viz. the increased upward velocity of the mixture to which alone Prof. Galloway alludes.

My own previous explanation was inadequate to explain the continued oscillation, and only important in relation to the lighting back of Bunsen flames.

ARTHUR SMITHELLS.

The University, Leeds, May 19.

Ancient Fire Festivals.

IN reference to your series of articles which have recently appeared in NATURE on Stonehenge and the ancient festivals, I send you the following notes on a Wiltshire celebration of the August fire customs. Tan Hill Fair is held on August 6, and the coincidence of the name Tan (Celtic for fire) and the date point to a time long prior to our era, when the fire festivals were annually held.

This fair, the origin of which is lost in antiquity, is held in the very last place likely to be chosen for such a purpose, and must have had its beginning at a time when men assembled there for some purpose very different to what brings them there now, for neither roads nor waterways (conditions essential to most fairs) lead to Tan Hill.

Tan Hill is on the highest part of the downs (near Devizes, north Wiltshire), 958 feet above sea-level, looking down on Avebury and dominating the whole country, and crossed only by British trackways which lead to the fair.

Sacred fires lit of old on this Tan Hill would have been seen from Martinsell (near Marlborough), Hackpen, Oldbury, and for miles around, and were probably eagerly watched for by the people taught to expect the blessing on the crops of the ensuing year consequent on these fires; and it is on this bleak, desolate down that one of the largest fairs of the country is held.

Fairs in Ireland and in Wales carry on the same tradition of the ancient fire festival held in August, as well as this one at Tan Hill.

In ancient Ireland this August celebration was called "*the Lugnassad*," the feast of Lug (a sun god), and according to Prof. Rhys "this festival was the great event

of the summer half of the Celtic year, marking the victorious close of the sun's contest with the powers of darkness . . . when the crops were fast coming to maturity," and he suggests that the great festival held on the first of August "at Lyons (ancient *Lugduna*) superseded an older feast held on that day in honour of Lug, and was the Gallo-Roman continuation of the Celtic custom of old days." Gwyl Awst (the Yule of August) is the name by which this same August festival was known in ancient Wales.

He remarks that "the Lugnassad was, so to speak, the Summer Solstice of the Celts, whereas the longest day was then of no special account" (Rhys, Hibbert lectures).

Very interesting accounts of an August festival are given by Mr. Frazer ("Golden Bough") as celebrated by the Creek Indians and also by the Natchez tribe on the Lower Mississippi, when fires were lighted to destroy what was old before the ceremonial renewal of new fire took place by the priests by the friction of two pieces of wood, on the appearance of the first ray of the rising sun.

Among the special marks distinguishing the primitive ritual of heathendom from later customs, Mr. Frazer remarks that there were no temples, but that the celebrations took place by brooks, in woods, barns, harvest-fields, &c.

This interesting fair is clearly a survival from pre-Celtic days, but the interest in the place has unfortunately been much obscured by the alteration of the old name Tan to St. Anne's Hill on all modern maps.

It was a very common and well-known custom of the Church in late times to alter the name of a place to that of a saint, where, finding large gatherings assembled for religious ceremonies, their object was to substitute Christian for heathen ideas. *Caer Anna* in Brittany became St. Anne d'Auray, and Tan Hill became St. Anne's Hill. St. Anne's Day was not fixed for the whole Latin Church until 1584, when Gregory XIII. appointed the feast to be held on July 26 (August 6); the name of St. Anne does not occur in the older church calendars, and her cult is a very late one.

THEREZA STORY-MASKELYNE.

Carbon Dioxide in the Breath.

THE presence of 0·06 per cent. of carbon dioxide in the atmosphere is held, I believe, to render the air unfit for breathing purposes, whereas 0·03 per cent. may be taken as normal. A consideration of the quantity of this gas which must be continually present in the lungs makes such sensitiveness on their part to appear rather extraordinary.

Taking an average expiration as 300 c.c. and the reserve "air" in the lungs as 2000 c.c., and assuming that the atmosphere contains 0·03 per cent. of carbon dioxide and expired air 4 per cent. of carbon dioxide, we have the following figures (a homogeneous mixture in the lungs is imagined for simplicity):—

Just before expiration		Just after expiration		Just after inspiration		
2208	...	1920	...	2219·91	...	c.c. air
92	...	80	...	80·09	...	,, CO_2
2300	...	2000	..	2300	..	,, in lungs.

Hence before the next expiration 11·91 c.c. of carbon dioxide must accumulate to make up the original 92 c.c., the corresponding oxygen being absorbed.

Now if conditions remain the same, excepting that the atmospheric carbon dioxide reaches 0·06 per cent., we have

Just before expiration		Just after expiration		Just after inspiration		
2208	...	1920	..	2219·82	...	c.c. air
92	...	80	...	80·18	...	,, CO_2
2300	...	2000	...	2300	...	,, in lungs.

Before the next expiration 11·82 c.c. of carbon dioxide are required to make up the original 92 c.c.

Comparing these numbers, 11·91 and 11·82, we find that in the case of a person breathing at the rate of sixteen times a minute, only one more respiration would be required every seven minutes to get rid of the extra carbon dioxide due to an increase of 0·03 per cent. in the atmosphere.

One is tempted to wonder, therefore, whether carbon dioxide *per se* in these small quantities can have any appreciable effect. Or, on the other hand, is it possible that this gas in the lungs is in some manner "vitalised," as questioned by Prof. Meldola some time ago (see NATURE, 1902, vol. lxvi., p. 492), and that on reaching the outer world it is in a short time changed into the ordinary and more poisonous form?

F. SOUTHERDEN.

Royal Albert Memorial College, Exeter, April 25.

AMERICAN PALÆOBOTANY.[1]

THESE two volumes form the second instalment, under the editorship and to some extent the authorship of Mr. Lester Ward, of a detailed report on the Mesozoic floras of the United States, the first part of which appeared in the twentieth annual report

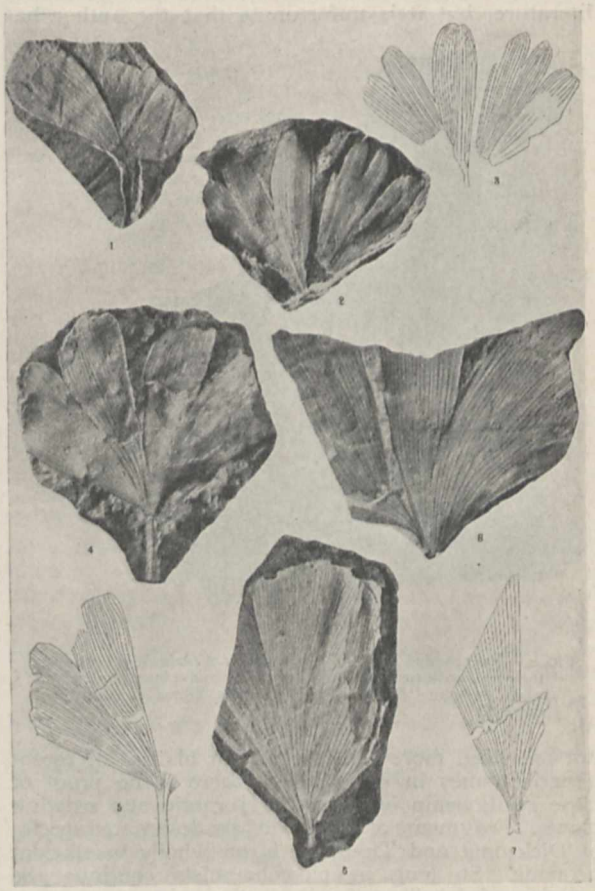

FIG. 1.—Jurassic Ginkgo leaves from Oregon. (From "Status of the Mesozoic Floras of the United States.")

of the U.S. Geological Survey published in 1900. The second paper deals with Triassic, Jurassic, and Lower Cretaceous floras, and includes observations on the stratigraphical relations of the plant-bearing strata.

The excellent quality of the plates, many of which consist of photographic reproductions of specimens, is in welcome contrast to the unsatisfactory figures

[1] "Status of the Mesozoic Floras of the United States." Second Paper. By Lester F. Ward, with the collaboration of William M. Fontaine, Arthur Bibbins, and G. R. Wieland. Part i., Text. Part ii., Plates. Pp. 616; Plates i–cxix. Monographs of the U.S. Geological Survey, vol. xlviii. (Washington, 1905.)

in some of the earlier monographs on American fossil floras. Under the head of Triassic floras an account is given of the results of an expedition into Arizona in 1901, which seems to have been more successful in discovering fossil vertebrates than the remains of vegetation. Reference is made to the "inexhaustible quantity of silicified wood," some specimens of which are included in the genus Araucarites, a type widely distributed in Mesozoic strata in many parts of the world. By far the most important part of the report is that by Mr. Fontaine, which deals with the rich Jurassic flora of Oregon. An inspection of the photographs and drawings reveals the interesting but not unexpected fact that the general facies of the vegetation exhibits a striking agreement with that which has been described from the Oolite rocks of East Yorkshire, Siberia, and other Old-world localities. A few species occur which appear to be identical with Wealden plants, while others are reminiscent of the older Rhætic floras. We welcome this exceedingly valuable addition to palæobotanical literature, but it is unfortunate that the author has

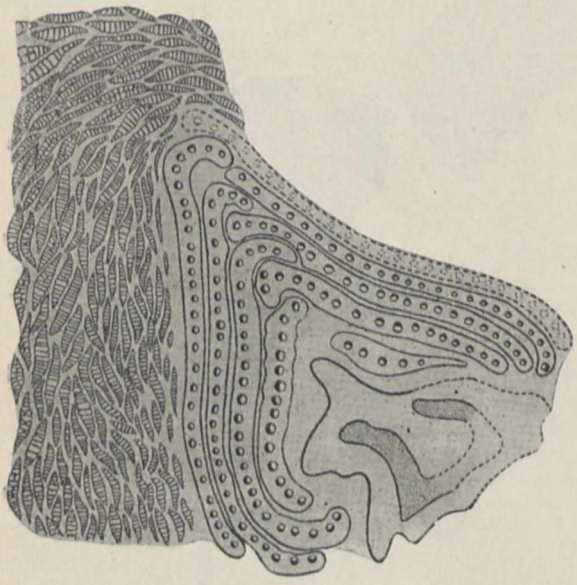

FIG. 2.—Unexpanded Frond of *Cycadella utopiensis*, Ward, showing the rachis with two rows of young pinnæ and a mass of ramental scales. (From "Status of the Mesozoic Floras of the United States.")

not exercised more self-restraint in his use of recent generic names in cases where there is no proof of close relationship between the Jurassic and existing plants. Fragments of fern fronds are designated species of Dicksonia and Thyrsopteris on wholly insufficient grounds. So long as palæobotanists continue the practice of labelling fossil species with the names of recent genera merely because of superficial resemblances presented by vegetative organs, their lists of species cannot be accepted as trustworthy contributions towards a fuller knowledge of the plant-distribution of former ages. Ferns and Cycads are well represented, and the abundance and variety of leaves referred to the genus Ginkgo—that striking embodiment of the "past in the present"—constitutes a notable feature of the Oregon flora (Fig. 1). The volume also contains an account of Lower Cretaceous floras, together with much information on the plants of the older Potomac formation, and descriptions of additional specimens of silicified Cycadean stems from the Jurassic rocks of Wyoming and the Potomac beds of Maryland. Mr. Wieland gives a particularly interesting figure of a young frond of a species of Cycadella in which the rachis is traversed by a U-shaped vascular band bearing a much closer resemblance to the meristele of a fern petiole than to the conducting strands in the rachis of a Cycad (Fig. 2). The notes which Mr. Wieland has already contributed on the morphology of Mesozoic Cycads have raised a keen desire for further information, and embolden us, who wait with envy and impatience, to urge him to publish with all speed an instalment of his promised monograph.

By the publication of these volumes Mr. Lester Ward has laid his fellow-workers in palæobotany under a further obligation. Although there are various matters of detail which we should venture to criticise if space permitted, there can be no doubt as to the value of this latest contribution from the veteran author and editor. A. C. SEWARD.

RECREATIONS OF A NATURALIST.[1]

THE "naturalist" on the present occasion is Mr. J. E. Harting, from whose pen we have welcomed during the past forty years (*eheu! fugaces*) many volumes on many aspects of sport and natural history. Among his recreations are outings on the moor, the hill, and into the quiet byways of the

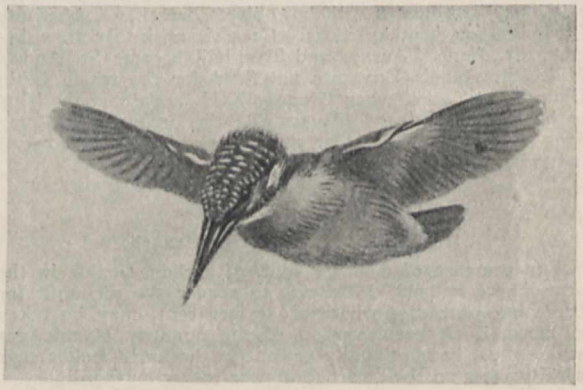

FIG. 1.—A Kingfisher hovering. From "Recreations of a Naturalist."

country, with gun or rifle (in their proper season), or with neither with equal enjoyment to him, and, as frequently as fortune favoured, with what it is easy to see he perhaps loves best of all, "a cast of hawks." Another form of "recreation" has been—metaphorically speaking—"finding a hare in the library and hunting it through the preserves of ancient authors until the hunt had a happy termination, or the literary hare escaped to give sport another day."

