THURSDAY, APRIL 23, 1903.

SCHOOL GEOMETRY REFORM.

Practical Exercises in Geometry. By W. D. Eggar, M.A. Pp. xii+287. (London: Macmillan and Co., Ltd., 1903.) Price 2*s.* 6*d.*

Geometry. An Elementary Treatise on the Theory and Practice of Euclid. By S. O. Andrew, M.A. Pp. xi+182. (London: John Murray, 1903.) Price 2*s.*

Theoretical Geometry for Beginners. By C. H. Allcock. Pp. ix+135. (London: Macmillan and Co., Ltd., 1903.) Price 1*s.* 6*d.*

Elementary Geometry. By W. M. Baker, M.A., and A. A. Bourne, M.A. Books i. and ii., pp. xxix+126; price 1*s.* 6*d.* Books i.–iii., pp. xxix+213; price 2*s.* 6*d.* Books i.–iv., pp. xxix+272; price 3*s.* Books i.–vii., pp. xxix+474; price 4*s.* 6*d.* (London: George Bell and Sons, 1903.)

The Elements of Geometry. By R. Lachlan, Sc.D., and W. C. Fletcher, M.A. Pp. xii+207. (London: Edward Arnold, n.d.) Price 2*s.* 6*d.*

Plane Geometry. Adapted to Heuristic Methods of Teaching. By T. Petch, B.A. Pp. vii+112. (London: Edward Arnold, n.d.) Price 1*s.* 6*d.*

Euclid: Books v., vi., xi. By Rupert Deakin, M.A. Pp. 144. (London: W. B. Clive, 1903.) Price 1*s.* 6*d.*

A Short Introduction to Graphical Algebra. By H. S. Hall, M.A. Pp. 49. (London: Macmillan and Co., Ltd., 1903.) Price 1*s.*

THE movement having for its object the improvement of the teaching of elementary geometry is making rapid progress; witness the enthusiastic support of the teachers, the adhesion of important examining bodies, and the number of new text-books now appearing in rapid succession.

In the "Practical Exercises in Geometry," by Mr. W. D. Eggar, we have a contribution of remarkable freshness. In this valuable text-book the method pursued is on lines indicated long ago by W. G. Spencer, the father of Mr. Herbert Spencer, in his "Inventional Geometry,"[1] a little work that should be known to all teachers. The principal advance on Spencer's geometry is in the amount of *quantitative measurement* introduced, and in the use of squared paper methods. The author describes his book as "an attempt to adapt the experimental method to the teaching of geometry in schools." He says:—

"The main object of this method, sometimes called 'heuristic,' is to make the student think for himself, to give him something to do with his hands for which the brain must be called in as a fellow-worker. The plan has been tried with success in the laboratory, and it seems to be equally well suited to the mathematical class-room."

And readers of the book will agree that the author has very good grounds for this opinion.

The first five chapters are devoted entirely to the measurements of lines, arcs and angles. The author wisely uses only decimal scales. These are the inch and the centimetre scales; in regard to the latter it is no small advantage for a youth to be trained so as to be able to think in metric units. The degree of accuracy aimed at will appear from the requirement that students are asked to measure lengths correctly to within the one-hundredth part of an inch. This, however, will prove to be rather trying for lines in some of the figures, in the absence of short cross lines defining their ends. Several methods are suggested of how to measure the circumference of a circle, but the use of tracing paper and a pricker, perhaps the best of these, is overlooked.

The student is next introduced to the use of set-squares, and the notions of parallel and perpendicular lines naturally follow. Explanations are then given of how areas and volumes are measured, the subject being illustrated by the use of squared paper, unit cubes, graduated flasks, weighing, &c. The quantitative work is here largely arithmetical. This free admixture of arithmetic and drawing is, in fact, a feature throughout the book, and one marvels at the long unnatural divorce which has existed between the two in the past.

Chapters xi. and xii. are devoted to some fundamental constructions, such as the bisection of lines and angles, and the division of lines. The student by this time is quite familiar with the notion of a locus.

So far the work has been more or less of preparation. The student is now led to study more particularly the properties of triangles, quadrilaterals, circles, proportionals and similar figures. But there is no change in the method of treatment. By judicious directions, by questions and suggestions, the reader all the while seems to be discovering new truths for himself by drawing and measurement, and his interest is secured and maintained. Then follows the reason, given quite informally, perhaps by a mere hint, but none the less perfectly logical, and absolutely convincing and satisfactory, and the student feels that he has, or could have, discovered this also.

The concluding chapters relate to mensuration rules, the graphical solution of quadratic equations, the construction of scales, and graphs.

Material is provided at the ends of some of the chapters for the student to exercise himself in riders, constructions, and numerical examples. The answers to the latter are collected at the end of the volume.

The course above outlined is developed on satisfactory lines, and may be regarded as a first important instalment to the new literature of the subject. Taught in this manner, geometry would seem likely to become the most popular, as well as the most illuminating branch of elementary mathematics. It ought to replace not only Euclid, but the wretched system of practical plane geometry now in vogue in our elementary day schools. The course includes everything contained in the first six books of Euclid that a boy need know; and he knows it so thoroughly that any subsequent study of Euclid or its equivalent will add little to his knowledge of geometry, whatever may be its other merits or demerits.

We notice that the use of the T-square is not introduced at all. This seems a pity, in view of its great utility and of future developments.

While in general agreement with the author, we should like to see his course of study extended. What-

[1] Published by Williams and Norgate.

ever may be added, however, should be carefully selected, having regard to modern conditions. Very little additional matter will be taken from Euclid. We think the book would have been improved by a chapter on the solution of right-angled triangles, using the trigonometrical tables given at the end of the volume, results obtained graphically being verified by calculation. In subsequent work graphical and numerical computation would go on side by side. There are calculations relating to right-angled triangles quite as important as that of Euc. i. 47, and the drawing class seems to be the proper place in which to teach them to beginners. What better examples than the trigonometrical functions are to be found of ratio and proportion? Consider what a satisfaction it must be to a boy to find himself in possession of and familiar with this powerful modern weapon. And, moreover, the knowledge gained is of the utmost importance. In connection with this part of the subject, the radian measure of an angle should not be neglected; it is very desirable that a student should be trained so as to be able to think in radians as well as in right angles and degrees.

Next, a course seems very incomplete without some notion of projection, and how lengths and angles in three dimensional space are measured and represented. Following the author's plan, the principles of Euclid xi. would be inculcated along with exercises in descriptive geometry, involving quantitative measurement. This can be rendered quite interesting.

And lastly, one of the most fruitful additions that could possibly be made would be to introduce the idea of a vector, giving the triangle or parallelogram law, with some of its consequences. Geometry is essentially a vector subject, and an early knowledge of vectors would have far-reaching effects.

In the "Geometry" by Mr. S. O. Andrew we have another text-book in which exercises in drawing and deductive reasoning are carried on together, so that the student acquires some practical acquaintance with the subject-matter. But the work is not based sufficiently on accurate quantitative measurement, and the author seems satisfied with drawing of an inferior quality. We find no description of what sort of scales are suitable for measuring lengths. There is no information as to the manner of using and testing straight edges and squares. In the absence of any guidance to the contrary, the student is sure to use soft blunt pencils. There are no numerical answers given to any of the exercises.

But a teacher using the book could, to some extent, supply these omissions, and would find the volume very serviceable; it is the result of practical teaching experience. It covers substantially the same ground as the book previously considered, with a chapter on solid geometry and orthographic projection. Loci and graphs are introduced, and trigonometrical tables are given and explained, but are made very little use of in the text.

The text-books of Messrs. Allcock, Baker and Bourne, Lachlan and Fletcher, and Petch are alike in having for their main object the development of a system of formal geometry on Euclidean lines. The changes they introduce with the object of improving geometrical teaching are such alterations as the revision of the definitions and axioms, the rearrangement and regrouping of the propositions, the employment of arithmetic, algebra, loci, &c. Euclid's *form* of reasoning has in all cases been retained. Experimental geometry is not made prominent; it is brought in rather in connection with the examples which follow the propositions.

As it appears to us, these books are not sufficiently free of the Euclidean tradition to make them suitable for boys at school. They are more fitted for subsequent study. The presentation of the substance of Euclid i. by Allcock is excellent, and may well replace Euclid when the time comes for taking up the philosophy of the subject. In the volumes by Messrs. Baker and Bourne there is an introductory chapter on experimental geometry, extending over twenty pages, comprised of nearly two hundred exercises, ranging over the whole subject up to the end of Euclid vi., and intended to make the student practically acquainted with the ground to be subsequently covered. This chapter is a valuable and extremely suggestive one, so far as it goes; if the material had been set out in greater detail, and worked in along with the deductive geometry and accorded equal importance with the latter, a geometry quite suitable for youths would have been the result. As text-books of formal geometry these manuals by Messrs. Baker and Bourne can be strongly recommended. They cover the ground usually studied, including Euclid xi., and there are chapters on graphs and mensuration formulæ. They are beautifully printed and arranged, and contain many practical exercises.

Mr. Deakin's Euclid is written on strictly orthodox lines; it contains some useful notes and exercises by the author. The only evidence of any influence of the reform movement is at the end of Euclid vi., where an abstract is given of the recommendations of the committee of the Mathematical Association of 1902.

The little book on "Graphical Algebra" by Mr. Hall is intended to accompany the well-known "Elementary Algebra" of Messrs. Hall and Knight. It is concerned with graphs and squared paper work, and illustrates some part of the service which geometry is rendering to algebra. Some of the examples are evidently taken from previous publications, though the author forgets to acknowledge their source. J. HARRISON.

SYSTEMATIC PETROGRAPHY.

Quantitative Classification of Igneous Rocks Based on Chemical and Mineral Characters, with a Systematic Nomenclature. By Whitman Cross, Joseph P. Iddings, Louis V. Pirsson, and Henry S. Washington, with an Introductory Review of the Development of Systematic Petrography in the Nineteenth Century, by Whitman Cross. Pp. x + 286. (Chicago: the University of Chicago Press; London: Wm. Wesley and Co., 1903.) Price 8*s.* net.

BY the very first page this book is defined as dealing with "the science of petrography." Petrology is "the broad science or treatise of rocks"; petro-

graphy is "the descriptive, systematic science, leading to the nomenclature of these objects." This elevation of systematic description to the rank of a science disarms a certain amount of criticism. The able authors, who confront us after a long period of careful thought and collaboration, take their stand here as petrographers, with all the dignity of a well marshalled mediæval "battle." Right and left we may read the blazon on their shields; their pages trumpet forth the titles by which they would be known; they stand for system and for order, for a "hierarchical classification" (p. 3), against a hitherto careless and indifferent world.

If the four champions are, for the time, not petrologists, but petrographers, still more strongly do they stand apart from the geologists. We have usually regarded rocks, and the lessons to be learned from them, as coming within the scope of the geologist. Just as the mineralogist begins with molecular aggregates, so the geologist begins with mineral aggregates, and from them seeks to read the history of the world. No such agreeable considerations are to be tolerated in the science of petrography. Our authors, some of whom, at least, have long been welcomed as geologists, have entered the field under sober vows of self-denial. The object of the petrographer (p. 63) is "to secure logical excellence for his system."

We are truly grateful for Mr. Cross's term "hierarchical." It seems to define the situation, and to add zest to the devious paths of heresy in which most of us at present wander. We even foresee that the petrologists—not the petrographers—will in the future be divided into two schools, those who desire a classification and those who would rather be without it. For the first school, there is much salvation in the present treatise; it will, indeed, give them as logical a classification as the imperfect human mind can conveniently grasp. As such, it has been welcomed by Mr. F. D. Adams in the pages of *Science* (February 27, 1903).