No doubt the writing of the essays that describe these recreations formed a supplementary one, not improbably combined with "business" as an enhancement to the diversion; for most of the forty essays in the present volume have previously appeared elsewhere, chiefly in the columns of *The Field*. Mr. Harting's library hunts are fewer in number and less engaging than those pursued by him out of doors. Of these one here and there might, perhaps, have been omitted, as somewhat belated, such as the account of "Swan-upping," in which the information is eleven years old, while the "Horse and its Historians" is a review of a work published in 1888,

[1] "Recreations of a Naturalist." By James Edmund Harting, author of a "Handbook of British Birds," &c. With 81 illustrations. Pp. xvi+433. (London: T. Fisher Unwin, 1906.) Price 15s. net.

though since then has not the "Thoroughbred Horse" been written by Prof. Ridgeway?

The majority of the other essays are, however, worth issuing in collected form. In reading them we recognise the spirit of the genuine sportsman naturalist—the best combination in a human being for the full enjoyment of the external world—and follow with deep satisfaction his excellent companionship out into the open in his "Marsh Walk in May," "On the Hill," and "Bird Life on the Broads." An interesting chapter on "Small Birds on Migration carried by Large Ones" leaves the question as undecided as before. It may be worth recording, however, that many years ago the present writer listened with intense interest to his *vis-à-vis*, at a Lisbon hotel *table d'hôte*, relating how he had seen in Egypt small birds landing from the shoulders of an immigrant crane. The writer on inquiry learned that the name of his co-resident was "von Heuglin."

In his essay on the "Fascination of Light," Mr. Harting records some circumstantial evidence for believing that the powder-down patches of certain herons are phosphorescent, and probably provide a "living light" for alluring fishes to the surface of the water, and within sight of the foraging bird during the darkness. It is suggested also in regard to the common kingfisher that its orange-coloured breast may serve the same purpose when the bird is hovering (during daylight) over water "on the feed." While it would be very difficult to prove the latter suggestion experimentally, it seems that the former might be investigated with much chance of success by a couple of unprejudiced, enthusiastic and properly equipped ornithologists spending a few dark nights in a punt in the quiet haunts of the heron.

These "Recreations" may be cordially recommended to the lover of nature as a companion on his summer holidays. The book is full of delightful illustrations—those especially by Joseph Wolf and George Lodge—and, as a specimen, the beautiful hovering kingfisher, by the latter artist, is reproduced here. F.

FORTHCOMING VISIT OF REPRESENTATIVES OF UNIVERSITY EDUCATION IN FRANCE.

THE Senate of the University of London has invited representatives of the University of Paris (Faculty of Letters and Faculty of Sciences) and of the Collège de France to visit London at Whitsuntide. These representatives will be accompanied by the highest officials of the French Ministry of Public Instruction and by a number of representatives of the French provincial Universities. The Société des Professeurs de Langues vivantes and of the Guilde Internationale will be simultaneously entertained by the Modern Language Association, and the University has arranged for the representation of all these bodies at the various ceremonies. The French delegations will be headed by M. Liard, the Vice-Rector of the University of Paris.

The King has graciously expressed his desire to receive a number of the French visitors at Windsor on Thursday afternoon, June 7.

The general programme will include the following items:—Monday, June 4, an informal dinner at the Royal Palace Hotel, Kensington, at which the guests of the University will stay. Tuesday, June 5, a reception at the Foreign Office by Lord Fitzmaurice and by Mr. Lough, Parliamentary Secretary of the Board of Education, at noon; luncheon at the University; addresses at the University by Sir Edward Busk, Vice-Chancellor, M. Liard, Sir Arthur Rücker, and Prof. Sadler (on behalf of the Modern Language Association); informal receptions of French and English specialists. Wednesday, June 6, visits to Westminster Abbey, to Westminster School, and to some of the London County Council educational institutions, followed by a luncheon to be given by Mr. Evan Spicer, chairman of the County Council, at Belair, Dulwich; in the evening a dinner at University College, and various private dinners, followed by a reception by his Excellency the French Ambassador at the French Embassy. Thursday, June 7, addresses by the Deans of the Faculties of Arts and Science of the Universities of London and Paris, by Sir William Ramsay, K.C.B., and by representatives of the Collège de France, the French provincial Universities, and the French Modern Language Association; and in the evening a conversazione at the University. It is understood that a number of the French guests will, on Friday, June 8, visit the Universities of Oxford and Cambridge.

The guests will include the following representatives of science in France:—

University of Paris: M. Liard, Vice-Recteur de l'Université; Profs. Appell, G. Bertrand, Léon Bertrand, Vidal de la Blache, Borel, Boutroux, Bouty, Bouveault, Dastre, Delage, Fernbach, Hérouard, Houssay, Joannis, Lapicque, Leduc, Lippmann, Matignon, Matruchot, Painlevé, Pellat, Perrin, Pruvot, and Puiseux.

Collège de France: Profs. Henneguy and Pierre Janet.

University of Bordeaux: Prof. Lorin.

University of Caen: Prof. Guinchant.

University of Lille: Prof. Ponsot.

University of Nancy: Prof. Cuénot.

NOTES.

GREAT surprise and regret have been caused in German chemical circles by the announcement that Prof. W. Ostwald has requested the Saxony Minister of Education to allow him to give up the position which he has held in the University of Leipzig for so many years. German scientific journals and papers are unanimous in saying that of living chemists not one has exercised so great an influence on the progress of modern chemistry as Prof. Ostwald in his almost twenty years of academic teaching. But Prof. Ostwald finds the direction of a large university laboratory making so many calls on his time as to prevent his carrying out the amount of original and private work which he would like, with the result that he has decided to retire to his country house at Grossbothen (Saxony), where a small private laboratory has been arranged, and devote himself to literary and experimental work, dealing in the first instance with the technology of painting.

AT the invitation of the Anglo-German Friendship Committee a number of editors of German newspapers will visit London shortly. According to present arrangements, the visitors will arrive in London on June 20. Among the many entertainments provided is a visit to the Natural History Museum on Sunday, June 24, under the guidance of Lord Avebury and Prof. Ray Lankester. On Wednesday, June 27, the party will go to Cambridge to be entertained at one of the colleges and taken over the University.

THE President of the Board of Trade has appointed Major P. A. MacMahon, F.R.S., to be Deputy Warden of the Standards, to succeed the late superintendent of weights and measures, Mr. H. J. Chaney.

THE Friday evening discourse at the Royal Institution on June 1 will be delivered by Prof. H. Moissan, on "L'Ébullition des Métaux," and on June 8 by Sir James Dewar, on "Studies on Charcoal and Liquid Air."

THE anniversary meeting of the Royal Geographical Society was held on Monday, May 21, when the medals and other awards announced in NATURE of April 5 (p. 541) were presented.

A FEATURE of the "Country in Town" Exhibition which will be held on July 5–19 in the Whitechapel Art Gallery will be photographs illustrating what can be done to beautify urban gardens, streets, and parks. Photographic prints for the exhibition will be gladly received by the honorary secretary, Mr. Wilfred Mark Webb, at Toynbee Hall, Whitechapel, E.

THE death of Mr. Charles Eugene De Rance occurred on May 9, after eleven days' illness, the result of an unfortunate accident. Although Mr. De Rance began and ended his professional career as a civil engineer, he was for thirty years an officer of the Geological Survey of England and Wales. During this period he was engaged in the south of England and upon the Coal-measures of Flintshire and elsewhere, but most of his work was among the Triassic rocks of Lancashire and Cheshire, and the Glacial deposits of the same districts. He contributed to several memoirs of the Geological Survey, but his principal published work was the "Water Supply of England and Wales" (1882). For sixteen years he acted as secretary of a committee of the British Association on the circulation of underground waters; he was associated also with a committee on coast erosion. Problems of water supply always enlisted his attention; one of his last acts was an appeal for information as to the influence of the recent earthquakes on the flow of water in wells.

WE notice with regret the announcement of the death on May 1 of Prof. I. C. Russell, head of the Department of Geology at the University of Michigan. He was for a short time assistant professor of geology at Columbia University, and became geologist in the U.S. Geological Survey in 1880. In 1892 he became professor of geology in the University of Michigan. Prof. Russell was vice-president of the American Association in 1904, and was president of the American Geological Association at the time of his death.

MESSRS. C. VENKATARAMAN AND V. APPARAN, of the Presidency College, Madras, write to describe a modification of Melde's experiment with a weighted string attached to the prong of a tuning-fork. When the string to which the pulley is attached is held so as to be neither parallel nor perpendicular to the vibration of the tuning-fork, then, if the tension is properly adjusted, the string takes up a stationary form of vibration capable of simple explanation.

REFERRING to the correspondence on "Sounding Stones" published in our issue for January 4 (vol. lxxii., p. 222), Mr. E. M. Buchanan, writing from Henzada, Burma, directs attention to the resonant properties of fossilised wood and a long established custom in Upper Burma, where such wood is common. The natives collect pieces of a kind with even grain, obtainable in lengths of 4 feet to 6 feet, and convert them into gongs by polishing them slightly. In the monasteries or shrines the monks accompany their recitations at matins and vespers with the music of their stone gongs, which are usually well attuned and give a pleasing effect.

WE learn from the *Times* that the Government has given its sanction to a scheme for the organisation of the Archæological Department of India on a permanent and improved footing. Although much has been done since a Director-General of Archæology was appointed in 1902 for a period of five years, the experience gained has proved that the task of restoring and conserving the antiquities of India will always require trained ability for its adequate discharge. The present Director-General of Archæology is confirmed in his appointment. In lieu of the present Government epigraphist for Madras, the scheme provides for the appointment of a Government epigraphist for the whole of India, whose duty it will be to organise and collate the results of the epigraphical work of the provincial surveys. At the same time, the importance of Madras for this form of research and its special linguistic conditions necessitate the retention of a special epigraphical expert in that presidency.

THE chief annual meeting of the Verein Deutscher Chemiker will be held this year at Nurnberg on June 6–9. Prof. C. Duisberg, of Elberfeld, will report on the work of the commission appointed by the Gesellschaft Deutscher Naturforscher und Aertze to consider the science teaching in German schools; Herr A. von Baeyer will lecture on the anilin dyes; Dr. Lehner, of Zürich, on artificial silk; Prof. Stockmeier, of Nurnberg, on explosions in the aluminium bronze colour industries; Prof. F. Haber, of Karlsruhe, on the optical analysis of coal gas; Prof. A. Werner, of Zürich, on valency; Dr. F. Raschig, of Ludwigshafen, on catalysis; Prof. M. Busch, of Erlangen, on new methods of determining the amount of nitrogen in nitrocellulose; Dr. Ed. Jordis, of Erlangen, on the chemistry of silicates; Dr. L. Eger, of Munich, on the examination and evaluation of railway materials; Dr. O. Röhm, on the manufacture of illuminating gas; and Dr. M. Neumann, of Cronberg, on the theory of the Glover process and the manufacture of sulphuric acid in towers. Visits will be paid to several chemical works and large engineering works in the neighbourhood, including Messrs. Siemens and Schuckert's, while excursions to Erlangen on June 8, to Rothenburg a.T. (Württemberg) on June 10, and to the Jubilee exhibition on June 9 are to be arranged.

THE Connecticut Agricultural College has been authorised to accept the Edwin Gilbert bequest consisting of a farm of 350 acres at Georgetown, Conn., together with a fund of 12,000*l.* for the maintenance of the farm. The tract of land is, according to *Science*, to be used for experimental purposes in connection with the work of the agricultural college, but it is not intended to establish a branch of the college at Georgetown. From the same source we learn that the additional appropriation of 1000*l.* for the agricultural experiment stations, provided by the Adams Bill, has now been paid. This Bill increased the present appropriation of the agricultural stations under the Hatch and Morrill Acts by 1000*l.* for the year ending next June, and by an additional 400*l.* annually above the amount of the preceding year for the next five years. At the end of the five years this will amount to an increase of 3000*l.*, bringing the total appropriation to each experiment station to 6000*l.* annually. The funds are to be applied only to original researches or experiments bearing directly on the agricultural industry of the United States, with due regard to the varying conditions and needs of the States in which the stations are located.

THE contents of the May number of *Naturen* include articles on mosquitoes and gnats, on the Yangtse-kiang district and its products, and on dogs—prehistoric and modern—the last of these being by Dr. Reinhardt.

OWING to the advent of abnormally high temperatures at an unusually early period, which rendered collecting in the desert practically impossible, Dr. C. W. Andrews,

of the Natural History Museum, has returned from his Egyptian trip. We understand that he has obtained some important specimens from the Fayum deposit, but that he was unable to visit the zeuglodon-beds of the Mokattum range.

THE greater portion of the April issue of the *Museums Journal* is taken up by an illustrated article by Colonel Plunkett, director of the Dublin Museum, on the methods employed at that institution in circulating objects of art, or reproductions therefrom, among schools and other local establishments. A special endeavour has been made to reduce so far as possible the labour and expense connected with handling, packing, receiving, and dispatching the circulation sets, and although the scheme has only been in operation for a couple of years, it appears to be a conspicuous success.

AN important paper by Mr. F. W. Thyng appears in the Proceedings of the Boston Society of Natural History (vol. xxxii., No. 11) on the squamosal bone of the skull in four-footed vertebrates. After maintaining, in opposition to the views of Gadow, Broom, and others, that the mammalian incus corresponds to the reptilian quadrate, the author proceeds to demonstrate that, of the two bones lying between the parietal and the quadrato-jugal in the labyrinthodont skull, the lower one, as not overlying the otic capsule, represents the squamosal of mammals, while the upper one should be called the supratemporal. According to the generally accepted scheme of cranial osteology, these names are transposed. The author's re-determination is largely based on the evidence afforded by the larval skull of the limbless amphibians, or cæcilians, which appear to come the nearest of all living groups to the labyrinthodonts.

THE articles in the combined second and third parts of vol. lxxxi. of the *Zeitschrift für wissenschaftliche Zoologie* are only three in number, but each is of unusual length. In the first Mr. Hans Dunker discusses the homology of the cirri and the elytra in the "sea-mouse" (Aphrodite); the second is a continuation of Dr. L. Böhmig's studies of the planarian worms of the Tricladida group; while the third, by Mr. C. von Janicki, of Basle, is devoted to certain new or little-known cestode parasites infesting marsupials, bats, insectivores, rodents, and edentates. In the case of the last paper, especial interest, from a geographical point of view, attaches to the discovery in a Brazilian opossum of a new species of tape-worm belonging to the genus Linstowia, which was established by Zschokke in 1898 for the species *L. semoni* infesting one of the Australian bandicoots, but included another species found in the Echidna or spiny anteater of the same region. The new evidence is of the highest importance in confirming the opinion as to the close affinity of the South American to the Australasian marsupials, and also as to the relatively late date at which the two groups were sundered. Whether the common habitat of the ancestral type was, as has been suggested, in south-eastern Asia or in a sunken southern land remains to be determined.

SOME cultural notes by Mr. H. Drion on hardy bamboos, continued from the previous number, are published in the April number of *Le Bambou*. Prof. E. de Wildeman contributes a note on the bamboo-hat industry in Java, that gives employment to a large number of natives. The hats are made double and in various qualities depending upon the degree of fineness of the woven strips. Their cost varies from four pence to eighteen pence; the chief defect is their tendency to become discoloured.

THE Para rubber tree and its cultivation, also the cultivation of other American rubber trees, have attracted a great deal of attention lately, but *Ficus elastica*, the source of india-rubber, is seldom mentioned, and its cultivation is by no means fully understood. A small brochure written by Mr. C. Bald contains much information on the subject that will be useful to rubber planters in the north of India and elsewhere. Wild plants generally begin life as epiphytes, but the writer describes how seedlings can be readily germinated and transplanted, or a branch may be specially prepared for layering, whereas artificial attempts at epiphytic germination have mostly failed.

THE third number of the Kew Bulletin for this year contains a series of identifications of new plants by workers in the herbarium. Dr. Stapf contributes a decade of African plants and a selection from various countries, including four species of Icacineæ from Borneo. Among the new orchids named by Mr. Rolfe are a Catasetum from Colombia and a Pteroglossaspis that is interesting as the first American record of a genus hitherto known only from Africa. Mr. G. Massee concludes an account of animal and plant parasites destructive to beets and mangolds by pointing out the risk of growing two root crops in succession.

IN the Bulletin of the Department of Agriculture, Jamaica, vol. iv., part iii., an article by Mr. H. Q. Levy is published on the cultivation and marketing of oranges and grape fruit. Mr. Levy treats the subject from the point of view of the small grower, and gives advice on the laying out of the plantation, suitable catch crops, and the diseases of citrus fruits; the varieties of orange recommended are the seedless Petersfield navel and the seeded Pineapple. The hints on grading and packing the fruit are pertinent and practical. The part also contains a list compiled by Mr. Wm. Harris of the seasons and prices in Kingston for fruits, vegetables, and other products.

MR. E. P. STEBBING writes a short note in the *Indian Forester* (March) on *Termes gestroi*, a termite that attacks Para rubber trees. This parasite has been reported previously from Borneo, Singapore, and the Straits Settlements, and now from the Mergui plantations in Burma. Little appears to be known of the habits of these white ants except that they hollow out their galleries in the crown of the root, where they collect and store the latex, and that they have increased greatly owing to the favourable conditions they find in the plantations of this exotic tree. Further information with regard to their life-history is required before satisfactory methods of treatment can be suggested.

ALTHOUGH an exhaustive investigation into the methods of cultivating and manufacturing natural indigo in India was carried out by Mr. Rawson a few years ago, and valuable suggestions were made by him for effecting improvements, the importance of the subject warranted further experiments that have been undertaken by Mr. C. Bergtheil, the agricultural bacteriologist to the Government of India. In the recent report of the Indigo Research Station at Sirsiah the superiority of the Natal plant, *Indigofera arrecta*, as improved by cultivation in Java, over the ordinary Bengal plant, *Indigofera sumatrana*, is clearly established, except under certain conditions. Mr. Bergtheil also emphasises the importance of seed selection. In the manufacturing processes the chief point inculcated is the necessity for maintaining the steeping vats at a temperature of 90° F.

MR. E. R. PRATT, of Ryston Hall, Norfolk, writes an interesting article on the East Anglian timber willow in the recently published Journal of the Royal Agricultural Society. The supply of timber suitable for their trade has in recent years caused manufacturers of cricket-bats some anxiety. In East Anglia, and apparently in other parts of England, all large willows have been felled, except those kept by landowners for ornamental purposes, and the price of timber good enough for bat-making has risen to 5*s*. per foot. Two varieties of willow are purchased, the "close-bark," which is considered much the best, and the "open-bark." Growers of willows have found it a difficult matter to ascertain what variety the bat-maker wants, as his descriptions of the tree have been very vague. Mr. Pratt has gone carefully into the question of variety, and has examined a great many willows in the eastern counties. On the authority of a botanist who has given special attention to the genus (Rev. E. F. Linton, of Edmondsham, Salisbury), he states that the "close-bark willow" is not *Salix alba*, but *S. viridis*, a variable hybrid between *S. alba* and *S. fragilis*. Many of Mr. Pratt's specimens closely approached the former species, but could always be distinguished by the bronze-red winter shoots. He believes that the genuine *S. alba*, of which he has cultivated specimens obtained from Kew, is very rare in the eastern counties. Mr. Pratt further states that the "open-bark willow" of the bat-maker is *S. fragilis*, the crack willow, or its variety, *S. Russelliana*, the Bedford willow. In his experience *S. viridis* is much more common in East Anglia than *S. fragilis*.

IN the *Engineering Review* (vol. xiv., No. 5) illustrations are given of the works at Notodden where the synthesis of nitrates from the air has been found commercially practicable.

SOME very useful hints for horseback travel and transport are given in an article by Mr. F. L. Waldo on outfitting for the prospecting trail in northern Mexico in the *Engineering Magazine* (vol. xxxi., No. 1). During a ten years' residence in Mexico the author's attention has many times been directed to the incongruity of the outfits prepared and brought into that country by those whose business or pleasure call them into the Sierras. While the suggestions given refer specifically to a certain region, many of them will be of value elsewhere.

A BULLETIN (vol. iii., No. 54) has been issued by the Department of Agriculture, Madras, describing experiments on well irrigation made by Prof. A. Chatterton at Metrosapuram in 1902–5. The results show that with adequate pumping power it is possible to improve the water supply and to cultivate a very considerable tract of land from a single well. If in the future oil engines and pumps are extensively used for well irrigation in India, it appears certain that the 3-inch centrifugal pump will be most largely employed, and that such a pump will water six acres per day of twelve hours, and will be suitable for areas ranging from thirty to fifty acres.

THE annual progress report of the Geological Survey of Western Australia for 1905 (Perth, 1906) shows that much valuable work has been done. The Wodgina tinfield has been carefully examined, and it is believed that it will prove an important tin and tantalite producer. About 1 cwt. of tantalite specimens have been presented to the Survey museum. During the year there was a sudden demand for tantalum ores which had hitherto been considered useless. Considerable interest has been taken locally in deposits of graphite, and those on the Donnelly River have been worked to a slight extent. A sample of laterite iron ore from Comet Vale, North Coolgardie, proved of great interest on account of the occurrence in it of a notable proportion of chromium, mostly in the form of a hydrate. A large portion of the report is devoted to the results of examinations of the various goldfields, full reports of which will be published in due course.

THE weather report of the Meteorological Office for the week ending Saturday, May 19, shows that the recent rains were excessive in places, while in other parts of the United Kingdom the rainfall was below the average. In the east of Scotland and in the north-east of England the aggregate fall was at least four times the average. The measurements due to the exceptionally heavy rains of Saturday, May 19, were:—2·53 inches at North Shields, 2·40 inches at Alnwick Castle, and 2·23 inches at Seaham. Both France and the Spanish Peninsula participated in the heavy rains of Saturday, the measurement for the twenty-four hours at Lyons being 2·25 inches, and at Corunna 2·40 inches.

WE have received copies of the *Boletim mensal* of the Observatory of Rio de Janeiro, issued under the auspices of the Ministry of Industry. Anyone wishing to study the climate of that part of the Atlantic shore lying between the mouth of the Amazons and Rio de Janeiro will find trustworthy statistics for several of the coastal stations. The data are chiefly for ten-day means, with monthly means and extremes, but for Rio de Janeiro the actual observations for three-hourly periods are given in addition, and furnish most valuable details for all meteorological elements.

THE Republic of Uruguay has recently established a National Institute for Weather Prediction, with its central observatory at Monte Video; the meteorological observatory at that place was founded by the municipal authorities in 1895. Observations have been made at several stations for some years, and the new institution has commenced its operations by the collation and discussion of the means and extremes already available, and by the investigation of the characteristics of the severe storms which affect the navigation of the estuary of the Rio de La Plata. The most dangerous storms are those from the south-east, as they usually occur with a rising barometer, in connection with anticyclonic conditions over the Atlantic, and are frequently accompanied by thick fog on the coast. The first number of the bulletin of the institute contains an exposition of the hydrography of the estuary, and tables showing, *inter alia*, the effect of the various winds upon the tides of the river.

TWO reports have recently been issued on rates of deck watches and of box and pocket chronometers on trial for purchase by the Board of Admiralty at the Royal Observatory, Greenwich, in the latter half of last year. The number of deck watches on trial from August 5 to November 25, 1905, was 125, and the makers of the first five in the list, in which the watches are arranged in order of merit, are:—(1) W. Potts and Son, Leeds; (2) L. Hall, Louth, Lincs; (3) S. D. Neill, Belfast; (4) and (5) J. Player and Son, Coventry. The makers of the first five box chronometers of those on trial from June 17, 1905, to January 6, 1906, are:—(1) Kullberg, London; (2) and (3) Johannsen, London; (4) Lilley and Son, London; (5) M. F. Dent, London. In the same period the makers of the leading five pocket chronometers are:—(1) Newsome and Co., Coventry; (2) and (3) Kullberg, London; (4) Lindqvist, London; (5) Newsome and Co., Coventry.

PROF. B. WALTER states in a brief note published in the *Annalen der Physik* (vol. xix., p. 874) that the ultra-violet portion of the spectrum of a high-tension arc in air shows a series of bands identical with those observed by Eder in 1892 as characterising the combustion of ammonia, and considered by him as ammonia bands. It would appear probable that these bands are to be attributed rather to an oxide of nitrogen, produced in both cases, than to the cause suggested by Eder.

SOME successful attempts, made in the geophysical laboratory of the Carnegie Institution, to prepare small plates of quartz glass suitable for the construction of lenses, mirrors, or other optical apparatus, are described by Messrs. Arthur L. Day and E. S. Shepherd in *Science* (vol. xxiii., No. 591). The glass obtained was nearly free from air bubbles, and was only slightly discoloured by the presence of silicon. The conditions for obtaining such a material by the fusion, in a small graphite box, of pure crystallised quartz or tridymite, are summarised as follows:—an initial temperature of 2000° or more without pressure, so as to allow of the production of sufficient vapour to drive out the air between the grains, followed by pressure (at least 500 lb.) and a reduced temperature of about 1800°, with time for the quartz to flow compactly together without being attacked by the graphite.