The reader, in mere fairness, must consider the principles of any classification independently of its nomenclature. The first proposition here made is (p. 128) to divide igneous rocks into five "classes," according to the minerals which might have crystallised, under certain conditions, from the magma represented by the chemical analysis of the rock. On the one hand we regard the group of minerals, quartz, felspars, felspathoids, zircon and corundum; on the other the group pyroxenes, olivine, magnetite, hæmatite, &c., in fact, broadly speaking, the ferromagnesian group (p. 116). The five classes are simply established according to the numerical predominance of one group or the other.

Each of the two mineral groups is divisible into two subgroups; in the first three classes of rocks, the silica-alumina group of minerals is of such importance that five "subclasses" may be based on the relative proportion of the two subgroups within this group in each particular rock. Similarly, the two subgroups of minerals of the ferromagnesian group are utilised to establish five subclasses of rocks inside classes iv. and v. (p. 130).

We may now pass on to "orders." One mineral subgroup in each subclass of rocks predominates over the other subgroup; on this basis we obtain orders of rocks, of which there are as many as nine in each of the first three subclasses of each of the first three classes (p. 132). Orders, with equally strict logic, may be divided into "sections."

So far, the possible minerals have given a position to the rock. We may, however, consider the "general character of the bases in the minerals of the preponderant group in each class," which enables us to assign a "rang" to the same rock. Rangs are so absorbing that we confess to some annoyance when we come on p. 141 to "grads," which look like another exercise in subclasses, a matter that we have already taken carefully to heart. "Subgrads," a further division, need not be discussed in the present brief review.

Suddenly it flashes upon us that we have all this time been dealing with a possible but wholly imaginary object, and not with the rock which we have plucked, after miles of travel, from its parent mountainside. Let not this thought obtain the mastery; it is a temptation of the evil one, whom we may call Lossen, or Judd, or Rosenbusch—for even the last-named author is now classed with the geologists. The rock, for hierarchical purposes, has both a body and a soul; the former (p. 147) is its "mode," or actual mineral composition; the latter is its "norm," or standard mineral composition, as obtained by calculation. Some species, of saintly character, have modes coincident with their norms; where this is not the case, the difference demands investigation.

Herein clearly lies the great value of precision in petrography, such as our authors introduce. The definite statement of the facts is obviously of first importance, before we seek to explain the deviation of mode from norm by experimental or observational geology. In such a statement, geological considerations are out of place; geological conditions have controlled the mode, but should not influence the name and rank assigned to the resulting product in a system of pure petrography. If we very properly reject geological age as a factor in rock-classification, so it is equally desirable to reject such groupings as "plutonic," "dyke-rocks" and "volcanic." Pp. 149 to 153 of the present book go far indeed to justify the precision of its system.

When, however, we come to part ii., on nomenclature, we prefer to leave the reader to go forward by himself. Every science must have its technical phraseology, and Mr. Bather justly objects[1] to the replacement of *Rhinellus furcatus* by "the fork-tailed Nosey." Yet those who multiply technical terms, and especially technical adjectives, forget that even the most specialised of specialists is not dealing with each term once a day; nor is he forced to describe a natural object as if a railway-whistle had sounded which summoned him for ever from the scene. May not scientific workers take heart, and gain grace, from the cultured descriptions of pictures in an ordinary well conducted catalogue? What are rocks but pictures, recording the most varied incidents in the history of the ground be-

[1] See the *Museums Journal*, vol. ii., p. 138.

neath us? The canvas was prepared of old time, but the design first traced upon it has been modified again and again by natural agents; new pigments have been absorbed by it, while others have changed their nature, and have often become more beautiful and permanent in their decay. The describer of a rock, the petrographer, may well pause before it, and proceed to fill in the details with an almost affectionate care.

Is life, in fact, so brief that the name assigned to each object must express it completely in its habit as it lived?

We have no right to raise objections to the scheme of these four serious and conscientious workers, on the ground that it involves a considerable tax upon the memory. Yet we may question the advantage of compressing all our information into the tabloid form, and leaving the reader to dissect the compound in order to find out its contents. Abbreviation goes far when a rock, already accepted as *dosalane* in class, that is, with *s*ilica-*al*umina minerals pred*o*minant in its norm, is also found to be *grano-hornblende-germanare*.[1] In the scheme proposed, there is special virtue in the last syllables of such words. Yet what would be gained for the correct appreciation of a work of art if it were described as *samsodelic angelo-italare*, because it contained (or might in other circumstances have contained) Samson and Delilah, and belonged to the Italian school of which Michael Angelo is the representative? Or should we describe the House of Commons for 1903 as *unanim-hibern-britannare*, and also as *dochamberlane*, on account of the predominance of a particular constituent? "Is't not possible to understand in another tongue?"

Were we to comment on all the details selected as a basis for rock-classification, we should unduly extend the present notice. The historic review is of great interest and value, and the proposal (p. 180) to revert, for field-purposes, to the old loose signification of granite, diorite, &c., has some points in its favour. Similar reasoning, however, would allow us to speak of a mineral as a fossil; nor are the historic authorities always correctly invoked by the reformers of petrography. D'Aubuisson, that is to say, Haüy, from whom he had the term, does not (p. 182) use aphanite in the wide sense stated; for him, it is a compact diorite, with amphibole predominant over felspar. If we loosen the bonds of peridotite (p. 183), we must go back to Cordier, and use it for a basalt or dolerite rich in olivine. As for felsite (p. 184), the authors can hardly have realised the odd mixture of materials associated under the name by Gerhard. It may be sufficient to mention labradorite felspar and the pitchstone of Meissen as felsitic rocks in the sense of the inventor of the term.

However, we conclude as we began; there are persons who desire classification in order to promote accuracy of comparison. Such accuracy must be welcomed by every geologist, where individual specimens are concerned. Whether it is of so much service when we consider rock-masses as portions of the earth's crust is a question for the worker in this or that particular district. At any rate, our authors have sought perfection in the domain on which they set their gaze. To all of us is the mission sent, of Sir Persalane, Sir Salfemane, Sir Dofemane, and Sir Perfemane—for we cannot but regard these names (p. 102) as those of champions seeking for a Grail. The path is lit by their high endeavour, even if we may not follow it to the end.

GRENVILLE A. J. COLE.

[1] Mr. H. Stanley-Jevons (*Geological Magazine*, 1901, p. 313) has already attempted such terms as *Sodali-midalkalite* and *Ægiaugi-natrijolite*. It would of course be similarly possible to express a whole chemical analysis by a skilfully constructed word some decimetres in length.

ALTERNATING CURRENT ENGINEERING.

Die Grundgesetze der Wechselstromtechnik. By Dr. Gustav Benischke. Pp. 141. (Brunswick: Friedrich Vieweg und Sohn, 1903.) Price 3.60 marks.

THIS volume, the third issue of "Elektrotechnik in Einzel-Darstellungen," comes as rather a surprise after the first two highly specialised parts of this series on lightning arrestors and the parallel running of alternators. In order to peruse the book with profit, the reader must be acquainted with the fundamental theory of electricity and magnetism, and also with the general laws of electrical engineering. Ability to use the differential and integral calculus is also necessary, in order to understand the mathematical reasoning given.

The book is divided into six parts—introduction, the simple alternating current circuit, mutual induction, capacity phenomena, composite wave forms, and polyphase currents. The arrangement and scope of the book will render it of most use to the practical electrical engineer, who, though using certain symbols and equations every day, yet is apt to lose sight of their fundamental origin, and, in order to comprehend new problems, needs, now and then, to refresh himself in the theoretical basis of his work. Such a simple thing as the measured value of an alternating current is an example of what we mean. Every engineer knows, of course, that what he calls the current is the root of the mean of the squares of the instantaneous values of the current. Why this should be, and to prove the reason why, would, we think, puzzle a good many men who would be very much insulted if they were told that they could not do so. The why and the wherefore of this matter is set forth in the introduction of the book. Part ii. deals chiefly with the application of Ohm's law to the alternating current circuit, the work done by an alternating current and the use of vectors. The third and largest part of the book is concerned mostly with the laws of the transformer. No attempt to treat of design is made, nor is the practical performance of any actual machines studied. The subject is treated purely from the theoretical engineering point of view.

Part iv., on capacity, is very short, and does not give much beyond the deduction of the formula for the calculation of the effective current in a circuit containing resistance, self-induction and capacity, and also showing the conditions under which electrical resonance can occur. Part v. is the most useful of the book, as it serves as a guide to the difficult task of dealing with the irregular wave-forms given by alternators and transformers. The appendix can be used in con-

junction with this division of the book, as it contains a set of formulæ, deduced from Fourier's theorem, with the coefficients worked out, for calculating the harmonics (up to the 11th) of an alternating current wave-form. The author states that in all curves actually met with in practice, the 13th and higher harmonics can be neglected, as they are so small. This is, however, not true. It has been recently shown that in the E.M.F. curve of the alternators of the Glasgow Corporation Tramways, the 13th harmonic is one of the most important, and alternators may very well exist in which the 15th and 17th harmonics are the largest.

The last division, on polyphase currents, does not do more than show the general star and delta relationships, and contains a chapter on the measurement of three-phase power.

As stated above, the book will be mainly useful to practical engineers who desire to have at hand a volume which will help them out of mental entanglements which arise from time to time in working with alternating currents. The general theory (general differential equation) of the electric circuit is not dealt with at all. This being so, we of course find no mention of the exponential terms which vanish with time, and which appear in the full solution of the general equation. These, though airily dismissed by many writers, are really of the utmost importance, as on them depends the theoretical treatment of all the important phenomena met with in electric switching, and oscillations set up by sudden changes in the current flowing. These exponential terms certainly constitute a "Grundgesetz," and as such should have been mentioned. The work is closed by a table of formulæ, but that greatest sin of omission, no index, is committed. C. C. G.

THE PRINCIPLES OF DYEING.

The Principles of Dyeing. By G. S. Fraps, Ph.D., of North Carolina College. Pp. xii+270; with 22 illustrations in the text. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1903.) Price 7s. net.

IN the preface to this work the author states that "it attempts to apply to the teaching of dyeing the same methods of class-room work, coordinated with experiments in the laboratory, which have proved so successful in the teaching of inorganic chemistry and other branches of science," and its novel feature consists in the insertion, interspersed throughout the text, of a series of experiments, seventy-nine in number, which the student is to carry out in the laboratory.

Although no such division is made by the author, the book may conveniently be considered in two portions, chapters i. to vi. giving a general survey of the subject in 53 pages, while the remaining sixteen chapters, occupying 200 pages, are devoted to a systematic amplification.

This larger portion of the book follows the lines adopted in most modern text-books on dyeing, and little need be said in reference to it beyond the obvious remark that, even with the most careful condensation, it is not possible, without dangerous generalisations, to compress into 200 small pages any adequate discussion of the various matters treated under the headings cotton, linen, wool, silk, bleaching, scouring, machinery, general observations, direct cotton colours, basic colours, acid colours, mordant colours, insoluble colours, mercerisation, dyeing of unions, theory of colour, spectrum analysis, dye testing and detection of dyes. The inevitable result of too general statement follows; for example, on p. 251 the following sentence is found:—"A dye on cloth has nearly the same absorption-spectrum as a solution of the dye of corresponding strength." This is by no means the case, since the hue of the dyed fabric often differs considerably from that of a simple solution of the dye. In the same section a normal spectrum is figured, while the description refers to the prismatic spectrum.