AN interesting contribution to the study of fluorescence is contained in a paper published by Mr. Harry W. Morse in the Proceedings of the American Academy of Arts and Sciences (vol. xli., No. 27) under the title "Studies of Fluorite." The fluorescence and thermoluminescence of fluorite and the nature of the gaseous and liquid inclusions in fluorspar are dealt with under different headings. The fluorescence spectra shown by fluorite when excited by the light of the condensed electric spark between electrodes of certain metals contain sharp lines and narrow bands; the lines of these fluorescence spectra do not appear to belong to any known substance, and are remarkable inasmuch as different lines are obtained with different exciting sources. The spectrum also varies sharply from crystal to crystal with the same means of excitement. The cause of fluorescence, whatever be its nature, is removed or destroyed by heating at a temperature of about 300° C. At the same temperature the colouring matter of the different varieties of fluorite is destroyed; the nature of this colouring matter is discussed by reference to the gaseous products liberated at higher temperatures. As these consist of hydrogen, carbon monoxide, and carbon dioxide, the colouring matter would appear to be organic in its origin; the gases are probably produced by its undergoing a process of destructive distillation

No. 3, vol. xxiii., of the *Astrophysical Journal* contains an important paper by Mr. Theodore Lyman on the extreme ultra-violet spectrum of hydrogen. Part of this spectrum was previously photographed and investigated by Dr. Schumann, whose work was briefly described in vol. lxix. (p. 262) of NATURE. Unfortunately Dr. Schumann, although he photographed the spectrum down to λ 1270, was unable to give the wave-lengths beyond λ 1850, but this omission has now been rectified by Mr. Lyman, who has not only determined the missing wave-lengths, but has also extended the known spectrum down to λ 1030 (see NATURE, p. 465, vol. lxix., and p. 110, vol. lxx.). In the present paper the author describes the apparatus and methods employed in great detail, "in the hope that an exact knowledge of the conditions necessary to success may prove of value to investigators who work in this field"; he also gives reproductions of his spectrograms, with wave-length scales, for the region between λ 1670 and λ 1270.

THE Watkins Meter Co., Hereford, has published a third edition of "The Watkins Manual of Exposure and Development," by Mr. Alfred Watkins.

THE report for the year 1905 of the council of the Hampstead Scientific Society has been received. The Christmas juvenile lectures, and those on nature-study, intended to encourage the teaching of this subject to children, proved very successful. Among lectures delivered at the general meetings of the society may be mentioned those by Prof. Marcus Hartog, on the end and beginning of individuality as shown in the living cell; Dr. R. S. Clay, on the peculiarities and paradoxes of fluid pressure; Sir Samuel Wilks, F.R.S., on spirals; Dr. C. W. Andrews, F.R.S., on fossil hunting in the Libyan Desert; and Mr. F. W. Rudler, on the geology and scenery of the British Isles.

THE seventy-second annual report of Bootham School (York) Natural History, Literary, and Polytechnic Society shows that the pupils of this school continue to receive every encouragement to devote their leisure hours to the outdoor study of natural phenomena. During 1905 the boys were particularly successful in discovering rare plants, and though we have been unable to find a specific caution in the report, we trust that all observers are urged not to uproot plants or in any other way to assist the disappearance of rare species. It is satisfactory to find that attention is given to many branches of natural science so that the predilections of as many boys as possible may be satisfied.

OUR ASTRONOMICAL COLUMN.

SPECTRUM OF NOVA AQUILÆ No. 2.—A visual observation of the spectrum of Nova Aquilæ No. 2, made at the Lick Observatory on September 5, 1905, showed a number of bands, the brightest of which was recognised as Hβ. Hγ and a band near λ 4600 were distinguished with difficulty owing to their extreme faintness.

Photographs obtained with the one-prism spectrograph on September 6 and 10 (exposures three and four hours respectively) confirmed the visual observation, the intensities of the bands at λ 4600 and Hγ being respectively one-fifth and one-tenth that of Hβ. Hδ was also seen, but was very faint.

A faint continuous spectrum was seen to extend from about λ 4500 to the region of the Hγ band. Hε and the so-called nebular lines were not visible.

Visual and photographic observations made on October 11, 1905, agreed in showing a marked diminution in the brightness of Hβ, which was then no brighter than Hγ (*Astrophysical Journal*, vol. xxiii., No. 3).

A number of magnitude observations of this Nova, made on various dates between September 20 and November 24 at the Utrecht Observatory, are recorded in No. 4089 of the *Astronomische Nachrichten* by Dr. A. A. Nijland.

STEREO-COMPARATOR DISCOVERIES OF PROPER MOTIONS.—At a meeting of the Paris Academy of Sciences, held on May 7, Prof. Loewy announced that Prof. Max Wolf had met with considerable success in discovering and measuring stellar proper motions by means of his stereo-comparator.

In one instance a star of known proper motion was seen to be obviously displaced after the very short interval of four years. When the two photographs, taken at this interval, were placed in the stereoscope, the star in question was seen to stand out in a plane considerably different from that in which the neighbouring stars appeared to be set.

Prof. Wolf has also been able to show that a ninth-magnitude star in the constellation Leo has a proper

motion hitherto unsuspected, and he has obtained a value for the motion which he believes to be more correct than could be determined by ordinary micrometric measures. In this case a period of fourteen years separated the times of taking the photographs (*Comptes rendus*, No. 19, 1906).

MEASURES OF DOUBLE AND MULTIPLE STARS.—The measures of 1066 double and multiple stars are published in vol. ii., part iii. (astronomical series), of the Publications of the University of Pennsylvania by Prof. Doolittle.

The measures were made with a wire micrometer attached to the 18-inch refractor of the Flower Observatory, and include, among others, 733 Burnham stars, 109 OΣ, and 102 Σ stars. Four hundred and ninety-two stars from Prof. Hough's catalogue have also been re-measured but are not included; it is Prof. Doolittle's intention to re-measure all the stars discovered by this observer.

The micrometer, the corrections of the instrument, and the method of observing are all fully discussed in the present publication, which is a continuation of part iii., vol. i.

Part ii., vol. ii., of the same publications gives the results of the observations made with the zenith telescope of the Flower Observatory from October 1, 1901, to December 28, 1903, and also contains a re-discussion of the 1896–1898 series, of which the details appeared in part ii., vol. i., in 1899.

OBSERVATIONS OF COMET 1905*c*.—Numerous observations of comet 1905*c* are recorded in No. 4090 of the *Astronomische Nachrichten*.

This object was observed at Vienna from December 17, 1905, to January 14, 1906, and during that time its apparent diameter increased from 2′ to 4′–5′, the length of its tail from 5′ to 40′, and its total magnitude from 9·5 to 4·0. On December 30 a nucleus of magnitude 6·0 was observed.

Heliometer observations at the Cape Observatory showed the comet as a faint nebulous mass with no visible nucleus. Observations of position were recorded from February 5 to February 20, 1906.

The observations at Strassburg Observatory extended over the period December 10 to March 21, and the apparent position, the total magnitude, and the diameter were recorded on eleven different dates.

A LUNAR TIDE ON LAKE HURON.—Whilst examining the curves showing the periodical oscillations of the *seiches* on Lake Huron, Prof. W. J. Loudon, of Toronto University, was struck by the regularity of their general outline, which seemed more marked in calm weather. Further investigation of the matter showed a well-marked and regular rise and fall twice a day, and also showed that no oscillation of the lake could have a period of more than four hours.

From these facts Prof. Loudon concluded that a true lunar tide occurs on Lake Huron, a conclusion which his further experiments seemed to verify.

THE HAUNTS OF THE OKAPI.

ACCORDING to a report in Monday's *Times* (May 21) the expedition to the Congo Free State under the charge of Captains Boyd Alexander and C. B. Gosling has been successful, not only in procuring a fine skin (and it may be hoped a skeleton) of the okapi, but likewise in obtaining some important particulars with regard to the habits of this animal. The specimen, which it is stated will ultimately find a home in the Natural History Branch of the British Museum, was obtained at Bima, on the River Welle, in the northern territory of the Congo State. It is mentioned in the letter that the animal was seen alive by the expedition, but further particulars on this point are desirable, as it is not stated whether anyone but the Portuguese collector by whom it was trapped had this good fortune. The animal was caught in a pit according to native fashion, previous attempts to shoot it having proved ineffectual.

Hitherto the only definite account of the kind of country inhabited by the okapi and the probable nature of its food is one given by Mr. J. David under the title of "Weitere Mitteilungen über das Okapi," and published in vol. lxxxvi. of *Globus* (1904). Captain Alexander's notes, which differ in some respects from the former, are therefore of great value and interest, and may be quoted in full.

"The okapi here is generally found singly or in pairs, but Mobatti hunters state that sometimes three may be found together. An essential to the life of the okapi is a small stream of water with some muddy and swampy ground on either side. In this grows a certain large leaf that on its single stalk attains a height of 10 feet. It is the young leaf of this plant that is the favourite food of the okapi, and I venture to say that where the plant is not to be found the animal will not exist. During the night he will wander along in the mud and water in search of it. Here he may be found feeding as late as 8 a.m. in the morning, after which he retires to the seclusion of the forest, where he remains until nearly dusk. On the three occasions that I was at close quarters with the beast, he was perfectly concealed in this swamp leaf. Near the River Welle I found his spoor on ground frequented by buffalo and waterbuck, but this is unusual, and his companions in the forest are the elephant, the greater bushbuck, the yellow-backed and small red duikers. The okapi is very quick of hearing, and in that respect is classed by the Mobatti with the bushbuck (local name 'bungana'). In the forest here I consider this latter beast to be more difficult to obtain than the former. On the hunting ground of the first village that I visited I estimated the number of okapi as five or six, at the second and third nil; and twenty miles south in the forest, on very likely ground where my guide said they were formerly numerous, there was one only, probably owing to rubber-collectors who had been there."

Several specimens had been speared, shot, or trapped by natives shortly before the date of Captain Alexander's visit, but time did not admit of further investigation. The sex of the new specimen is not stated, but it is to be hoped that it will prove to be a male, as Sir Harry Johnston's example, now exhibited in the Natural History Museum, is a female. A pair of okapis are exhibited in the Congo Free State Museum at Tervueren, near Brussels, which also possesses other skins; and there are likewise a few other examples in Europe, notably one in Italy and another in Mr. Rothschild's museum at Tring. It is a great pity that the Belgian Government does not take immediate steps to publish coloured figures of its specimens in order to aid in solving the question as to whether there is more than one species (or race) of okapi. Important information on this point will, however, doubtless be afforded by the Alexander-Gosling specimen, which, it may be hoped, will also indicate (if a male) whether the tips of the horns always protrude through the skin, and thus foreshadow the antlers of deer.

THE TARAWERA VOLCANIC RIFT, NEW ZEALAND.

MR. JAMES MACKINTOSH BELL, director of the New Zealand Geological Survey, contributes a paper to the April number of the *Geographical Journal* describing the present topography of the great volcanic rift of Tarawera, in the north island of New Zealand, and the changes which have taken place in the configuration of the region since the great eruption of Mount Tarawera on June 10, 1886, which is memorable for the destruction of the famous pink and white terraces, and their submergence in Lake Rotomahana.

Mount Tarawera lies near the centre of the Taupo volcanic zone, and about 135 miles south-east of Auckland. This zone, which has a breadth of some twenty-five miles, extends from near the great volcanic cones of Ruapehu, Tongariro, and Ngaurahoe north-eastwards to White Island, on the Bay of Plenty, a distance of nearly 160 miles. A great rift, which was the scene of greatest intensity of the 1886 eruption, stretches from near Lake Okaro along the Tarawera range to Mount Wahanga, in the most north-easterly part. This rift, really a line of craters, forms a huge fissure about nine miles in length, cutting the summit of the range, and appearing on its south-western slope. It is divided into several somewhat distinct craters by low partitions, and on the south-west side a long narrow rift extends to the base of the hill, so far as the edge of Lake

Rotomahana. Lake Rotomahana is a sheet of dirty, muddy green water, some three and a half miles long by less than two miles in the opposite direction, and with a maximum depth of 427 feet. In continuation along the same line, beyond Lake Rotomahana, are the deep holes forming the Black, Fourth, Waimangu, Inferno, Echo Lake, and Southern craters. Hot water and steam issue in larger or smaller quantities from these craters, the water finding its way to Lake Rotomahana.

The most remarkable feature of the region during the last few years has been the great geyser of Waimangu. This geyser was discovered in January, 1900, and is believed to have become active only a short time before that date. While playing, outbursts occurred nearly every day, and sometimes more frequently. Mud, sand, and immense boulders were shot up in huge columns of dirty black water. At some hundreds of feet above the water the column broke, showering boulders, mud, and sand back into the pool, and even high up on the walls surrounding it.