Less importance, however, should be attached to slight errors of statement than to the general scope of the work, and from this point of view the chief interest attaches to the preliminary chapters, to which the author's statement, quoted in the first paragraph, chiefly applies. After a short introductory chapter dealing with the fibres and explanatory of the scheme of the book, the following five sections are each devoted to a study of the composition and characteristics of one of the important groups of dyes, one or two members of each group being used as illustrative of the group. The scheme is well worked out, but sufficient care has not been taken to prevent, what is always a pitfall to students, over generalisation; and instead of giving the student a clear general view of dyeing phenomena, he will probably acquire, by a perfectly logical process, some very erroneous views. For example, chapter vi. is devoted to indigo, chrome yellow, theory of dyeing, and classes of fibres. Now indigo and chrome yellow have absolutely nothing in common, either chemically or in mode of application, and there is not a word of explanation as to the reason for coupling them together until chapter xix. is reached, when it is seen that it is based on the fact that they both form insoluble pigments on the fibre—a purely artificial and altogether insufficient connection.

One would expect, in a book of this type, that the various theories which have been put forward to account for dyeing phenomena would receive considerable attention, but they are not only dismissed in a page and a half, but are quite incorrectly stated.

The experiments detailed in the text are in most cases well chosen, and add greatly to the value of the book, but a student of inquiring mind may well ask why cotton should be dyed with Congo-red in an *alkaline* bath and wool in a *neutral* bath, and the results considered as comparative (Exp. 4). Exp. 12 should certainly be modified. It is highly dangerous to tell a student to pour boiling concentrated sulphuric acid into water, even if the word "caution" is interpolated.

This book is very welcome as an obviously original attempt to teach the general principles of dyeing on novel lines, and most of its shortcomings are explainable by the opening sentence in the preface:—"This book is the result of two years' instruction in dyeing."

W. M. G.

AGRICULTURAL RESEARCH IN ITALY.

Annali della Regia Scuola Superiore di Agricoltura di Portici. 2nd series. Vol. iv. (Portici, 1903.)

THIS well printed volume contains a series of ten papers contributed by the professors of the Royal Agricultural College of Italy at Portici since the publication of the last report in 1898, together with a general review of the work of the chemical department since its foundation.

The papers are very varied in character; the first is a statistical inquiry into the production of fruit in Italy and other civilised countries; two papers treat of a fungoid disease of maize and of the olive; and of three papers by Prof. Casoria the chief deals with the composition of various saline waters as compared with the rocks they traverse and the deposits of tufa, &c., formed from them. In some of the waters traces of arsenic and nickel are recorded, with titanic acid in measurable quantities.

But the paper which is of most agricultural interest is the record drawn up by Prof. Giglioli, the director, of the experimental work in agricultural chemistry carried out at Portici since 1877. It includes studies in the life of seeds, which were shown to retain their vitality when immersed for years in alcohol or chloroform, so that oxidation, however slow, is prevented and the respiratory process entirely stopped. Another interesting observation was the occurrence of copper in the bat's guano found in certain Calabrian caves, which led to the discovery that copper is a regular constituent and probably possesses some biological function in some insects, from which it passes to the bodies of bats and other insectivorous animals. Experiments on the introduction of plants new to Italian agriculture are recorded, such as the Soja bean, the camphor laurel and the Smyrna fig, over the acclimatisation of which the United States Department of Agriculture has spent so much care.

The field experiments carried out at Suessola include trials of various manurial substances occurring naturally in Italy, such as seaweed, a phosphatic deposit from Otranto, and leucite, a mineral characteristic of the Vesuvian and many of the older lavas of Italy, containing at times as much as 20 per cent. of potash. The dryness of the climate renders the action of merely finely ground mineral manures slow and uncertain, but the phosphatic deposit gave good results when used first for a green crop which was afterwards turned in, while the trials with leucitic earth show promise, and might give better returns if a plant were chosen for experiment more sensitive to potassic manuring than wheat is.

Other investigations deal with the effects of electricity in stimulating crop production, with the action of manganese dioxide as a constituent of manures, and particularly with the cultivation of wheat, the important series of experiments on which have before been noticed in these columns. The author claims that, as at Rothamsted, the plots at Suessola "demonstrate that a large production of cereals can continue indefinitely provided the land be well cultivated and manured. But while at Rothamsted the growth of wheat alone is possible in each year, in the 'Campania Felice' in the same year crops of wheat and maize forage can be raised. Thus, by the intensity of its production of grain, the fourteen years of experiment at Suessola are equivalent to twenty-eight years in England."

While the above list is by no means exhaustive, it will serve to show the activity of the experimental station at Portici, and the many-sided interests of its director, Prof. Giglioli. A. D. H.

OUR BOOK SHELF.

La Telegrafia senza Filo. By Augusto Righi and Bernardo Dessau. Pp. vii+518; wth 259 woodcuts. (Bologna: Nicola Zanichelli, 1903.)

PROF. RIGHI has considerable claims to be regarded as the father of practical wireless telegraphy. It was from him that Marconi, as a student at Bologna, derived the knowledge of modern electricity which has enabled him to cross the gap which separates the Old World from the New. The benefits that the university and its professor have conferred on mankind by training a Marconi suggest the question: Should not universities be endowed with exceptional scholarships to assist exceptional men? The advantages of expending 100*l.* annually to help on students of average mediocrity are well known. On the other hand if a university should produce a man with the enterprise of Marconi once in 100 years, the advantage to the community of enabling him to carry on his experiments with the accumulated amount of an annuity that had been left unawarded during the interval cannot be overestimated.

A work on wireless telegraphy, coming from the physical department of the University of Bologna, and bearing Prof. Righi's name, will be read with great interest. The present volume is, however, rather of the nature of a popular treatise intended for readers not starting with any previous knowledge about electricity. Hence the first part, extending over about 110 pages, is taken up with a general account of the principles of electricity and magnetism. The second part deals with electromagnetic waves, the electromagnetic theory of light, and coherers. In the third we have an account of all the different methods of telegraphy, from the earliest attempts at making a telegraphic current flow across a river by conduction, down to a close examination of the Marconi system and the various inventions which have been proposed or patented on parallel lines. In the preparation of this part the authors have evidently made a careful study, not only of the published literature of the subject, but also of the patent specifications both of the "Wireless Telegraphy and Signal Company" and of other inventors, the object evidently being to give an unbiased account of what Marconi actually discovered, and what he derived from other workers in the same field. The fourth part deals with the systems of wireless telegraphy and telephony depending on the use either of ordinary light or ultra-violet rays combined with a photo-voltaic receiver. In a brief appendix, M. Dessau deals with the recent experiments in long distance "Marconigraphy," and gives illustrations of the Poldhu station and the arrangement of the antennæ on ships. This appendix contains several statements of interest concerning the effect of solar radiation on the transmission of signals, the relative merits of the coherer and the magnetic detector (the latter being considered superior by Solari), and such matters.

While the book has been specially drawn up for the general reader, there are few physicists who can read

it without learning something new about the history of the series of inventions and discoveries which have culminated in Transatlantic Marconigraphy.

Catalogue of the Collection of Palaearctic Butterflies Formed by the late John Henry Leech. By Richard South, F.E.S. Pp. vi+229; portrait and two coloured plates. (London: Printed by Order of the Trustees of the British Museum, 1902.)

IT is very gratifying to notice how frequently, at the present day, large private collections of objects of natural history, when of real importance, find their final resting-place in the British Museum, or in some other great public collection, where their treasures are available for ever, instead of being dispersed on the death of the owner, and by such dispersion alone, losing a large part of their scientific value, besides the probability of a considerable portion being neglected, and sooner or later lost or destroyed.

Especially is this the case with great special collections, like that brought together by Mr. Leech, at great expense, and with untiring energy and perseverance, from Lapland to Marocco and Algeria, and from thence to Cashmir, and from Cashmir to Japan, including the materials used in the preparation of his great work on the "Butterflies of China, Japan, and Corea," which is likely long to remain the standard authority on the subject. A great part of these collections was formed by Mr. Leech himself in his numerous entomological journeys, while others were procured for him by enterprising collectors like Mr. A. E. Pratt, in almost unknown and unexplored parts of Western China and Thibet. Besides these, Mr. Leech's collection includes (by purchase) the bulk of the collection formed by the late Mr. Henry Pryer, himself the author of the first important separate work published on the butterflies of Japan, which is also noticeable as having been issued in two languages, English and Japanese. On the other hand, there are comparatively few species and specimens from North Africa and Western Siberia.

Mr. Leech also interested himself specially in the variation of species, and purchased a large selection of varieties of European Lepidoptera from the collection of the late Herr Mützell, of Berlin, as well as from other sources; and as the types of new species in Mr. Leech's collection have already been fully illustrated in the works and papers published by Mr. Leech himself during his lifetime, the two plates which illustrate the present memorial volume are devoted to figures of some of the most interesting varieties, chiefly European. Every specimen in the collection is carefully enumerated in the volume before us, the sex and exact locality being carefully indicated, and all types marked.

Entomologists owe a deep debt of gratitude to Mr. Leech himself, to the liberality of his mother, and to the careful work of his friend and coadjutor, Mr. South, in ensuring the permanent value of this unique collection.

Bacteria in Daily Life. By Mrs. Percy Frankland. Pp. 216. (London: Longmans, Green and Co., 1903.) Price 5*s.* net.

MRS. FRANKLAND has compiled an interesting, instructive, and accurate account of the modern developments of bacteriology. Such subjects as sewage disposal, the prevention of tuberculosis, micro-organisms in milk, air, and foods, which are of public importance, are fully dealt with, and the modern ideas regarding toxins and antitoxins are briefly discussed. No one nowadays laying claim to a liberal education can dispense with a slight knowledge, at least, of microbes and their actions, and for such this work will prove an adequate text-book. R. T. HEWLETT.

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.*]

A New Theory of the Tides of Terrestrial Oceans.

IN NATURE of September 4, 1902 (vol. lxvi. pp. 444–445), Prof. G. H. Darwin makes some criticisms upon a paper of mine to which I should like to reply.

Upon referring to pp. 537 and 624 of the paper criticised, it will be seen that it aims at "rude approximations to the cases found in nature," and at a "partial explanation of the tides." In fact, it bears the title, "Manual of Tides, Part ivA., Outlines of Tidal Theory." If, therefore, the paper establishes, even in a few cases, the principal causes of the tides, connecting the latter with the known tidal forces, it can hardly be regarded as a "failure," even though the approximations are rather rough; for I believe this object has not been heretofore attained for any ocean tide, although statements have elsewhere been made by our critic which might, perhaps, lead some people to think otherwise.[1]

Again, granting for the moment that the theory involved in the paper is erroneous, I should still say that if observed facts can be conveniently grouped by aid of it, a useful purpose will have been subserved. In fact, the mere collection of tidal data which a test of any theory implies is here, as elsewhere, not without value. For instance, if our critic could have had this paper before him while preparing his book on tides, he would not have overlooked Berghaus's invaluable cotidal chart and written "No more recent attempt (than Airy's) has been made to construct such a map."[2]

Prof. Darwin's principal criticisms are three in number:—

(1) He sees no use for the equation of virtual work in ascertaining the times of high water.

(2) He thinks that the deflecting force of the earth's rotation cannot be generally disregarded in a first approximation, which is all that my paper aims at.

(3) He does not believe that ocean basins exist the free periods of which are sufficiently near the tidal period to account for the tides.

(1) Concerning my application of the principle of virtual work, Prof. Darwin is mistaken when he says "Mr. Harris takes the displacements as proportional to the actual displacements per unit time." What is really done is this:—The magnitude of the virtual displacement (δx, say) at any given point of the system is taken to be the same for any given time or hour, but varies from point to point. Since the law of the oscillation of the particles is known, viz. it is simply harmonic in time, and the particles throughout the body are at a given instant in like or opposite phases, the virtual displacement at any given point may always be represented by the maximum value of the actual total displacement at the point (*cf.* rule quoted in criticism). In other words, if we choose to consider the small virtual displacement as identical with a small actual displacement corresponding to a time variation, the implied δt will not be constant for all hours. Hence the virtual displacements at different hours are not simply proportional to the actual displacements *per unit time*. He is evidently mistaken when he says, "Thus all sustaining forces vanish at the instant when the displacement is a maximum." Why should they? Surely they generally vary in magnitude and phase for the various parts of an extended oscillating body. Probably the use of the rule quoted in the criticism and founded upon the principle of virtual work can be most readily seen when it is applied to a binodal canal-like area of uniform cross section, selecting for simplicity, say, the nodes as the points of application of the sustaining forces (*cf.* § 63). The process implied in the rule seems to be correct, and, so far as I see, about as simple as it could

[1] "The Tides," p. 177, lines 2–10. [P. 160, lines 16–23, English edit. I thought that the passage referred to would be understood to refer to the ideal case there under consideration.—G. H. D.]

[2] "The Tides," p. 189, lines 10–12. [P. 171, lines 19–21, English edit. This was an oversight; a reference to Berghaus will be found in the forthcoming article on the tides for the German "Encyclopædia of Mathematics."—G. H. D.]

have been made. Further on the criticism reads, "I fail to see any adequate consideration of the variability of depth, of the absence of synchronism in the disturbing force in the direction of the canal." This "absence of synchronism" is precisely what the criticised equation 308 (or 311) enables us to take account of.

It seems to me that enough has been given in §§ 38, 42, 45, 55, and 63 to show that the variability in depth has not been permanently lost sight of, and also enough to convince one that "areas" as nearly uniform in depth as are many portions of the ocean can, as a first approximation, be treated as bodies having strictly uniform depths.

(2) Of course there are instances where the deflecting force due to the earth's rotation becomes important; for example, most moderately narrow arms of the sea in which the current is swift—such as the English Channel, Irish Channel, and Gulf of Georgia. But if in any of these a large stationary wave actually exists, it is hard to see how the times of its high and low waters near the loops can be seriously affected by this force, and these are the only times which chapters vi. and vii. undertake to determine. Near the nodes, when the current is swift, the deflecting force may, in a canal the width of which is but a moderately small fraction of a half wave-length, cause high water at one end of the nodal line, and at the same time low water at the other. This is true because the narrowness of the body permits its transverse slope to respond at once to the transverse forces. A progressive wave can be so superposed as to diminish or even destroy the range at one end of the nodal line while increasing the range at the other end.

Considering now a broader "area," with one or both of its lateral boundaries wanting, it is hard to see how the transverse motion occasioned by the earth's rotation can seriously interfere with the character of the stationary wave, and especially the time of elongation of the particles; for its effect cannot accumulate and so tend to produce a transverse stationary oscillation. If, on the other hand, a square or rectangular "area" about half a wave-length wide have solid lateral boundaries, it would seem that the deflecting force might, except in the equatorial regions, so alter the mode of oscillation that it could not be ignored even in the first approximation. So far as I know, there is no near approach to this case in any of the "areas" which probably exist (see Fig. 23 of my paper).

Hence, while it is true that the free oscillations in a rotating rectangular sheet of water is an unsolved problem, we see that the critic's remark, "It seems to follow that either Lord Kelvin or Mr. Harris is wrong," if in any sense true, really has very little to do with the case. In a word, taking an oscillating body as a whole, it seems to me that the oscillation, in accordance with a simple mode, can generally be regarded as the fundamental and important thing, and the effect of the earth's rotation a modifying or induced phenomenon.

(3) Now in regard to the improbability "that any large portion of our curiously shaped oceans should possess even approximately the critical free period," several things can be said. In the first place, we are not restricted to *single* half wave-lengths; the rectangular "areas" may run in any direction; the "areas" may be approximately trapezoidal, triangular, or of other forms, their free period may differ perhaps 10 per cent. or more from the period of the forces, and still have their tides greatly augmented by their approach to critical lengths. There are, indeed, portions of the ocean which cannot be covered by any areas the periods of which would be satisfactory, and in which it would be possible for the tidal forces to incite a considerable tide. Upon referring to the map, Fig. 23, it will be seen that one such region exists west of Australia, another south of New Zealand, another east of southern South America, the Arctic Ocean constitutes another. Upon referring to the map of the diurnal tides, Fig. 24, it will be seen that the South Atlantic, the South Pacific, and all of the Arctic Ocean are not regions where we can reasonably expect to find large diurnal tides.

Referring again to Fig. 23, and noting that the ocean is for the most part actually parceled out into areas of considerable width the free periods of which can hardly differ greatly from twelve lunar hours, and are, moreover, so situated that the forces do not approximately destroy one another, as can be seen by applying the rule quoted in the criticism, it may, perhaps, be justifiable to ask how it happens that the times of high and low water at the loops, as determined by this rule, do approximately agree with observed times, unless there is some considerable truth in this "partial explanation of the tides."

Recently I have been working out in considerable detail the tides in the equatorial belt of the Indian Ocean, where it is fair to assume that the effect of the deflecting force must be small. The work goes to show that the theory set forth in the criticised paper is substantially correct. I therefore venture to refer Prof. Darwin to this discussion, which will appear in the March number of the *Monthly Weather Review*.

To avoid needless misunderstanding, it may be added here that I am well aware of the incompleteness of the treatment given in my paper. For instance, mathematicians have not up to this time been able to treat the simple problem of a rectangular "area" the rigid boundary of which consists of only two opposing end walls, although much has been done upon analogous problems relating to the open organ pipe. Even an approximate absolute value of the range of tide (excepting in small deep bodies) has not been attempted in this paper, because its determination would involve the numerical value of frictional resistance, which can be kept in abeyance when we seek only the times of tides in systems which have as free periods very nearly the tidal period. Many deductions and refinements were purposely omitted from my paper—the chief aim being simplicity. I hope eventually to be able to consider more fully matters like these in connection with detailed studies of the tides in various seas.

R. A. HARRIS.

Washington, D.C., March 28.

March Dust from the Soufrière.

SIR W. THISELTON-DYER has kindly forwarded to me a packet of volcanic dust sent to him by Dr. D. Morris, which fell in Barbados last month after an eruption of the Soufrière of St. Vincent, a brief description of which may be of interest. The sample, Dr. Morris states, was collected at Chelston, Bridgetown, on sheets laid out upon the lawn, the material being brought in and weighed every hour, and the fall continuing from 11 a.m. to 5 p.m. on the day of the eruption. It is free from all extraneous matter, and may be regarded as typical of the ash which fell on Barbados. The weight of this is estimated at about 6000 pounds (avoir.) per acre. At an average rate of three tons per acre, this would be equivalent to about 300,000 tons for the whole island.

The dust is of a dull dark brown colour, showing on close examination a minute speckling with a lighter tint. If poured on a piece of white paper and removed in the same way, a distinct warm-brown tint remains, produced by the very finest part of the powder, which is not easily removed. In Dr. Flett's excellent account of the dust which fell in Barbados after the eruption of May 7 (*Quart. Jour. Geol. Soc.*, lviii., 1902, p. 368), it is stated that this was at first brown, then slightly redder, and at last a whitish-grey impalpable powder. A bulk sample of that fall is distinctly greyer than the recent one, and a small one of the fall of 1812, in my possession, is a rather pale grey with a slight brown tinge. The new sample under the microscope differs only in detail from that described by Dr. Flett. The fragments, as a rule, do not exceed 0·01 inch, and are thus very slightly smaller than some in the May eruption; from 0·06 to 0·08 is a rather common size, and there is a fair amount of exceedingly minute dust. The principal minerals are the same, plagioclastic felspar, hypersthene, and a green augite, but in the first steam cavities are now more abundant than glass enclosures, and I think brown glass is more often adherent, but to make certain of this point requires a fuller examination than I can give for the next few days.

T. G. BONNEY.

The Lyrid Meteors.

THE Lyrid meteors excite an interest that might be regarded as quite disproportionate to their numerical importance. They are a very rare shower, and even when considered by experienced observers as unusually abundant, they seldom appear at a higher rate than about twenty per hour.

During the past century the Lyrids have been subjected to pretty close observation. The star shower seen in America on the morning of April 20, 1803—just 100 years ago—seems to have far excelled in brilliancy its Lyrid successors, though a display witnessed, it is supposed, in 1860 in the equatorial regions of Africa is described as having rivalled in splendour the November meteor-shower of 1866. Shooting stars were seen in unusual numbers in America on April 20, 1838, and Prof. Forshey observed a Lyrid display in Louisiana on the night of April 18, 1841, when he counted sixty meteors in 2½ hours, which gives a mean rate of twenty-four per hour for one observer. On the morning of April 21, 1863, these meteors were reckoned by an English observer as appearing at the rate of forty per hour. On the night of April 18, 1876, a party of American students casually noticed that shooting stars were unusually numerous during the hours 10 to 12. Lyrid meteors were also conspicuous on the night of April 20, 1874. Mr. Denning has recorded important appearances of Lyrid meteors in 1882 and 1884, especially in the latter year on the night of April 19. The same observer has also stated that the Lyrid radiant was unusually active in 1893 and 1901, in the former on the nights of April 20 and 21, and in the latter on that of April 21. The foregoing are the most important displays on record since April 20, 1803. Periods of somewhat different lengths have been proposed with respect to the Lyrid showers, but the true period seems to be one which overlaps, and consists of nineteen years. Thus, from 1803 to 1860, we have exactly three periods of nineteen years, and from 1803 to 1841, two periods of the same length. Again, thirty-eight years, or twice nineteen years, separate the showers of 1838 and 1876. The nineteen-year period also connects the displays of 1863 and 1882, of 1874 and 1893, and of 1882 and 1901. This nineteen-year cycle is specially interesting, as it is completed at the Lyrid epoch of the present year, reckoning from the somewhat important display of April 19, 1884. A calculation made by the writer indicates that the maximum in 1903 is on April 19, 10h. 30m. G.M.T. The Lyrid radiant ought therefore to be found active in the early part of the night of April 19, probably from the hours 9 to 12. There is no prospect of Lyrids being numerous on the nights of April 20 and 21.

JOHN R. HENRY.

UNLIKE the August Perseids, the Lyrid meteor-stream, like those of the Quadrantids, Orionids and Geminids in January, October and December, seldom exhibits an abundant shooting-star display, more nearly resembling in that respect the Leonid and Bielid meteor-systems than the stream of August Perseids, its materials appearing to be still collected in one or more dense clusters in its orbit. Its brightest as well as its ordinary apparitions are also, like those of the Leonids, of remarkably short duration, so as to be very liable to escape observation unless splendid enough to arrest attention at some observing station on the globe. The great shower seen in America on the morning of April 20, 1803, only lasted in full splendour for two hours, from 1h. to 3h. a.m.; and a rather sensational abundance of the Lyrids on the morning of April 21, 1863, was entirely confined to the night of April 20, when 11 meteors, chiefly Lyrids, were seen at Hawkhurst in 45m., and 7 bright and several smaller ones were observed in 30m. at Weston-super-mare, between 11h. and 12h., and in a quarter of an hour after 15h., at Hawkhurst, 11 shooting-star tracks were noted, the meteors falling too rapidly then in all directions to be all recorded; the radiant point obtained from that night's tracks, and from a few Lyrids mapped on April 19 (23 Lyrid paths together, some of which may perhaps really have diverged from other centres), was at 277½°+34½°, close to the position which was first obtained of it "near α Lyræ," by Prof. E. C. Herrick, in America, 24 years earlier, on the morning of April 19, 1839. On the preceding night, of April 19, the hourly rate of meteors from 10h. to 11h. was only ordinary, and on the night of April 22, not a single meteor was seen in an hour by either of two observers who watched the clear sky simultaneously from 11h. 15m. to 12h. 15m. in London and at Hawkhurst for hoped-for accordances.