In July, 1904, the great geyser suddenly ceased, and remained dormant for seven weeks and five days; then it again burst into action, and until November 1 following outbursts occurred almost daily. Then it stopped, and since then there has been no further explosive activity. We reproduce a photograph of the highest known eruption of Waimangu, from the illustrations accompanying Mr. Bell's paper. It is estimated that this "shot" ascended 1500 feet above the water, and carried a volume of 800 tons.

FIG. 1.—Highest known eruption of Waimangu.

HYDROLOGY IN THE UNITED STATES.

THE papers relating to the hydrological work in the United States which are issued by the department of the Geological Survey have from time to time been noticed in NATURE. We have now to acknowledge twenty-six of the papers last issued. The greater part of these relate to the progress of stream measurements in the different States, and to other matters which are of local interest. There are, however, some of the papers that deserve the attention of those engaged in works of water supply.

On a previous occasion, in NATURE of December 21, 1905, we gave a short account of the investigations that are being made as to the movement of underground water. A further paper on this subject has now been issued as the result of investigations made by Prof. Slichter, No. 140, on field measurements.

This paper presents an amplified exposition of the method of measuring underground water as described in his former paper of 1902. It contains descriptions of the apparatus used for the laboratory study of wells controlling horizontal and vertical movements, and the result of these studies confirms the conclusions described in the former paper as to the possibility of measuring the flow of subsurface water with trustworthy accuracy. Some improvements that have been made in the apparatus as the result of experience are described.

The author shows that the flow of water in a given direction through a column of sand is proportional to the difference in pressure at the ends of the column, and inversely proportional to the length of the column, and is also dependent upon a factor which he terms the transmission constant of the sand.

Experiment shows that the resistance to the flow of water through sand is very great, the water having to pass through pores, usually capillary in character, and the diameter of which varies from one-fourth to one-seventh of the diameter of the sand particles. When the sand is not of uniform size, and is mixed with grains slightly larger, the effect is to increase the capacity of the sand to transmit the water. Where particles seven to ten times the diameter of the original sand grains are added, each of these tends to block the course of the water. For example, a boulder placed in a mass of fine sand checks the passage of the water, and the rate of flow decreases in proportion to the number of such boulders until the amount of the large particles is equal to about 30 per cent. of the total mass. After this the flow increases until the mass of fine particles becomes negligible, and the capacity to transmit approaches that of the mass of large particles alone.

These facts are shown to have an important bearing upon the capacity of gravels to furnish water to wells, or to transmit it in the underflow to rivers.

Tables are given showing the transmission constant for sands and gravels of different sizes and different degrees of porosity.

It is also shown that the rate of flow is affected by temperature, a change from freezing point to 75° nearly doubling the power of the soil to transmit water. This paper contains a great deal of information as to the discharge from wells used for irrigation or other purposes.

Paper No. 144, by Mr. Daniel D. Jackson, deals with the normal distribution of chlorine in the natural waters of New York and New England. The author shows that, with the exception of local deposits, the normal chlorine in natural waters is derived from the salt of the ocean, blown over the land by storms, and that it diminishes in amount as the distance from the ocean increases. This decrease is so definite that equal amounts of chlorine are found along lines generally parallel to the sea coast, thus affording a basis for the establishment of *isochlors*. Charts and tables are given showing the proportion of chlorine at different distances from the coast. The samples were taken from ponds or open water basins as far removed from human

habitation as possible. The charts show that the quantity of chlorine near the coast amounts to 6 parts in a million, at 4 miles away to 5 parts, at 20 miles to 3 parts, at 40 miles to 1 part, and at 100 miles to 0·4 part.

The fact that chlorine exists in rain water to a large extent near the sea coast was stated in the report on domestic water supply of the Rivers Pollution Commission in 1874. It was there shown that on the coast of Devonshire, where with south-west winds sea spray is blown over the land, the amount of chlorine varies from 1·20 to 2·10 parts in 100,000, and at the Land's End, with a strong south-west wind blowing, it amounts to as much as 21·8 parts. Inland the average quantity of chlorine diminishes to 0·39 part; increases to 0·99 part at Liverpool and 0·79 part at Newcastle.

Paper No. 151, by Mr. Marshall O. Leighton, deals with the field assay of water, and describes the methods which have for some time been used in connection with the investigations into the quality of water in various parts of the United States. The methods described relate, not to laboratory experiments, but to simple tests to ascertain the general character of the water by methods which can be carried out on the spot. These field determinations give the turbidity and colour of the water, the presence of chlorine, carbonates, calcium, and iron, and the amount of hardness; also the amount of suspended matter. The former are more particularly required in water for domestic supply, and the latter for that used for irrigation purposes. The amount of gradient to be given to a canal for conveying water for irrigation is governed to a great extent by the solid matter in suspension, and this also affects the capacity of the storage reservoirs. The method for determining turbidity, accompanied by an illustration of the gauge used for this purpose, was given in NATURE of January 7, 1904. A description and illustration of the Geological Survey field case is given in the paper.

Paper No. 143, by Mr. J. H. Quinton, details the experiments made under the direction of the Reclamation Department on steel concrete pipes for the purpose of determining the durability and permanence of these structures in connection with the supply of water for irrigation purposes. The pipes experimented on were 5 feet in diameter, 20 feet long, and 6 inches thick, of concrete, enclosing an armour of steel rods sufficient to resist a head of 150 feet of water with a factor of safety of 4. The experiments showed the difficulty, even with the closest attention to the construction, of making pipes of this kind that would stand a head of 100 feet.

Paper No. 150, by Mr. Robert E. Horton, gives the results of an investigation of the theory of weir measurements, and the discharge over different forms of weirs. The various coefficients of Bazin, Fteley, Stearns, and Hamilton Smith are analysed. A further description is given of the experiments performed at the Cornell University laboratory, where a closely regulated volume of water was passed over weirs of different forms placed across an experimental canal, and the results obtained compared with the different formulæ for obtaining the discharge. Tables are also given for calculating the discharge over weirs.

GREENWICH OBSERVATIONS.[1]

IN the introduction to the first work mentioned below, an opinion is expressed that the revision of an old catalogue must always be a source of anxiety to those who advise and undertake the revision, and that only the final result can justify the expenditure of the time and labour. Those who are responsible for this work need be under no apprehension that their efforts have been misspent. It would rather seem that in this case they have fulfilled a necessary duty, and discharged an honoured trust. It has always seemed to the writer that the ancient authorities at Greenwich were a little wanting in patriotism and enterprise in entrusting to a foreigner, however eminent, the reduction and discussion of Bradley's observations. Groombridge's observations, in a sense, may not be so completely a national possession as those of Bradley, but certainly it is not unfitting that at the Royal Observatory, almost within the shadow of which Groombridge erected his transit circle, his observations should be examined and discussed.

There are several circumstances which tend to give distinction to Groombridge's work. At the beginning of the last century his instrumental equipment was equal to, if not more powerful than, that of any other observer in Europe. The fact that, as an amateur, he gave his time and leisure to the repetition of the same mechanical performance shows that he was a lover of order and accuracy. Pond, the Astronomer Royal, whatever his failings may have been, appreciated the necessity for certainty and accuracy, and he must have impressed these qualities upon Groombridge. Further, the lapse of time, that factor which has increased the value of so much astronomical work and enhanced the reputation of so many worthies, has fought on the side of the retired West Indian merchant.

The method to be pursued in the reductions, how far the observations are to be treated as independent, how far they are to be regarded as differential, are points which must be left to the decision of the computers. They must accept the entire responsibility, since the knowledge and experience is theirs. In this case it is not impossible but that they have had the assistance of tradition. The interesting remarks of Colonel Colby and Dr. Firminger quoted by the revisers, probably do not exhaust the information at their disposal. It would be an impertinence for anyone who has not even seen the originals to offer any criticism on the methods employed by those who have gained familiarity and experience by long contact with Groombridge's figures. These methods are described with clearness and in sufficient detail, but the revisers must know so much more than they can set down.

The result is to obtain a catalogue for the equinox of 1810 of 4239 stars. The number in the original Groombridge catalogue was 4243, but of these nine have been rejected on various grounds, and five have been added as separate stars. The places of a few more stars have been considered discordant, and have not been used in the subsequent discussion of proper motion. The accuracy of the catalogue and the care of the observer can both be estimated in some measure from the fact that a discrepancy of four seconds of arc in either right ascension or polar distance has been considered a proper limit to warrant the exclusion of the observation. The number excluded is 75 in right ascension and 214 in polar distance, slightly more than 1 per cent. of the total number of observations.

The peculiar value of this catalogue lies in the fact that its epoch is 1810. Therefore, by comparison with modern observations, it offers the means for a new determination of the precessional constant, while the new proper motions which it makes available should give greater certainty to researches into the amount and direction of the solar motion. The length of time elapsed since Groombridge's day is not much less than that available in the case of Auwers-Bradley, and the accuracy of the observations would seem to be of the same order; but Bradley's optical means were smaller, and the average of his stars considerably brighter. Groombridge's stars include many of the ninth magnitude, and fill a gap between those to which Bradley's observations refer and the results that will be derived from photography. On the other hand, Bradley's stars were better distributed over the whole sky. Groombridge limited his observations to the circumpolar regions. Against this drawback, as against many others, the Greenwich authorities have struggled with apparent success, and a few of their final results may be given.

We have, in the first place, the proper motions of more than four thousand stars determined by comparison of places at intervals of approximately ninety years. These proper motions have been derived for the most part by a

[1] "New Reduction of Groombridge's Circumpolar Catalogue for the Epoch 1810·0." By F. W. Dyson, F.R.S., and W. G. Thackeray. Under the direction of Sir William H. M. Christie, K.C.B., F.R.S., Astronomer-Royal. (Published by order of the Board of Admiralty in obedience to His Majesty's command. Edinburgh: Neill and Co., Ltd., 1905.) Price 24s.

"Telegraphic Determinations of Longitude made in the Years 1888-1902, under the direction of Sir W. H. M. Christie, K.C.B., F.R.S., Astronomer-Royal. (Published by the Board of Admiralty in obedience to His Majesty's command. Edinburgh: Neill and Co., Ltd., 1906.) Price 15s.

simple comparison of positions at the extreme limits of time. It is not made clear why observations at intermediate dates, such as those of the Radcliffe Observatory, have not been used. The plan adopted seems the more strange, since the precessional variation has been applied and a comparison has been instituted. Considering the important part these proper motions were to play in the subsequent discussion, it would seem that too much care could not be exercised in their determination. These proper motions have been arranged in tables according to their amount, or the magnitude of the stars, or the character of spectrum, and, indeed, in every way that ingenuity could suggest as likely to be useful. This method of distribution cannot but be of essential service to those who wish to make further use of the material.

Next we have a determination of the precessional constants. The final result may not possess more than an academic interest, but the research is thorough and valuable. It would serve no useful purpose to enter into details, since those who are interested in such recondite questions must refer to the original sources for information, but the numerical results may be quoted, since they differ from Newcomb's values by a greater amount than would have been anticipated. For the centennial values of m and n we have :—

	m	n
Newcomb	4607″·11 ...	2005″·11
Dyson and Thackeray ...	4607″·57 ...	2005″·31

Another result which follows incidentally from the method of discussion is to show that, so far as this material is available, there is no reason to suspect any rotation of the brighter stars, as a whole, relatively to the fainter stars.

Lastly, the authors assign a direction to the solar motion, or rather many directions, for the material is discussed in many ways, all interesting. Here, again, we must content ourselves with the final result, which places the apex of the sun's motion in right ascension 275° and north declination 37°, referred, presumably, to the equinox of 1850.

In tendering our congratulations to Messrs. Dyson and Thackeray, and all who have been engaged in this work, we cannot help remarking that, as in the past, the Royal Observatory has distinguished itself by its energy in laboriously piling up observations, so in this instance, it demonstrates equally happily its power to make the accumulated material available for the advance of philosophical astronomy.

The title of the second book reminds us how loyally the Greenwich Observatory has served the purposes of its foundation. To determine, or to supply the means for determining, the longitude has constantly figured in its programme of work. The times have altered, the conditions of the problem have changed, and, above all, accuracy has increased, but, steadfast to its original design, the Royal Observatory has always been willing to assist in such inquiries, whether in the interests of navigation or for the purposes of geodesy. The Paris meridian seems to have been a constant source of anxiety to Greenwich, and the present volume gives the history of no less than three attempts to grapple with the difficulty. The two earlier results, 9m. 20·85s. and 9m. 20·79s. west of Greenwich, seem fairly accordant to the lay mind, but since they both differed in the same direction from the results of the French observers, the small discrepancy led to a third attempt in 1902, from which it appeared that Paris was west of Greenwich 9m. 20·932s., with a probable error of only 0·006s. Since this probable error is equivalent to about the length of an ordinary writing table, it would seem to possess the necessary accuracy, and the problem of the distance between the meridians of Greenwich and Paris may be considered as laid aside for some time to come. The remaining portion of the book is concerned with the longitudes of Montreal, Waterville, and Canso, and of stations incidentally connected with the scheme of operations. The result is to place Montreal in west longitude 4h. 54m. 18·62s., with an uncertainty of about 20 feet. Doubtless the day will come when this error will be felt to be intolerable, but if a demand is made for a fresh inquiry, we may be sure that the best traditions of Greenwich will respond to the appeal. W. E. P.