Records of bright Lyrid showers are therefore of peculiar interest, as they may not improbably represent clusters of meteor-dust along the Lyrid stream, like some which appear to have been noted in the stream of Leonids[1] on the mornings of November 15 and 14, in 1871 and 1872, on November 13, 1879, and on the morning of November 14, 1888, when in a watch of 2½h. until daybreak, at Bristol, Mr. Denning noted the appearance of 17 Leonids, although such strong recurrences of the shower are only rarely seen in the interval of some thirty years between the maximum Leonid displays. But the comet 1861, I., of which the Lyrid shooting-stars are supposed to be the streaming wake of pulverised materials, is one of those which it was pointed out by Prof. G. Forbes in his important paper in the *Observatory*, 1888, on the probable existence of an ultra-Neptunian planet, may presumably have been captured by such a planet, and would thus be moving now with long periodic time in a very long elliptic orbit; and this would seem to be a rather serious objection to the short period of 19 years assigned in Mr. Henry's letter to the meteor, unless it should be really true, which seems hardly probable, that the meteors and the wake of dust-materials of the comet are only accidentally in extremely near agreement in their radiant points, and may yet not be actually associated together with each other in a common orbit.

In its two last returns in 1901 and 1902, the Lyrid shower was very distinctly observed to attain its greatest brightness on the night of April 21, and as this retardation of a day from its usual date of April 20 accords like the present similar retardation of the January, August, October and December showers with the postponement of all annual astronomical events by one day, since February, 1900, from the omission at the end of that month of the usual four-yearly leap-year day, attention should certainly, in the reasonable expectation of its fixity, be directed again to the night of April 21, in the approaching Lyrid period, as well as to that of April 19, which the very interestingly detailed evidence presented in Mr. John R. Henry's letter shows also to be one on which an unusually bright display of the April Lyrids may perhaps be expected.

A. S. HERSCHEL.

Observatory House, Slough, April 15.

Mendel's Principles of Heredity in Mice.

I APPRECIATE Prof. Weldon's reluctance to defend his position in a short letter, and I look forward with peculiar interest to the number of *Biometrika* where I gather this task will be undertaken.

Though deferring a reply on the simple matter of the eye-colour in the Oxford mice, Prof. Weldon finds space to ask an "explanation" of two over-lying complexities. To debate these finer points with one who doubts the Mendelian nature of the phenomena taken as a whole is like discussing the perturbations of Uranus with a philosopher who denies that the planets have orbits. Still, at the risk of diverting attention from the main issue, I will suggest how these complications may be regarded—scarcely "explained."

(1) The "lilac" mice illustrate that resolution, and partial disintegration, of characters commonly witnessed when a compound colour is crossed with an albino. The statistical value of the "lilacs" and their place in the colour-system can only be determined by further breeding. The *appearance* of "lilacs" or analogous types is what we expect, though their *absence* in the offspring of hybrids × albinos constitutes a certain problem. This and other genuine difficulties call for careful statement and analysis.

(2) The diversity of coats in the first crosses points to heterogeneity among the gametes of one or both "pure" races. The nature of that heterogeneity is the question. Each race may breed true to colour, but the cross-bred offspring of the two is not necessarily uniform. The pigment excreted by heterozygotes may, as I could easily demonstrate, depend on factors (probably determinable) other than the visible colours of the parents, and having an independent distribution amongst their gametes. Also, while we are comprehensively assured that the coloured race was pure, the precise, if as yet uncontrolled, testimony of the records that certain individuals were *not*, seems to have

[1] From a table of principal observations of the Leonids from 1870 to 1896, in a portion of Mr. W. F. Denning's admirable review of the whole history of "The Great Meteoric Shower of November"; the *Observatory*, vol. xx. p. 201, May, 1897.

been overlooked. More elaborate hypotheses may be needed, but not until the simpler have been disproved.

Grantchester, Cambridge, April 10. W. BATESON.

P.S.—A reviewer declares (NATURE, April 9) that the data in this case are "by no means easy of interpretation," on what hypothesis I know not; and that "much of the evidence is *primâ facie* in favour of ancestral inheritance." It is scarcely too much to state that in each set of matings the distribution (1) of pink and dark-eyed, (2) of coloured and albino coats, (3) of "waltzers" and non-waltzers, is in punctilious agreement with Mendelian prediction. The variety of colour in the first cross I have dealt with. Knowing something of the recent history of fancy mice, two kinds of grey in this generation cause me no surprise. In the whole evidence I can find only three real difficulties, all surely of minor importance. One is named in my letter. The second is the occurrence of three dark-eyed *fawn-yellows* in the offspring of first crosses. The third is the scarcity of yellows in the offspring of hybrids × albinos. If the individuality of the parents were declared, two, perhaps all, of these points could be cleared up. I am not accquainted with any other conception of heredity which elucidates any part of the facts.

Experiment to Illustrate Precession and Nutation.

THE following account of a simple experiment may be of interest to some of the readers of NATURE. The common peg-top and tee-totum are commonly referred to as affording a good example of the phenomenon of precession. I do not think that it is generally known that the motion of nutation can be beautifully shown by the same simple means. Sir John Herschel says in his "Outlines of Astronomy" that the motion of precession can be shown by "that amusing toy, the te-to-tum, which, when delicately executed and nicely balanced, becomes an elegant philosophical instrument." If, however, the tee-totum is not perfectly balanced we have realised the conditions for showing nutation also. If the earth were perfectly homogeneous and undisturbed by any outside irregularity, there would be no nutation. In the same way a tee-totum will not exhibit the motion of nutation if it be perfectly balanced. When, however, one side is made heavier than the other we obtain the phenomenon of nutation. The magnitude of the nutation increases with the extra weight. A series of experiments was made by spinning a small clock wheel on its axis. The best way to see the result is to spin the wheel on a white plate which has been smoked. The trace thus obtained may be studied perfectly. In order to get a permanent record, the wheel was made to spin on a piece of clear glass which had been slightly smoked. The record thus obtained may be used as an ordinary negative, and prints obtained on sensitive paper in the ordinary way. With a little care very beautiful and instructive results may be obtained. The little apparatus may also be projected on the screen, and the actual formation of the curve exhibited. H. V. GILL.

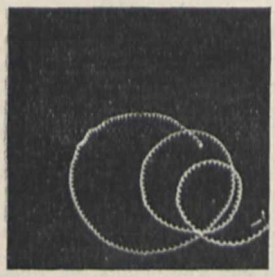

FIG. 1.—Trace made by imperfectly balanced watch wheel spinning on its axis, illustrating precession and nutation.

Clongoweswood College, Sallins, Co. Kildare.

Distribution of Pithophora.

IN October last, I found an old-established paddy-field near Tanabe, the bottom of which, to the extent of several tens of feet every way, was luxuriantly grown with the *Pithophora Oedogonia*, Wittrock, var. *Vaucherioides*, Wolle, with resting spores yet incompletely formed. The locality is some sixty miles south of Wakayama Shi, where I had gathered the same with full spores, October, 1901 (see NATURE, vol. lxvi, pp. 279, 296). The occurrences of the alga in such distant places seem to prove that it is indigenous to Japan. The Floridan specimens I collected in 1891–92 were with spores mature in the months of June and July.

KUMAGUSU MINAKATA.

Mount Nachi, Kii, Japan, March 10.

PEDIGREES.

THE trouble of compiling pedigrees and their unmanageable size led me to devise a method of recording relationships in a form suitable to my own particular wants. As it promises to answer exceedingly well, and to be of more extended utility, I venture to publish it.

The system of relationships between those who live or have lived in a long-established community is wide in extent, of indefinite depth, and interlaced in all directions. The problem is how to arrange its records so that when any individual is selected as a point of departure, it shall be easy to trace his relationships in every direction, whether ascending, descending, or collateral, so far as materials exist. The representation of such a system is wholly beyond the powers of a chart, but its object can be attained by breaking it up into what will be called "Family Groups," each of which slightly overlaps those with which it is immediately connected. A family group, in the sense used here, consists of (1) a parental couple, (2) all their sons and daughters, (3) the wives and husbands of them. Their names are supposed to be written on one page of a register, and the group, as a whole, to be defined by the No. of that page. The group is also defined and indexed under the joined surnames of the parental couple. I subjoin three specimen groups, but in a much abbreviated form for the sake of compactness,

Family Groups.

John Gore.	16 Feb.	31	101	
Amy Myers.	24 Mar.	43		
Fred. Gore	101	Mary Drew ...	144	205
George Gore ...	101	Jane Boyle	136	211
Ellen Gore	101	John Piers	105	237
Susan Gore	101	*Unmar.*	—	—
Steph. Gore	101	*Unmar.*	—	—
Fanny Gore	101	Harry Pitt	163	223

George Drew.	14 Jan.	51	144	
Eliz. Patten.	3 April.	62		
Harry Drew ...	144	Rose Spry	123	315
Mary Drew	144	1. Fred. Gore ...	101	328
" "	144	2. George Lewis	165	340

Fred. Gore.	26 Nov.	101	205	
Mary Drew.	4 Oct.	144		
Frank Gore	205	Anne Fox	218	340
Amy Gore	205	James Moss ...	265	344
Anne Gore	205	*Unmar.*	—	—
Alex. Gore	205	Eva Sully	241	370
Rose Gore	205	Steph. Bell ...	270	315

only half a line being allotted to each individual. In reality, a short paragraph of full-length lines would be used, to admit of the entry of long names, and of such details as are commonly inserted in pedigrees. Taking group 205 as our subject for explanation, it will be observed that each of the five members of the fraternity—Frank, Amy, Anne, Alex. and Rose—bear the same register No. of 205, which defines that group. The justification for indexing them in the same group lies in the solidarity of each fraternity,

all its members having the same parents, grandparents, uncles and aunts, and every other ascending or collateral relationship. It is not strictly so as regards descent, because the children of each brother or sister are nephews or nieces to all the others, but this material exception leads practically to no confusion. A fraternity is, therefore, treated as a compound unit, the individuals who form it being distinguished by their several names. Thus Rose Gore, 205, serves as a complete definition of her. The husbands and wives of the fraternity 205 belong severally to fraternities of their own, the numbers of which are attached to their names; thus the husband of Rose Gore, 205, is Stephen Bell, 270. Her father, Fred Gore, belongs to group 101, and her mother, Mary Drew, to group 144. Both of these latter groups are printed here. Each parental couple heads a new group; thus, Fred. Gore, 101, and Mary Drew, 144, combine to form the head of the new group 205. Similarly, Rose Gore, 205, and Stephen Bell, 270, form that of the new group 315. It must be clearly understood that there is no relation between these numbers as such; they indicate no more than the No. of the page on which the new group happens to be entered. Every individual who is married and has children is entered in at least three different family groups, (1) that of his own fraternity, (2) in that of his wife, (3) in that in which he appears as one of the parental couple. If he marries a second time and has children, his name will appear as a parent in a fourth group, thus Mary Drew, 144, is entered as mother in each of the two groups 328 and 340. It will be noticed that the day and month of birth is added to the name of each parent. This is a useful distinction in some Welsh and Scotch pedigrees where the same names repeatedly occur. It is a distinction of great efficacy, as the chance against a namesake having the same birthday is about 365 to 1. If so, the chance against a namesake *couple* having the same birthdays as the couple in question would be 365×365, or upwards of 130,000, to 1.

Employment of the Tables.—Let us follow out the relationships of Frank Gore, 205, as far as these three tables permit. His father, as we know, is Fred. Gore, 101. Referring to 101, we see that his paternal grandfather and grandmother are John Gore, 31, and Amy Myers, 43, respectively, so we should have to refer to the family groups 31 and 43, which are not given here, to know more about them and their own near relations. We see that Frank Gore, 205, has two paternal uncles, George and Stephen; George married Jane Boyle, 136, and has the children described in 211; Stephen is unmarried. Frank has also three paternal aunts, Ellen, Susan and Fanny; the second unmarried, Ellen married to John Piers, who has children in 237, and Fanny married to Harry Pitt, 163, who has children in 223. Jane Boyle's immediate relations are to be found in 136, those of John Piers in 237, and those of Harry Pitt in 163. The fraternities 211, 237 and 223 exhaust the list of Frank Gore's first cousins on the paternal side. The group 144 enables an equally complete analysis to be made on the maternal side. We can proceed in this way step by step as far as material exists. Intermarriages create no difficulty. The extreme confusion that arises from the ambiguous words of uncle, aunt, cousin, &c., is wholly eliminated by this method of working, also that which is due to half-blood relationships.

It should be remarked that information is usually to be obtained with ease concerning any particular family group, because a knowledge of its details is shared by many persons. The father and the mother each know, of course, the names of their own children, and of those to whom they are married, in all but very exceptional cases. Similarly each brother and sister knows the full Christian name of his father and mother, and the mother's maiden name also, as well as the names and order of birth of his or her own brothers and sisters. This same knowledge is usually shared by the brothers- and sisters-in-law.

This method of fraternal unities and of family groups may be applicable to experiments in breeding animals and plants, but with modification of detail appropriate to each case. Where the breeding season is brief, the birthday would be of small distinctive value, even when the year of birth is added to it. FRANCIS GALTON.

STANDARDISATION.[1]

THE first two publications referred to below are the first direct outcome of the work of the Engineering Standards Committee; the third is very intimately connected with that work.

The committee was appointed nearly two years ago, and owes its origin to the councils of the five great technical engineering societies acting on the suggestion of the council of the Institution of Mechanical Engineers.

Its existence is a symptom of the times, an indication of the fact that English engineers have grasped the importance of scientific cooperation and the necessity for organisation on a scientific basis.

The main committee consists of fourteen representatives of the five societies, leaders in the various engineering industries which they represent, and these have called to their assistance seven or eight sectional committees and a number of subcommittees to advise on special points. Representatives of the technical Government departments serve on many of these, and the movement has the support of the leading manufacturers. The work has grown and is growing; investigations of various kinds are needed to elucidate doubtful points before the committees can finally report; some of these are in progress at present at the National Physical Laboratory and elsewhere, and many men are working in a manner unknown before to strengthen English industry and to enable it to compete on favourable terms with foreign rivals.

Some months since it was announced that the committee dealing with steel structures was prepared to reduce considerably the number of sections to be rolled as a regular thing and stocked by the manufacturers, and the list it has proposed has just been issued. The committee is to be congratulated on its work. In all cases there has been great reduction and simplification, a result which will lessen the cost of production by reducing the number of rolls required, and will quicken the rate of supply by permitting stocks to be kept on hand. Thus it appeared that some forty-nine or fifty sizes of beams were in common use; these have been reduced to thirty; while for channels, in place of sixty-three, there are to be twenty-seven sizes rolled.

The recommendations as to rails have not yet been finally issued; at present there are seventy-three different sizes of tramway rails rolled; it is hoped to reduce these to five.

Messrs. Dorman Long and Co.'s new list referred to above is based on these standard sizes, of which a large supply is kept in stock at their various depots. The list gives, in addition to the dimensions and weight of the beams, various other data of importance, *e.g.* the moments of inertia about certain axes, and the safe distributed load for spans of various lengths.

[1] British Standard Sections issued by the Engineering Standards Committee.
British Standard Beams. (Dorman Long and Co.
Standard Sizes of Conductors. (Cable Makers' Association.)

But these lists, valuable as they are, contain but a very small portion of the results we may hope for. The committees on sections used in ship building, on locomotives, and on electrical plant, each appeal to an enormous industry, and in each of these there is much that can be standardised. Take, for example, the various sizes and speeds used in dynamos and motors, the numerous voltages in electric light and power systems, and the varying frequencies of alternators. The committee on electrical plant, of which Sir Wm. Preece is chairman, has subcommittees on electric generators, motors, and transformers under Colonel Crompton, on telegraphs and telephones under Mr. Gavey, and on cables under Mr. R. K. Gray.

Both in America and in Germany committees on the standardisation of electric plant have reported within the last few years, and the value of their work is generally recognised; their results will be of distinct service to the English committee when the time comes to frame its report. Meanwhile one important industry has already acted. The lists of standard sizes issued by the Cable Makers' Association carry out in an admirable manner the principle of standardisation.

There is no doubt that the belief expressed by the association that the adoption of these standards will act equally for the benefit both of the purchaser and of the manufacturer is well founded, and it is greatly to be hoped that they may be adopted.

Standardisation, of course, has its dangers; it may tend to crystallise the form of products, and thus to delay progress. These possible dangers are clearly before the minds of the practical men who form these various committees, and will have due consideration in their reports. Meanwhile, we can only repeat that the need for standardisation is enormous, and its advantages immense.

The announcement contained in the papers recently that a vote of 3000*l.* for the work of the committee is to be included in the estimates for 1903–1904 is a gratifying recognition of the value of its work, and Sir Francis Hopwood expresses the view of all qualified to judge when in his letter intimating this grant he writes:—

"The Board of Trade desire me to state that they regard the work undertaken by the committee, including as it does the preparation of standard specifications for engineering works, and of standard sections of rolled iron and steel, together with the standardisation of parts of locomotives and electrical appliances, as tending to reduce both the cost of production and the time occupied in completion, and as being of the highest value to the country at large."

But, as has been already said, the work yet accomplished is but a small fraction of that which remains to be done, and the further reports of the committee will be eagerly expected by engineers.

ITALIAN VISIT OF THE INSTITUTION OF ELECTRICAL ENGINEERS.

THE Institution of Electrical Engineers has just completed a visit to northern Italy to inspect the chief works of engineering interest. The Institution has made several continental visits of this kind during the last few years, and although it is difficult to gather much in the way of detail on such occasions, it nevertheless seems to be helpful to many to get some general ideas of what our neighbours are doing, and at the same time to get the advantage of a little pleasure from the scenery which, in this case, is among the most beautiful to be found in Europe.

Probably the piece of work that was looked forward to with the greatest interest was the electric railway from Lecco to Sondrio and Chiavenna on the Ganz system, as it forms a bold experiment, and is the first of its kind. The total length is sixty-three miles. The electric energy is generated by three-phase machines at 20,000 volts, and is transformed down at nine points along the line to 3000 volts, this comparatively high voltage being taken direct by the trolley to the motors. Voltage as high as this necessitates many unusual precautions of an interesting kind; for example, the rheostats and switches are worked pneumatically, so that the driver does not operate direct any apparatus subject to high tension. The method of coupling up the motors is also interesting from its novelty. Instead of working the motors in the usual way, they are divided into high and low tension motors. The high pressure current is taken only to the stators of the high tension motors; the rotors of these machines are used to supply low tension three-phase current to the stators of the low tension motors. The low tension motors are thus supplied with current at a lower frequency than the main current. This "cascade" method of working is continued until half speed is attained, when the low tension motors are cut out and full speed is reached on the high tension motors alone.

The recent arbitration, in which it was decided not to use the Ganz system for the Metropolitan Railway, is still fresh in the minds of most people. Although this system does not seem so suitable for cases in which the acceleration at starting and the speed must be high, it should certainly afford a cheap method of working long lines not having much traffic. As seen at Valtellina, the ease and smoothness of working were all that could be desired.

On looking at the boldness of the experiment, one cannot help being struck by the difference between Italy and our own country in taking up a thing of this kind. But it must not be forgotten that one of our greatest sources of wealth tends to keep us from using electrical methods. If the price of coal were double its present value, which is the sort of price which holds in Italy, then the coal bill would be a larger proportion of the whole cost, and it would be more worth while to attempt a saving.

The usual form of electric traction by means of direct current at 650 volts, transformed from high tension three-phase, was seen on the line from Milan to Gallarate and Porto Ceresio. This line is forty-seven miles in length, and also differs from that to Valtellina in having much heavier traffic and higher speeds, and in being partly worked by steam. It is therefore of great interest to those who are at present considering the electrical working of our main lines.

Overhead lines are, of course, a feature of every long-distance transmission. It does not seem to be generally realised how much we have to pay for putting all conductors underground, though this subject will no doubt come forward more prominently when our large power distribution companies get really to work. One disadvantage of overhead lines is that they are subject to lightning discharges. Many protecting devices have been tried, and a particularly interesting one was seen at the Monbegno generating station on the Valtellina line. It consisted of jets of water forming a permanent earth, but of such a resistance that the loss does not amount to more than about 2 kilowatts. The action is said to be very satisfactory.

At Milan several large works were visited, and also the Royal Technical Institute. The latter is not very large, but is usefully equipped. The room for electrical measurements contains instruments in one group for measuring all the usual quantities over a wide range. In the motor and dynamo testing room the

most interesting piece of apparatus was a three-phase motor carried on a suspended bed, so that the torque could be measured, and driving a dynamo coupled direct to the end of the shaft. The other end of the motor spindle was fitted with a disc divided into black and white sectors, so that the slip of the rotor when driving the dynamo at various loads could be directly observed by the stroboscopic effect produced on illuminating the disc with an incandescent lamp on the mains supplying the current. There are also two other small motor generators, and a motor of about three horse-power fitted with an electromagnetic brake disc.

The photometry room contains a Lummer Brodhun photometer with Hefner Alteneck standard for general photometric work. For variations of light in arc lamps, as shown by the illumination in a plane, a photometer due to Prof. Rousseau is used. This consists of a vertical disc with two radial arms carrying mirrors. The arc is placed in the axis on one side of the disc, and the light is reflected by the mirrors on to the other side, where it gives two shadows of an axial rod. One of the arms and the mirror on it being conveniently clamped, the other arm is moved from point to point, and the mirror on it is adjusted until the shadows are equally intense as in a Rumford photometer. The variation of the light is thus found in terms of the fixed direction, and the absolute value of

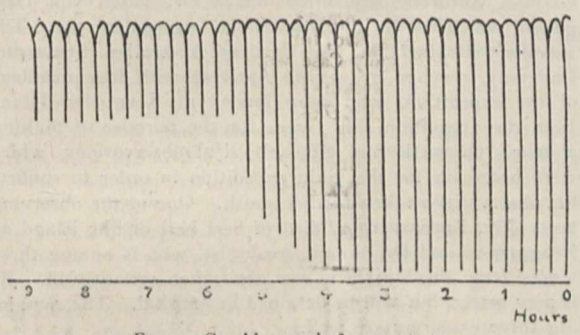

FIG. 1.—Graphic record of cement test.

this is found, if desired, by means of a Weber photometer.

The engineering laboratories contain a small experimental steam engine and other plant, including a dynamo driven by a high speed steam engine, a gas engine and pumps. Complete efficiency tests are carried out, of which the students are required to write detailed reports. There is also a 100 ton testing machine. This is worked hydraulically, the town water being received at three atmospheres and transformed to 250 atmospheres. There is also a fine adjustment worked electrically, the forward or reverse motion being put on by an electromagnetic coupling.