ANTI-TYPHOID VACCINE.

A MEMOIR "On the Standardisation of Anti-typhoid Vaccine," by Captain George Lamb and Captain W. B. C. Forster, has just appeared (Scientific Memoirs of the Government of India, No. 21. Calcutta: The Government Printing Office, 1906. Pp. 15. Price 7*d*.). After reviewing the various methods which have been proposed for the standardisation of Wright's anti-typhoid vaccine, Captains Lamb and Forster come to the conclusion that the virulence of the organisms used in the preparation of the vaccines must be taken into account. Since it appears that virulence is in direct proportion to the number, or avidity for immune body, of the receptors, an estimation of these latter in any vaccine will take cognisance of the virulence of the organism from which it was prepared. Admitting this as a basis, the method of standardisation suggested by Captains Lamb and Forster is to estimate what dilution of the various vaccines when mixed in equal parts with serum is able to remove completely the bactericidal power of that serum; in other words, to determine in what dilution of vaccine the receptors completely neutralise the amboceptor content of the serum. This is carried out by preparing a number of different dilutions of the vaccine, which are each mixed with the same amount (100 c.cm.) of fresh goat serum, and left in contact for an hour at 37° C. At the end of this period a small quantum of living typhoid culture is added to each tube, the several tubes are incubated for about twenty-four hours, and then sterile broth is added to each tube in order to ascertain whether the bacilli have been killed or no, and in this way various vaccines may be compared. The memoir must be consulted for the details of the method. R. T. HEWLETT.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The thirteenth "Robert Boyle" lecture of the Junior Scientific Club will be delivered by Prof. J. H. Poynting, F.R.S., on Wednesday, May 30, upon the subject of "The Pressure of Light."

Mr. J. S. C. Douglas, Christ Church, has been elected to the Radcliffe travelling fellowship for 1906.

Prof. Ritchie, fellow of New College, has been nominated as an examiner in preventive medicine for 1906, 1907, and 1908.

The 284th meeting of the Junior Scientific Club was held on May 16, when Mr. P. W. Robertson read a paper on "A New Method of Estimating Quinine," and Prof. E. G. Hill one on "Chemistry in India."

CAMBRIDGE.—The museums and lecture rooms syndicate has reported that the chemical laboratory of Gonville and Caius College will be closed at the end of the academic year 1906–7. It will therefore be necessary to provide further accommodation in the University for the students who have hitherto found places in the chemical laboratory. The museums and lecture rooms syndicate recommends that a site in the museums' grounds contiguous to the buildings of medicine should be set apart for this purpose. It is also recommended that the proposed extension of the Cavendish Laboratory should take place on a site with a frontage to Free School Lane to the north of the existing building. Lord Rayleigh's gift of 5000*l*. of the Nobel prize will, it is hoped, enable this building shortly to be begun.

The Vice-Chancellor has been authorised to convey to the Worshipful Company of Goldsmiths the thanks of the University for its munificent gift of 5000*l*., to be applied to the present needs of the University library.

The well-known authority on coral reefs and oceanography, Mr. J. Stanley Gardiner, has been nominated by the master and fellows of Gonville and Caius College to be pro-proctor for the ensuing year.

Dr. Bonney will lecture at 5 p.m. on Thursday, May 31, in the Sedgwick Museum, on "Volcanoes and Man's Experience of them."

Steps are being taken for the provision of a permanent endowment to place the Balfour library in a secure position. The library owes its origin to the generosity of the family of the late Prof. F. M. Balfour, who after his death in 1882 presented his scientific books to the University for the

use of the zoological laboratory. The library so constituted was housed in a room adjacent to the laboratory, and has ever since been freely open to all members of the University and to others qualified to make use of it. The library has been maintained hitherto out of the fees paid by students attending the classes; and the burden which it thus places upon the resources of the laboratory is undesirable. A committee has therefore been formed for the purpose of collecting subscriptions, and of establishing a fund to be called the Balfour Library Endowment Fund, with the object of putting the library on a secure and satisfactory basis. The committee at its first meeting agreed that the fund, when established, "be offered to the University at such time and under such conditions as the subscribers shall hereafter determine, provided that the management be closely connected with the zoological laboratory, and that the library be freely open to students." Subscriptions may be paid to the Balfour Library Endowment Fund, at Messrs. Barclay's Bank, or to the treasurer, Mr. Adam Sedgwick, Zoological Laboratory, New Museums, Cambridge. The sum already received or promised amounts to about 500*l*.

THE King and Queen will visit Newcastle on July 11 to open the new wing that completes the Armstrong College. The King will also open the new university buildings at Aberdeen on September 24.

IT has been resolved by the Corporation of McGill University, Montreal, to confer the honorary degree of LL.D. on Dr. D. Macalister, president of the General Medical Council of the United Kingdom.

IT is announced from the Agricultural Department of the University of Edinburgh that Mr. E. Thompstone has been appointed assistant deputy director of agriculture for Bombay Presidency, and Mr. Roger Prosser will go to La Germania, Argentina, to investigate salt soils.

THERE is a vacancy for a junior assistant secretary, holding a science degree or possessing equivalent qualifications, in the office of the department of technology of the City and Guilds of London Institute. Applicants for the appointment should communicate with the superintendent, Exhibition Road, London, S.W.

ACCORDING to the *Chemiker Zeitung*, the University of Basle has fallen into line with the German universities, and now requires from all German doctor candidates the leaving certificate of a nine-year gymnasium or of a corresponding Swiss institution. The German Government had threatened not to recognise the doctor's degree if the University continued to grant it on the old conditions.

A GENERAL meeting of old students of the Technical College, Finsbury, was held on May 8 to discuss the proposal to form an Old Students' Association. In a short opening speech Sir Owen Roberts, who occupied the chair, expressed his approval of such associations, and said that it gave him great pleasure to preside at the organisation meeting of such a one as this promises to be. Dr. M. O. Forster, F.R.S., was elected president of the association.

IT is announced in *Science* that Mr. Andrew Carnegie has made a donation of 20,000*l*. to Lehigh University; and that the movement to increase the endowment of Victoria University, Toronto, by 60,000*l*. is now practically completed. The amount has been raised all but 2400*l*., counting the 10,000*l*. given by Mr. Carnegie. The latter gift was conditional upon the raising of an additional 10,000*l*., but no trouble in fulfilling the condition is expected. According to the N.Y. *Evening Post* Sir William McDonald, of Montreal, has given 11,000*l*. for the purpose of erecting an extension to Prince of Wales College, Charlottetown, P.E.I. Additional facilities will be provided for teaching nature-study, domestic science and kindred subjects, and for training teachers.

THE commission appointed by the German Association of Naturalists and Physicians at Breslau in 1904 to consider the mathematical and scientific instruction in German schools held a general meeting in Elberfeld on April 9–11, and discussed the following questions at length:—the syllabus of the mathematical and scientific teaching in the girls' high schools, in the six-class Realschulen and in the Reformschulen; the science teaching of the elementary and continuation schools, as well as that of the commercial and special schools; certain hygienic and sexual questions in connection with school life; the chemical instruction given in the training colleges. While the results and reports of these discussions will be laid before the society at the Stuttgart meeting in the autumn, it has been decided to issue a report on the form of instruction recommended for the girls' high schools as early as possible.

AN addition to the many proofs which have reached us of the active interest taken on the Continent in the reform of mathematical teaching is afforded by the publication of a German translation of the address delivered to the *Mathesis* Society by Prof. Gino Loria on April 22, 1905, at Milan. The translation, which is literal, has been made by Dr. H. Wieleitner, and is published by G. J. Göschen, of Leipzig, under the title of "Vergangene und künftige Lehrpläne." The address affords evidence of a general tendency on the Continent to attach less importance in school curricula to the performance of gymnastic exercises of little educational value, and to introduce the wider ideas of higher mathematics at an earlier stage in the curricula. The object of mathematical teaching should be to give the pupils as wide an insight into mathematical methods, especially higher methods, as is consistent with thoroughness. It is impossible to study a paper like this without seeing how much better off in this respect our Continental rivals are than we are. This difference is due partly to the fact that under our university systems a large proportion of the mathematical teachers of our schools never learn any higher mathematics whatever, whereas in Germany or Italy every student has the opportunity of studying under specialists. A second cause of difference is due to the lesser importance attached on the Continent to examinations and syllabuses. In illustration of the spirit of the paper, Prof. Gino Loria considers that "elementary conics" is of little value as usually studied, as the subject contains no new ideas, and the pupils are only wearied with complicated exercises. This is certainly true of the subject as commonly taught, but, at the same time, a course of elementary mathematics ought to contain some introduction, however small, to the study of common curves, their tangents, and their other simpler properties treated geometrically and not as graphs.

THE conditions of admission of students to college not only vary in different countries, but also often in the colleges and universities of the same country. This subject is receiving interested attention among educationists in the United States. *Science* for April 27 prints an address by President G. E. MacLean, of the State University of Iowa, which discusses the question: Can there be a coordination of the examining, certificate, and accrediting (including school inspection) systems for admission to college, looking toward a common or national administration in the interests of students, colleges, and the preservation of standards? The American procedure in this matter is not uniform. The western plan may be said to be the admission of students to colleges and universities by certificates from duly inspected secondary schools, while in eastern States the method is to admit only by examinations conducted by representative boards or otherwise. Some valuable opinions are collected in the address as to the relative value of the two courses. President MacLean says that the accrediting system has raised the standard of the work done. It has linked the secondary school into one system with the college. It has given an increase of students entering college, and with better average preparation. It is sometimes alleged that the scholarship of students admitted on certificate is lower than that of students who are required to pass examinations, but President Schurman, of Cornell, says the experience at his university does not support the contention. On the other hand, Prof. Hadley, of Yale, believes that the examination method is fairer to boys who come from a distance to the university. Yet, with the exception of Harvard, Yale, and Princeton, practically a coordination of the examining, certificate, and accrediting system has been reached inasmuch as testimonials issued by the college authorities are interchangeable. President MacLean concludes by urging the need for liberty to each institution, and records his belief that it is a question of evolution—the best system or combination of systems will survive.

SOCIETIES AND ACADEMIES.

LONDON.

Zoological Society, May 1.—Dr. Henry Woodward, F.R.S., vice-president, in the chair.—Skin of a remarkable new duiker from Nyasaland, presented to the British Museum by Mr. S. W. Frank: Oldfield **Thomas.** The animal was named *Cephalophus walkeri*, sp.n.—Further notes on anthropoid apes: Hon. W. **Rothschild.** The author exhibited five mounted specimens, one skeleton, six skulls, and a photograph of the following races:—*Gorilla gorilla*, dark-headed race, *G. gorilla*, red-headed race, *G. gorilla matschiei*, *G. gorilla diehli*, *Simia vellerosus*, and *S. vellerosus fuliginosus*.—Mammals collected in South-West Australia for Mr. W. E. Balston: Oldfield **Thomas.** Thirty-two species and subspecies were enumerated, of which the following were described as new:—*Scoteinus balstoni*, sp.n., *Tachyglossus aculeatus ineptus*, subsp.n.—A series of papers on the Lepidoptera collected in South Tibet by the officers during the recent expedition to that country under Colonel Sir Frank Younghusband. Mr. H. J. **Elwes** gave an account of the butterflies contained in the collection, which comprised thirty-three species and varieties, four of which were described as new. The moths, exclusive of the Tineidæ, have been worked out by Sir George **Hampson,** Bart., who enumerated the sixty-three species of which specimens were obtained. Of these, examples of thirty-six species were taken at moderate elevations in Sikhim, and belonged to the Indian fauna, two being described as new; twenty-seven species belonged to the Palæarctic fauna, of which nine were widespread and eighteen Tibetan; ten of these were described as new. An account of the Tineidæ was supplied by Mr. J. Hartley **Durrant**; they were referred to four species, two of which were new.—Contributions to the knowledge of the vascular and respiratory systems in the Ophidia and to the anatomy of the genera Boa and Corallus: F. E. **Beddard.**