At the time of the visit tests were being made on the deflection of cement beams used for arching in floor work. They were being loaded up to the point of fracture.

One of the most interesting pieces of apparatus was that used for testing the setting qualities of Portland cement. For testing, the cement is made up in a mould about 3 inches in diameter and $1\frac{1}{2}$ inches thick. This is rotated slowly about its axis by clockwork, which allows a needle weighted with 300 grammes to fall once every quarter of an hour. If the cement is soft, it pierces the cement to the bottom, but as hardening sets in the needle does not pierce the full thickness, until finally it fails to make any impression. The result is automatically recorded as shown in the figure (Fig. 1), in which the ordinates represent travel of the needle, and abscissæ time. It will be noticed that the effect of hardening in this example appeared after about 4 hours, and the needle failed to make an impression after $5\frac{1}{2}$ hours.

The Italian visit made it evident that not only was beautiful scenery to be enjoyed, but that Italy is at present the home of some of the most interesting and original engineering works.

NOTES.

THE Royal Society's Croonian lecture will be delivered on Thursday, April 30, by Prof. Klement A. Timirjazev, upon "The Cosmical Function of the Green Plant."

A CORRESPONDENT informs us that on April 1 Dr. G. V. Neumayer left the Deutsche Seewarte at Hamburg, of which he had been director since 1876.

A REUTER message from St. Petersburg announces that the Imperial Russian Geographical Society will send a scientific expedition into Mesopotamia during the year. The expedition will be under the leadership of M. Kaznakoff, and will include among its members M. Alferaki, zoologist, and M. Tolmatcheff, geologist.

THE President of the Board of Agriculture has appointed a Departmental Committee to investigate experimentally and to inquire into and report upon:—(1) The composition and essential constituents of efficient dips and other preparations for the treatment and dressing of sheep, and their effect upon the animal treated or dressed, and upon the parasites and other organisms for the destruction of which they are used; (2) the methods in which such dips and other preparations should be employed, and the appliances and facilities requisite for the purpose; (3) the times and intervals at which sheep should be treated or dressed, regard being had (*a*) to the life-history and characteristics of the sheep-scab Acarus and of the other parasites and organisms of sheep which require external treatment, and (*b*) to the practical conditions under which sheep-farming is carried on in various parts of the United Kingdom. The committee includes Dr. T. E. Thorpe, C.B., F.R.S., Prof. J. R. Campbell, Mr. A. C. Cope, Mr. M. Hedley, and Dr. W. Somerville. Prof. Winter will act as secretary to the committee.

MR. W. DE FONVIELLE writes to say that for the first time since the Eiffel Tower was open to the public in 1889, it was used for astronomical purposes on the occasion of the recent lunar eclipse (April 11–12), when a number of members of the Société astronomique de France spent some hours making observations on the terrace of the monument at an altitude of about 870 feet above the Seine.

A REUTER telegram from Colon states that slight shocks of earthquake occurred there and at Panama on the morning of April 17.

THE *Athenæum* announces the death, in his seventy-third year, of Prof. Laborde, of the Paris School of Anthropology, and of M. E. Duporcq, the secretary of the French Mathematical Society, at the early age of thirty-one.

A GENERAL agreement has been arrived at between Marconi's Wireless Telegraph Company and a group of Danish financiers in Copenhagen for the establishment of a wireless system between Iceland and the north of Scotland.

THE following announcement appeared in Saturday's *Times* (April 18):—"Owing to the breakdown of a subsidiary device employed in connection with one of the telegraph stations established by the Marconi Company for

Transatlantic wireless telegraphy, the service of telegrams to the *Times* by Marconigraph from America is temporarily interrupted. The company state that the disablement of the apparatus is purely of a mechanical nature, and that the necessary repairs will shortly be completed."

A REUTER message from Rome states that the Marquis Luigi di Solari has submitted to Mr. Marconi, on behalf of the Italian Government, a convention for the establishment on the coast and on the islands off the Italian coast of a system of twelve Marconi radio-telegraph stations of an average range of 300 kilometres. Some of these stations are to be complete before the end of the present year, and the others within the first half of 1904. Two of these twelve stations will be those already established at Punta di Vela and Montemario, which will, however, be strengthened. These will be exclusively reserved for military use; others, to be used for both military and commercial purposes, will be established at Capo di Leuca, near Gaeta, at Elba, and at Asinara.

PROF. FLEMING, in a long letter to the *Times* of April 14, describes in detail the experiments on syntony which he recently carried out at Poldhu. The letter does not embody much more information than was given in Prof. Fleming's Society of Arts lectures, which we have already summarised (p. 518). That Prof. Fleming himself was thoroughly satisfied with the results may be gathered from the following paragraph:—"This experiment," he writes, "which was very carefully carried out with all precautions necessary to prevent collusion between the assistants concerned, and to secure that the conditions were such as will exist in practice, appears to me to afford a complete demonstration of the truth of Mr. Marconi's statement that the waves sent out from his power stations do not, and will not, interfere with the reception of messages from his apparatus as placed on board ship." It is very satisfactory to have this assurance, but even without it one could not help feeling that the Marconi Co. would not have pushed ahead so fast with the Transatlantic signalling if by so doing they were ruining the intermarine communication which they have established.

WE are informed that it is the American Geographical Society, and not the U.S. National Geographic Society, which has awarded the Cullum medal to the Duke of the Abruzzi for his ascent of Mount St. Elias and his Arctic explorations.

REUTER'S Athens correspondent has announced that the Italian Archæological Mission has discovered, near Herakleion, in Crete, on the site of ancient Phaestos, a magnificent palace and various objects of exceptional interest analogous to those found at Knossos.

M. LIPPMANN is to succeed M. Poincaré as president of the French Astronomical Society next May. M. Janssen has been elected *president d'honneur*. The Society's prize has been awarded to M. Charlois for the discovery of a large number of minor planets, and the Jannsen prize to M. Giacobini for the discovery of seven comets.

THE International Conference on Deep-sea Investigation was opened at Wiesbaden on April 16, under the presidency of the Prince of Monaco, representatives of geography being present from England, Germany, France, Norway and Sweden. The committee appointed by the Geographical Congress which met in 1899 presented a report on questions connected with oceanic research at great depths.

IN a letter addressed to Sir Alfred Jones by the expedition sent by the Liverpool School of Tropical Medicine to investigate the newly-discovered parasite of human trypanosomiasis, it is stated that a number of natives had been examined, but that the parasite had not been found in any. In two horses, however, a trypanosome was found, and it is stated that another horse had been infected with the human trypanosome. In a common species of horse fly that had fed on this last horse, numerous trypanosomes were found in the stomach. The letter was sent from McCarthy Island, 150 miles in the interior of Gambia.

WE learn from the *Times* that Dr. Jonathan Hutchinson, F.R.S., has now returned from his tour in India and Ceylon, in which countries he has been studying the ætiology of leprosy. Dr. Hutchinson has always held that leprosy is connected in some way with the eating of fish, and it was to test the truth of this hypothesis that he has made this tour, and, shortly before, one to South Africa. Dr. Hutchinson, as the result of his inquiries, believes that only in a very small minority of cases of leprosy can a fish diet be excluded. Its great prevalence is almost always in or near a fishing district. Dr. Hutchinson's general conclusion is that, as regards leprosy in India, there are no facts which controvert or render untenable the fish hypothesis, and that there are some which afford to it a support which he considers to be unassailable.

NEWS has been received at Berlin, from Australia, of the German Antarctic expedition under Dr. Erich von Drygalski, which left for the South Polar regions in 1901. The steamer *Stassfurt*, of the German Australian Steamship Company, reached Sydney on April 17 with four members of the expedition, who were landed at Kerguelen Island from the expedition ship *Gauss* for the purpose of making a year's magnetic and meteorological observations, which were necessary for the main expedition in order to confirm the observations taken further south. One of the observing party, Dr. Enzensperger, died of beri beri on the island on February 2, and Dr. Werth, geologist, who is among those landed from the *Stassfurt*, was also taken seriously ill. He is now better, but will be detained in hospital. The remaining three explorers are well.

DR. HANS REUSCH describes in *Naturen* for March the only known natural fountain in Norway, locally known as Bubbelen. It lies in a remote and little-known valley, Bognelvdal, 10 kilometres south of Sopnaes, at the head of Langfjord, a branch of Altenfjord, Lapland, 70° N. 22° E. It is formed by a stream which itself is fed by the overflow of a river, and has flowed underground through the limestone for three kilometres. The fountain rises from a basin six metres deep in a column of water which varies in size according to the season, and flows away as a stream, which even in dry weather is seven metres broad and two metres deep.

THE Naples Academy of Physical and Mathematical Sciences offers a prize of 1000 lire to the author of the best memoir on the theory of the invariants of the ternary biquadratic form, preferably in connection with the conditions for splitting into lower form. The papers may be written in Italian, Latin, or French, and must be sent in on or before June 30, 1904. In addition prizes are offered in connection with the legacy of Prof. Luigi Sementini, who in 1847 left a sum of 150 ducats per annum "to distribute it as a prize for three memoirs on applied chemistry which they shall judge the best, or to award it as a prize to the author of one single memoir containing great utility, or finally to give it as a life pension to the author of a classical discovery useful to sick mankind." Competitors for this prize are invited to send in their applications, accompanied by manuscript or printed papers, not later than December 31, 1903.

A NOTE in the *Times* refers to a report by Mr. Neville-Rolfe, British Consul in Naples, in which he mentions the widespread interest now being taken in Italy in the question of reafforesting the country. In 1877 about four millions of acres were withdrawn from the operation of the old forest laws, as well as about one million acres in Sicily and Sardinia. The consequence was a reckless destruction of forests, and now it is generally admitted that the State must step in to save those that are left and to aid in replanting. The question now being discussed is what trees are to be used for the latter purpose.

THE increase of temperature referred to in our last issue, caused by the advance of a small cyclonic disturbance on Tuesday, April 14, was of short duration; by the morning of April 15 the centre of the disturbance had reached the Dutch coasts, and in its rear the winds had become northerly; the day temperatures again became abnormally low. Severe frosts on the ground occurred at night, which, up to Tuesday last, have been continuous at Greenwich for ten days; the mean of the terrestrial radiation temperatures there for the week ending April 20 was 20°·8, being 10° lower than the mean for the corresponding period last year. On the morning of April 18 a temperature of 24° was registered at Newton Reigny and Dungeness. Such a low temperature had not been registered in the neighbourhood of the latter station, in April, in the values for thirty years published by the Meteorological Office.

A VIOLENT snowstorm passed over Berlin on Sunday night, and the snow lay several inches deep in the streets on the following morning, April 20. The Berlin correspondent of the *Times* states that more than forty trees were blown down in the Thiergarten. The Royal Park at Potsdam has suffered very severely, and many valuable trees planted in the time of Frederick the Great have been uprooted. Telegraphic communication with Sweden and Russia was interrupted, and many of the inland wires to the eastward of Berlin have broken down. The trains from the provinces of Posen, Silesia, and East and West Prussia arrived at Berlin many hours late on Monday, and on many sections of the railways in the eastern half of the Kingdom of Prussia traffic was completely interrupted. In Denmark the gale was even more severe. Trains could not proceed from Copenhagen in any direction, and telegraphic and telephonic communication was also interrupted. On Monday the Danish capital was, in fact, almost entirely cut off from communication with her immediate environs and with other countries. Snow reached a depth of four to six feet. Two local trains sent from Copenhagen with snow-ploughs only reached from ten to twenty miles from the capital. A severe snowstorm swept over the whole province of Petrikovo, Russia, on April 21.