Chemical Society, May 3.—Prof. H. E. Armstrong, F.R.S., past-president, in the chair.—The chairman gave expression to the sense of loss sustained by the Chemical Society in the death of Prof. Pierre Curie. The meeting endorsed the letter of condolence addressed by the president to Mme. Marie Curie, an honorary and foreign member of the society.—The relation between absorption spectra and chemical constitution, part v., the *iso*nitroso-compounds: E. C. C. **Baly,** Miss E. G. **Marsden,** and A. W. **Stewart.** From observations of the absorption spectra of several *iso*nitroso-compounds in neutral and alkaline solution it is found that the free substances most probably have the constitution $\begin{matrix} R.C:O \\ \cdot\ * \\ R.CH.NO \end{matrix}$ but in presence of sodium hydroxide the starred hydrogen atom is replaced by sodium and becomes labile. *Isorropesis* then takes place between the $>C:O$ and $>C:N$ groups, a tautomeric process being the actuating mechanism.—The residual affinity of coumarin as shown by the formation of oxonium salts: G. T. **Morgan** and Miss F. M. G. **Micklethwait.** Platinichlorides of coumarin, 6-aminocoumarin, ethyl-6-aminocoumarin, dimethyl-6-aminocoumarin, acetyl-6-aminocoumarin, and a coumarin hydriodide periodide were described. The formation of these salt-like additive compounds of coumarin agrees with the results of earlier investigators. Coumarin also exhibits an amphoteric character in combining with metallic oxides and hydroxides.—Brazilin and hæmatoxylin, part vii., some derivatives of brazilein: P. **Engels** and W. H. **Perkin,** jun. Brazilein is the colouring matter produced when brazilin is oxidised in alkaline solution by means of air. Trimethylbrazilein, trimethylbrazilein formic acid, trimethyl*iso*brazilein sulphate, and trimethylbrazilein hydroxylamine were described.—The action of tribromopropane on the sodium derivative of ethyl malonate: W. H. **Perkin,** jun., and J. L. **Simonsen.**—Pipitzahoic acid: J. McConnell **Sanders.** The author considers that the composition is best represented by the formula $C_{16}H_{14}O_2$, it being thus isomeric with camphorquinone, and similar to, although not identical with, the *iso*camphorquinone discovered by Manasse. The acid seems to behave as a hydroxy-ketone, forming a resinous acetyl compound and a greenish-brown copper derivative.—The constitution of the hydroxides and cyanides obtained from acridine, methyl-acridine, and phenanthridine methiodides: C. K. **Tinkler.**—The constitution of ammonium amalgam: Miss E. M. **Rich** and M. W. **Travers.** The results of determinations of the freezing points of a series of samples of ammonium amalgam have led the authors to the conclusion that it is a true solution of ammonium in mercury.—Action of light on potassium ferrocyanide: G. W. A. **Foster.** When a neutral or alkaline solution of potassium ferrocyanide is exposed to light, a purely photochemical action ensues, and ferric hydroxide is slowly precipitated. A mercury vapour lamp was used as a source of light.—Note on the constitution of cellulose: A. G. **Green** and A. G. **Perkin.** The supposed tetra-acetate of cellulose has been re-investigated and found to be in reality a triacetate. This affords further evidence of the correctness of Green's formula for the nucleus of the carbohydrate.—Some new derivatives of pinene: F. P. **Leach.** When pinene nitrosochloride is treated with potassium cyanate in alcohol at 50° to 60°, a compound, $C_{12}H_{17}O_3N_3$, separates. When heated with concentrated sulphuric acid it yields a *base*, $C_{16}H_{18}ON_2$. This is amphoteric, and appears to be an amino-oxime; it is also obtainable from pinene nitrosochloride by the action of ammonia.—Glutaconic and aconitic acids: S. **Ruhemann.** A criticism of Rogerson and Thorpe's work on these acids.

Anthropological Institute, May 8.—Mr. H. Balfour, ex-president, in the chair.—Phonograph records of native songs from the Congo, collected by Dr. J. L. **Todd,** were exhibited. The songs were all collected in the upper waters of the Congo, and were of great interest as specimens of native African music.—Notes on the ethnography of the Ba-Mbala: E. **Torday** and T. A. **Joyce.** The data on which the paper was based were collected by Mr. Torday. The Ba-Mbala are a Bantu tribe inhabiting the district between the Kwilu and the Inzai, tributaries of the Kasai, in the Congo Free State. The country had not previously been visited by a white man, at least for many years. The most interesting feature connected with these people is perhaps the fact that they are cannibals, men, women, and children all indulging, with the exception of a particular class known as *Muri*, who are distinguished by wearing a particular kind of bracelet. Another interesting feature of these people is that they appear to have borrowed all their knowledge of crafts from the neighbouring tribes. The paper was illustrated by a collection of specimens sent home by Mr. Torday, and also by lantern-slides.

Physical Society, May 11.—Dr. C. Chree, F.R.S., vice-president, in the chair.—The dead points of a galvanometer needle for transient currents: A. **Russell.** When many types of needle galvanometer are connected with a condenser and a battery in the ordinary manner by a charge and discharge key the following phenomena can easily be observed. When the needle is initially at right angles to the axis of the galvanometer coil, and the spot of light is in the centre, X, of the scale, the throws on charge and discharge are equal. If the controlling magnet be turned through a small angle, or if the suspending fibre be twisted slightly so that the spot of light is not in the centre of the scale initially, the throws on charge and discharge are not equal. The algebraic difference between them, however, is constant. Hence, for an initial position P_1 of the spot of light there is no throw on charge, and similarly for another initial position P_2 there is no throw on discharge. The author shows that these effects can be explained with considerable accuracy by supposing that the magnetism of the needle consists of two parts, one permanent and the other proportional to the magnetising force. He finds that it is easy to arrange with a low-resistance galvanometer so that a, relatively speaking, gigantic charge can be passed through the coil without producing any throw at all. He also finds that all the galvanometers he has tested, whether needle or moving coil, will produce throws when certain transient currents pass through them, even although the integral value of these currents is zero. It also appears that the effective internal resistance of ordinary condensers is appreciable in certain cases.

Royal Meteorological Society, May 16.—Mr. Richard Bentley, president, in the chair.—An instrument for testing and adjusting the Campbell-Stokes sunshine recorder: Dr. W. N. **Shaw** and G. C. **Simpson.** Experience has shown the necessity of an instrument for testing the shape and dimensions of recorders, and for verifying their adjustment when installed. But it is not at all easy by mere inspection or simple measurements with ordinary measuring instruments to check the adjustment, nor is it possible on a sunless day, without some special instrument, to check the orientation, and so the time-scale of the sunshine recorder. The authors have devised an instrument for this purpose, which they fully described in the paper.—The development and progress of the thunder-squall of February 8, 1906: R. G. K. **Lempfert.** This squall was first noted at Stornoway soon after midnight, and the last station in England to feel its effects was Hastings, over which it passed at about 4 p.m. The rate of progress was nearly uniform, though it increased somewhat in the south-east of the country, where the thunder and hail storms were most intense. The average speed of advance of the line of squall was about thirty-eight miles per hour. The most marked feature of this squall was the sudden shift of the wind in the course of a few minutes from south-west to north-west, and it was during this period that the thunderstorm occurred, accompanied by a rise of barometric pressure and a fall of temperature.

Society of Chemical Industry (London Section), May 7.—Mr. A. Gordon Salamon in the chair.—Notes on the Gutzeit test for arsenic: J. A. **Goode** and Dr. F. Mollwo **Perkin.** Owing to the difficulty of obtaining zinc free from arsenic, the authors used an ammonium salt—preferably the chloride—and metallic magnesium. Numbers are given showing the solution potential of magnesium in ammonium chloride and sulphuric and hydrochloric acids, also the difference produced by the addition of cadmium salts. The potential found was always lowered by the addition of the cadmium salt. Attempts to obtain a permanent stain were unsuccessful. The authors, however, do not consider that this is a matter of great importance, because as the test is so readily carried out it is easy to conduct several experiments simultaneously, one to produce a standard stain, one a blank, and the other with the substance under examination. The authors found that mercuric bromide is more delicate than mercuric chloride, and the stain is more intense. With mercuric bromide it is possible to detect 1/2000 mg. of arsenic. Although magnesium and ammonium chloride were employed by the authors, they also used zinc and acids, and obtained results equally as good. In fact, they consider that zinc and acid is fractionally more sensitive than magnesium and an ammonium salt.—The separation of brucine and strychnine by nitric acid; influence of nitrous acid: W. C. **Reynolds** and R. **Sutcliffe.** The authors have examined the processes proposed by Keller (*Zeit. Oesterr. Apoth. Ver.*, 1893, 542), Stoeder (*Ned. Tydschr. Pharm.*, 1899, xi., 1–5), and Gorden (*Arch. Pharm.*, 1902, ccxl., 641–4), and show under what conditions brucine can be completely oxidised with the minimum loss of strychnine. They have also investigated the part played by nitrous acid in the oxidation, and the action of alkalis on the products.—Absorption of gallic acid by organic colloids: W. P. **Dreaper** and A. **Wilson.** The absorption of gallic acid by silk and hide powder is shown to be of a similar nature to its absorption by gelatin or albumin. The influence of general reagents and the curves obtained indicate that the reactions are due to absorption. The precipitation of these colloids by tannic and gallic acids indicates, when studied in detail, that the solution state is a determining factor in the production of these coagula. The influence of gallic acid on the nature of a tannic acid gelatin coagulum is also observed. The results confirm the pseudo solution theory of dyeing, and indicate the nature of tanning.

CAMBRIDGE.

Philosophical Society, April 30.—Mr. J. J. Lister in the chair.—Demonstration of new apparatus for psychological tests: W. H. R. **Rivers.**—The measurement of the earth air current and the origin of atmospheric electricity: C. T. R. **Wilson.** The experiments, so far as they go, yield no support to theories which attribute the positive electrification of the air to effects of its contact with bodies at the earth's surface, *e.g.* to friction, or to greater loss of negative than of positive ions on account of their greater mobility. In an article in NATURE in June, 1903, it was suggested that the precipitation theory of the origin of the electrical field might have to be abandoned on account of the difficulty of explaining how positively charged air could be carried from wet-weather regions for any considerable distance without losing practically all its charge, and another possible origin of the electrical field was suggested, *i.e.* the arrival at the earth's surface, from external sources, of negatively-charged particles of the nature of extremely penetrating kathode rays. This hypothesis has been made less unlikely by the recent experiments of Campbell and Wood, which suggest the existence at the earth's surface of rays from cosmical sources. On the other hand, the difficulty in the way of the precipitation theory is removed if the current from the wet- to the fine-weather regions is regarded as due to conduction in the upper atmosphere, and not merely to convection of the positive charge by winds.—A class of integral equations: H. **Bateman.**—A suggestion as to the nature of the horny teeth of the Marsipobranchii: H. W. Marett **Tims.** It is difficult to accept the homologies which have been proposed between the horny teeth of the Marsipobranchii and the teeth of higher vertebrates. The published accounts of the development of the former appear to the writer to harmonise more closely with the development of the teleostean scale, from which it is suggested in the present paper that the horny teeth may have been derived.

EDINBURGH.

Royal Society, May 7.—Dr. R. H. Traquair, vice-president, in the chair.—Vibrating systems which are not subject to the Boltzmann-Maxwell law: Dr. W. **Peddie.** In this paper the question of the partitioning of energy in a system of mutually influencing masses is considered, the law of action assumed being the generalised Hooke's law. It is shown that equipartition of energy is in general impossible. An infinity of cases with a given number of degrees of freedom in which equipartition holds is possible, but the order of the infinity of cases in which it does not hold is greater. A method of time averages for a single system is used. When equipartition cannot hold in the case of any one system, the same result must be true for the space averages of a large number. In the course of the work a very symmetrical condition for the reality of the roots of an *n*-ic is found.—The superposition of mechanical vibrations upon magnetisation, and conversely in iron, steel, and nickel: James **Russell.** The wire under examination was, when required, set into mechanical vibration by means of an electric bell, to the sounding part of which the one end of the wire was fixed. The investigation was a systematic comparison of the temporary and residual magnetisations of these materials in various cyclic fields, according as the material was or was not in a state of vibration. The influence also of the condition of the wire, according as it was annealed or "quenched," was carefully studied. Of the many results obtained the following may be mentioned:—With permanently acting vibrations hysteresis loss is increased when the limiting fields are low, increased when they are high, but always decreased when the comparison is made with the limits given inductions instead of fields. In the annealed condition of all three metals, vibrations greatly increase the effects of "field on" and "field off." When the vibrations are not maintained permanently, but are superposed upon the magnetised condition at different stages of the cycle, the results are very different. Thus with continuous vibration the slope of the curve decreasing from the same maximum is always greater with vibration than without. On the other hand, when the vibration is superposed an increase of induction always occurs on the down curve as the cyclic extreme is departed from, and this increase passes into decrease in the opposite sense as the other cyclic extreme is reached.—*Neobythites brucei*, Poisson abyssal nouveau recueilli par l'Expédition Antarctique Nationale Ecossaise: Louis **Dollo.** This is a unique specimen of a new fish (family Brotulidæ) which Mr. W. S. Bruce found in the Weddell Sea at a depth of 2500 fathoms, 800 feet deeper than the deepest sounding obtained by the *Challenger* in the same

region.—The Nematoda of the Scottish National Antarctic Expedition: Dr. v. **Linstow.** Seven species were described, five of the parasitic genus Ascaris, of which two were new species, and one undetermined. The others were a new species of Monorygma and a free-living Thoreostoma. Mr. Bruce exhibited the specimens, the *Monorygma dentatus* found in the stomach of the Weddell's seal being specially interesting.—A Pfaffian identity and related vanishing aggregates of determinant minors: Dr. Thomas **Muir.**

PARIS.

Academy of Sciences, May 7.—M. H. Poincaré in the chair.—The discovery of the proper motions of the stars by the aid of the stereoscopic method of Dr. Max Wolf: M. **Lœwy.** The method consists of a comparison in a stereoscope of two photographs of a given portion of the sky taken at several years' interval. Among the photographs shown was one bringing out the proper motion of a star of the ninth magnitude in the constellation of Leo. The proper motion can be evaluated stereoscopically with a greater precision than by the ordinary micrometric methods.—Remarks on the twelfth volume of the "Annales de l'Observatoire de Bordeaux": M. **Lœwy.**—The methods for the detection of aggregations of luminous particles, mixed with the gases and vapours in the lower part of the solar atmosphere, at other times than during eclipses: H. **Deslandres.** Very little has been done on the composition and distribution of the non-gaseous portion of the solar atmosphere. The author reviews the difficulties of the subject, and gives suggestions as to the best mode of attacking the problem.—The nidification of bees in the open air: E. L. **Bouvier.** An account of two cases in which domesticated bees have built hives in the open air on the branches of trees, and of the modifications in the structure necessitated by the exposure to wind and rain. Owing to the neighbouring buildings, one side of the hive was more exposed than the other. This fact was appreciated by the bees, and the exposed side was strengthened accordingly.—The conglomerates from the explosions of Vesuvius, their minerals, and their comparison with the trachytic conglomerates of Mont Dore: A. **Lacroix.**—Remarks by M. Albert Gaudry on the forthcoming International Congress of Anthropology and Prehistoric Archæology at Monaco.—The synthesis of penta-methyl-ethanol: Louis **Henry.** The substance $(CH_3)_3$—C—C(OH)—$(CH_3)_2$ was obtained in an attempt to prepare

$$(CH_3)_2—CCl—C(OH)—(CH_3)_2,$$

by the interaction of magnesium methyl-bromide and ethyl chlorisobutyrate or the corresponding bromo-compound. The method described is the most advantageous one for the preparation of this alcohol.—Researches on the whitening of fur and feathers in winter: El. **Metchnikoff.** Observations are given showing the probability of the view that the blanching of the hair and feathers, in animals periodically and in man through old age, is due to the activity of living amœboid cells, chromophages, sensible to external influences, and capable of moving and attacking the pigment grains.—The generalisation of trigonometrical series: A. **Buhl.**—Certain asymptotic series: L. **Schlesinger.**—The acceleration of spherical waves of shock: M. **Jouguet.**—The application of the principle of superposition to the transmission of alternating currents over a long line. Its graphical representation: A. **Blondel.**—The interference effects produced by a grating limiting a thin plate: Georges **Meslin.** The theory of interference rings which appear when a grating is placed on the convex surface of a lens of small curvature, and are distinct from Newton's rings. These fringes can be applied practically to the verification of a surface without the use of monochromatic light, and this testing can be carried out without interrupting the working of the surface, owing to the fact that the diffraction grating may be placed at a distance of some millimetres from the surface without interfering with the production of the fringes.—The action of ammonia gas on anhydrous neodymium chloride: C. **Matignon** and R. **Trannoy.** Neodymium chloride forms seven different combinations with ammonia, containing respectively one, two, four, five, eight, eleven, and twelve molecules of ammonia to one of $NdCl_3$. These compounds form a further confirmation of the trivalency of neodymium, as the assumption of divalency for this metal would lead to improbable formulæ for these addition products.—The existence of sulphides of phosphorus; mixtures of phosphorus and phosphorus sesquisulphide: R. **Boulouch.** A criticism of a paper on the same subject by H. Giran, and a discussion of the nature of the eutectic mixture formed by phosphorus and the sulphide P_4S_3.—Some special brasses: Léon **Guillet.** The addition of an element such as aluminium to a brass containing copper and zinc only yields an alloy possessing mechanical properties and a micrographic structure corresponding to a pure copper-zinc brass of quite different composition. From numerous experiments on the addition of various elements, a quantitative expression is developed referring the properties of the alloys thus formed to the pure copper-zinc brasses of corresponding properties.—A method for the detection and estimation of small quantities of iron: A. **Mouneyrat.** The method is based on the production of a green colour in dilute solutions of iron salts by the action of sulphuretted hydrogen in ammoniacal solution. It is shown that the reaction is specific to iron and is of extreme delicacy, serving to estimate this metal between the limits of 1/1000 and 1/1,000,000.—The production of aromatic sulphamates by the reduction of nitro-compounds with sodium hydrosulphite: A. **Seyewetz** and M. **Bloch.** Nitrobenzene is reduced by sodium hydrosulphite in presence of sodium phosphate to the sodium salt of phenylsulphamic acid. The reaction is general for aromatic compounds, and has been extended to the three nitrotoluenes, metanitroxylene, and α-nitronaphthalene.—A seismic disturbance recorded at the Observatory of Ebro on April 18: P. **Cirera.**

NEW SOUTH WALES.

Linnean Society, March 28.—Annual General Meeting.—Mr. T. Steel, president, in the chair.—Annual address: the **President.** The question of rabbit destruction was dealt with, the proposal to introduce disease for the purpose being condemned, on the grounds that not only would it not affect the desired extermination, but also that it was extremely undesirable to introduce a foreign pathogenic microbe of unknown potency under changed conditions, to be broadcasted over the land. Attention was directed to the indiscriminate destruction, wilful as well as inadvertent, of useful and harmless indigenous animals, and the deplorable results in loss of crops through attacks of insects which are sure to follow the killing off of insectivorous birds. Taking as the special subject of his address that of oceanic physics, the president briefly sketched the formation of the primary ocean, showing that it was in all probability highly saline and that calculations of the age of the earth, based on the present rate of transport of salt from the land to the sea, are misleading. Regarding the observed rate of increase in temperature downwards in the earth's crust, which has been found to be about 1° F. for each 51 feet of descent, reasons were given for considering that this rate is not maintained, and that a maximum temperature of about 7000° F. is reached at a depth of some 800,000 feet, after which the temperature to the earth's centre remains practically unaltered. Dealing with the phenomenon of wind-raised waves, it was shown that these have well-defined properties, waves of any given size having all their other functions in unison, the height, length, frequency, velocity, &c., being fixed and invariable, relative to one another. Allusion was made to the enormous amount of energy involved in the evaporation which takes place daily from the ocean surface, and to the profound effect on climate caused by the transference of heat absorbed in vapourising water from the sea and again liberated at the places where this vapour condenses to form clouds and rain. The address concluded with an examination of the possibilities in regard to the withdrawal of water from the ocean to be stored as ice at the poles, and the result on the relation of land and water levels, also on the adequacy of change of land level at the poles to account for the known former existence there of a comparatively mild climate.—The first recorded occurrence of Blastoidea in New South Wales: T. G. **Taylor.** The Australian Blastoids at present known comprise three species from the Gympie beds (permo-Carboniferous) of the Rockhampton district, and provisionally referred to the genera Metablastus, Granato-

crinus, and Tricœlocrinus. The two specimens now recorded are different from the Queensland forms, and were obtained from the Glenwilliam (permo-Carboniferous) series at Clarence Town, New South Wales. They are provisionally classed as species of Metablastus.—A collection of Crustacea from the Port Curtis district, Queensland: F. E. **Grant** and Allan R. **McCulloch.** The paper deals with a collection of more than 100 species of Brachyura and Macrura taken in Port Curtis and at the extreme south of the Great Barrier Reef, in October, 1904. Five species are described as new. Twenty-one species are recorded as new for Australia.

CALCUTTA.

Asiatic Society of Bengal, April 4.—Notes on the tank fauna of India: Dr. N. **Annandale.** A cockroach of the genus Epilampra is recorded as being aquatic in Chota Nagpur, and a peculiarity in its spiracles and in those of some other members of its family is noted. A general account is given of the respiratory system of an aquatic glow-worm, probably the larva of a Luciola. Some further diagnostic characters (distinction of the sexes, structure of the eggs, relative proportion of body and tentacles) of *Hydra orientalis* are put on record. Two protozoa are noted as having been found associated with it, and the part played in its migrations by Paludina is pointed out. An account is given of a chironomid larva which binds both the polyp and certain Vorticellids and rotifers to a temporary protective case, and then devours them at leisure. The character of the food commonly eaten in the Calcutta tanks by Hydra is indicated.—Silver dioxide and silver peroxynitrate: E. R. **Watson.** If the crystalline substance formed during electrolysis at the anode from aqueous solutions of silver nitrate be washed and dried with sufficient care, it may be isolated pure, and proved to have the formula Ag_7NO_{11}, which Sûlc gave to it. On heating this silver peroxynitrate, the decomposition proceeds in two stages; for at first oxygen is given off, but later NO_2 as well as O, white silver being left. This behaviour suggested to Sûlc the structural formula $AgNO_3 3Ag_2O_2.O_2$; Mulder and Haringa suggested later the formula $AgNO_3.3Ag_2O_2$. To both suggestions there are considerable objections. Alternatives still under investigation are $Ag_7(NO_3)O_8$ and $Ag_7(NO_4)O_7$.—The Hindu method of manufacturing spirit from rice, and its scientific explanation: J. C. **Ray.** The fungus used in Orissa is prepared in small balls by the hill-people; it is mixed in a basket with wet steamed rice in the proportion of one to one hundred parts of dry rice. The mixture heats during the next twenty-four hours, after which it is made into circular cakes and exposed upon an earthen platform for three or four days, during which the mycelium so spreads as to make the grains in the cakes cohere. The cakes are now piled up, and in four or five days become black. Next the cakes are put with water into vats sunk in the floor of a shed, and an equal quantity of fresh, well-steamed rice is added. The vats before being charged are fumigated by burning straw. Fermentation is allowed to go on for eight to ten days, until bubbles cease to rise. Distillation follows. The average yield of spirit in a good distillery is 4 gallons, proof, from 82 lb. of rice. The maximum yield of 4·5 gallons is obtained in January, the minimum of 3·66 gallons in October. Experiments show that the caking is very essential to the process. The essential mould is believed to be *Mucor racemosus*; other moulds get mixed with it.

DIARY OF SOCIETIES.

THURSDAY, MAY 24.

ROYAL SOCIETY, at 4.30.—Croonian Lecture: On Nerve Endings and on Special Excitable Substances in Cells: Prof. J. N. Langley, F.R.S.
ROYAL INSTITUTION, at 5.—Man and the Glacial Period: Prof. W. J. Sollas, F.R.S.
UNIVERSITY OF LONDON, at 5.—The Atmospheric Circulation and its Relation to Weather: Dr. W. N. Shaw, F.R.S.
INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Annual General Meeting.—Report of Council and Election of the New Council.
SOCIETY OF ARTS, at 4.30.—The Parsis of Persia: Major P. M. Sykes C.M.G.
LINNEAN SOCIETY, at 3.—Anniversary Meeti

FRIDAY, MAY 25.

ROYAL INSTITUTION, at 9.—Compressed Air and its Physiological Effects: Leonard Hill, F.R.S.
PHYSICAL SOCIETY, at 5.—Colour Phenomena in Photometry: J. S. Dow.—Exhibition of an Automatic Arc Lamp: H. Tomlinson and Rev. G. T. Johnston.—The Theory of Moving Coil and other Kinds of Ballistic Galvanometers: Prof. H. A. Wilson, F.R.S.—Exhibition of a Bifilar Galvanometer free from Zero Creep: A. Campbell.

SATURDAY, MAY 26.

ROYAL INSTITUTION, at 3.—The Old and the New Chemistry: Sir James Dewar, F.R.S.

TUESDAY, MAY 29.

ROYAL INSTITUTION, at 5.—Northern Winter Sports: Colonel V. Bulck.
ZOOLOGICAL SOCIETY, at 8.30.
SOCIETY OF ARTS, at 8.—Glass Cutting: Harry Powell. (Paper to be read at the Whitefriars Glassworks.)

THURSDAY, MAY 31.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* On the Main Source of "Precipitable" Substances and on the *Rôle* of the Homologous Proteid in Precipitin Reactions: D. A. Welsh and H. G. Chapman.—The Viscosity of the Blood: A. du Pre Denning and J. H. Watson.—The Affinity Constants of Amphoteric Electrolytes, part i., Methyl Derivatives of Para-Aminobenzoic Acid and of Glycine: J. Johnston.—Part ii., Methyl Derivatives of Ortho- and Meta-Aminobenzoic Acids: Dr. A. C. Cumming.—Part iii., Methylated Amino-Acids: Prof. James Walker, F.R.S.
ROYAL INSTITUTION, at 5.—Man and the Glacial Period: Prof. W. J. Sollas, F.R.S.

FRIDAY, JUNE 1.

ROYAL INSTITUTION, at 9.—L'Ébullition des Metaux: Prof. H. Moissan, For.Mem.R.S.

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