WE have received the report of the Government Observatory, Bombay, for the year 1902; the director, Mr. N. A. F. Moos, is assisted by a native staff of ten members. The observatory is well equipped with self-recording instruments, and directs its attention chiefly to terrestrial magnetism, meteorology, and seismology, and to some extent to astronomical observations. The work appears to have been carried out with great efficiency; the seismic observations show distinct evidence of sudden increased activity during the year, and it is stated that the records promise to be of considerable value in connection with the relation which probably exists between earthquake phenomena and terrestrial magnetism. Special magnetic observations have been made (at times every twenty seconds) in connection with the international programme decided on during the period of the English and German Antarctic expeditions.

ALTHOUGH the surface wind was from the east, the dust cloud from the eruption of the Soufrière of St. Vincent at 6.30 a.m. on March 22 reached Bridgetown, Barbados, 100 miles to eastward, by 9 a.m., so that its rate of motion was not less than forty miles an hour after having attained an elevation of probably three miles at least above the Soufrière. Its altitude above Barbados was estimated at about 8000 feet, or double the height of the Soufrière. At several points the first fall of dust was observed at 11.15 a.m., it increased until 1.30 p.m., then diminished, and by 5 p.m. it had ceased. In the neighbourhood of Bridgetown the fall was at the rate of about 2½ tons per acre; considerably less at Bathsheba, fourteen miles to the north-east; while at Codrington House, two miles north of the town, it amounted to 6·52 tons per acre. Taking 3 tons per acre as the average would give 300,000 tons for the whole island. The May dust was a very light grey, that of March very dark—almost black, Dr. Spencer describing the March dust cloud as of a deep Prussian blue colour.

THE Imperial Department of Agriculture for the West Indies has now published the complete report and statistical information relating to the sugar-cane experiments in the Leeward Islands, Antigua and St. Kitts, in the season 1901–02. Part i., 55 foolscap pages, deals with experiments with varieties of sugar-cane, with an appendix on the chemical selection of sugar-cane. Part ii., 115 pages and six large diagrams, treats of manurial experiments. The general results have already been noticed in these columns.

THE London County Council has now issued the complete report upon the examination of the atmosphere of the Central London Railway, carried out by Dr. Clowes and Dr. Andrewes. A short statement of results submitted to the Council has already been described (p. 488). Generally, the amount of carbon dioxide was largest in the air of the carriages, but not, as might have been expected, in the smoking carriages. The highest proportion of carbon dioxide found was 14·7 volumes and the smallest proportion 9·6 volumes in 10,000 volumes of air. The air in the passages leading to and from the stations was generally better than in the lifts—on one occasion as much as 15·2 volumes of carbon dioxide in 10,000 volumes of air were present in a lift; but of all the samples 22 per cent. contained less than twice as much, and 34 per cent. contained less than 2½ times as much carbon dioxide as that found in outside air. Dr. Clowes suggests as a standard that air taken at any point on the railway should not contain more than 8 volumes of carbon dioxide in 10,000 of air. The bacteriological examination of the air by Dr. Andrewes showed micro-organisms to be present in somewhat greater proportion than in the fresh outside air in the ratio of about 13 to 10, the number of organisms being proportional to the concentration of human traffic. The air of the railway does not in its bacterial content compare unfavourably with inhabited rooms generally, and no pathogenic germs were detected.

IN the April number of *Climate* Dr. Louis Sambon gives an admirable popular account of malaria, illustrated by a number of original drawings by Signor Terzi. Dr. Harford discusses the physical qualifications necessary for residence or travel in the tropics, and there are other articles upon the "Spread of Yellow Fever," "Surgical Emergencies," and "Sanitary Reform in West Africa."

A SECOND edition has appeared of the "Meteorologia Dinamica," by P. A. Rodrigues de Prada, director of the Vatican Observatory. It is published in Madrid, and deals with atmospheric tides, winds, cyclones, and air currents generally.

MESSRS. HOEPLI, of Milan, have issued the second edition of Ingegnere G. Vacchelli's book on "Le Costruzioni in Calcestruzzo," the first edition of which appeared in 1899. It is one of the Manueli Hoepli, and deals with the properties of concrete, cement, and hydraulic lime, and their uses for building purposes. Special attention is given to the use of cements in the construction of bridges and submerged structures.

IN the *Atti dei Lincei*, xii., 6, Signor G. Guglielmo describes a method of determining the work-measure of the specific heat of water, which resembles the classical experiment of Joule in that the liquid is raised in temperature by agitation, but the liquid is contained in a closed vessel (the calorimeter of Fabre and Silbermann was used) having paddles or blades fixed projecting into the interior, and the agitation is effected by rotating the vessel alternately in one sense and then in the other.

SOME months ago the French Physical Society commenced the publication of a collection of elementary experiments in physics, and invited the cooperation of the members in describing experiments or details of apparatus which they had found useful, especially for teaching purposes. In a further circular the secretary, M. H. Abraham, states that the first part, dealing with geometry, mechanics, gravitation, hydrostatics and heat, is nearly complete, and the second part, dealing with acoustics, optics and electricity, is already in course of preparation.

THE French Physical Society held its annual exhibition of apparatus in Paris last week. The entrance hall and vestibule were lighted with "heliophone" lamps of the French Incandescent Gas Company, the staircase and ground floor by the French Oxyhydrogen Company, and the entrance hall of the first floor by Nernst lamps. Conferences were held in the Physics Theatre of the Faculty of Sciences on April 16, 17 and 18, at which the following papers were read:—On anomalous propagation of the form of vibrations in the neighbourhood of a focus, by M. G. Sagnac; recent researches in radio-activity, by M. P. Curie; experiments on electric convection, by MM. Crémieu and Pender; and further experiments on electric convection, by M. Vasilesco Karpen.

THE *Bulletin de la Société d'Encouragement* for February 28 contains two papers of interest in connection with the problem of aërial navigation. In the first of these M. Barbet describes the latest experiments by M. Canovetti, of Brescia, on the resistance of the air to moving bodies of various shapes. The method, which has already been described in previous papers, consists in attaching the body under observation to a small trolley (chariot) which descends under gravity, along a wire 380 metres long stretched from the top of the fortifications at Brescia to a point on the plain below, the difference of altitude being 70 metres. By comparing the times of descent with those observed when the resisting body was removed, an estimate was formed of the coefficient of resistance. From experiments with aëroplanes, M. Canovetti found that an aëroplane of 200 square metres, weighing 1000 kilograms, moving at a speed of 16 metres per second, would require 100 horse-power to maintain it in the air, and that under these conditions the problem was impossible; further, that more power was necessary for driving an aëroplane through the air than for propelling an automobile of equal weight on a road. By experiments on the resistance of two circular discs placed one behind the other, M. Canovetti has plotted the form of the cone of air entrained by a moving disc.

IN the second paper Commandant P. Renard discusses the conditions of safety of navigable balloons, and suggests to the Société d'Encouragement a list of seventeen questions which should be put to the inventor of every navigable balloon before offering him official support or assistance. These questions refer to the provision of an adequate secondary gas bag (ballonet), which can be inflated by a sufficiently powerful ventilator driven by an independent motor, the satisfaction of the conditions of longitudinal stability, the avoidance of rigid parts, especially in the neighbourhood of the balloon, the arrangement of the motor and the gas valves in such a way as to minimise the danger of the escaping gases accumulating where they could be set on fire by the motor, the refrigeration of the gases escaping from the motor, the provision of fire extinguishing appliances, and last, but not least, the all-important question, "Are you a good aëronaut, or do you intend to take one with you?"

TO the March number of *Petermann's Mitteilungen* Herr Arno Senfft contributes the first part of a paper on the ethnography of the island of Yap, in the Carolines. The botany of the Carolines has been treated by Prof. Volkens in his memoir on "Die Vegetation der Karolinen," and the geology by Dr. Kaiser in a paper published by the German Geological Society in 1902; Herr Senfft's paper is an important contribution towards the complete description of the group.

IN the *Zeitschrift der Gesellschaft für Erdkunde zu Berlin*, Dr. G. Wegener gives an account of the volcanic eruptions which occurred on Sawaii, in the Samoa islands, in the beginning of November last. There seems to be a good deal of evidence, geological and traditional, to show that volcanic disturbances occurred in the island within comparatively recent times, possibly about 200 years ago. The present activity is particularly interesting, because, after a long period of quiescence, the eruptions have recommenced without any violent display of energy.

FROM the Smithsonian Institution we have received a copy of a paper by Mr. R. S. Bassler on the structure of the extinct bryozoan genus Homotrypa, with descriptions of new species.

IN a recent issue of the *Proceedings* of the Boston Natural History Society (vol. xxxi., No. 1), Mr. M. T. Thomson describes the larva of *Naushonia crangonoides*, a rare shrimp, at present known in the adult condition by one specimen from Naushon Island and a second from Rum Island, both in the neighbourhood of Wood's Hole.

IN describing the best mode of rearing the curious larva of the annelid Polygordius, Prof. W. K. Brooks, in the *Johns Hopkins University Circulars* for March, comments on the circumstance that the adult has not hitherto been taken on the American coast. This he believes to be due to the lack of a sufficiently careful search.

ACCORDING to *Science* of March 27, the American Morphological Society and the zoologists of the central and western States have combined forces, under the title of the American Society of Zoologists, of which there is to be a western and an eastern branch. It is expected that the new body will meet once in three years, the meetings to be held alternately in the territories of the two branches.

IN reference to an idea that beavers survived in Yorkshire until a very late period, Mr. T. Sheppard, in the *Naturalist* for April, explains that the item "bever-heads" occasionally met with in old parish accounts refers to the otter. He adds, however, that remains of the beaver have been found near Beverley, as well as in other parts of the county.

WE have received vol. ii., part xiv., and vol. iii., parts i. and ii., of the *Annals* of the South African Museum. In the first of these Mr. S. Thor, of Christiania, treats of the South African water-mites (Hydrachnidæ), recording a number of new forms. In the second Dr. W. F. Purcell describes some new generic and specific types of Solpugidæ, and likewise gives an account of a collection of Arachnida recently made in one district of Cape Colony; while in the third Mr. Distant continues his notes on Rhynchota.

AT Toynbee Hall to-morrow, April 24, a course of five lectures on "The How and the Why of Decoration" will be commenced by Dr. A. C. Haddon, F.R.S. The lectures will deal with the origins of designs, art and handicraft, art as a means of instruction, art and religion, and the decorative art of British New Guinea as an example of method.

MESSRS. MACMILLAN AND CO., LTD., have added Kingsley's "Water-Babies" to their Illustrated Pocket Classics. The illustrations of Linley Sambourne are included, and it would be difficult to imagine a more attractive edition of this instructive fairy tale.

THE drawings contained in the three volumes of Mr. W. S. Taggart's "Cotton Spinning" have been published in a separate book, under the title "Cotton Machinery Sketches," by Messrs. Macmillan and Co., Ltd., at 2*s*. 6*d*. The author believes that many teachers will find these drawings useful to accompany their lectures, even though they may not approve of text-books in general.

MESSRS. J. AND A. CHURCHILL have published a second edition of "A Handbook of Physics and Chemistry," by Messrs. H. E. Corbin and A. M. Stewart. The primary object of the book is to meet the requirements of the first examination of the Conjoint Examining Board of the Royal Colleges of Physicians and Surgeons, and the new matter which has been added should increase the book's sphere of usefulness.

AMATEUR photographers will be glad to know that Messrs. R. and J. Beck, Ltd., have issued a second edition of "Photographic Lenses; a Simple Treatise," by Messrs. Conrad Beck and Herbert Andrews. The book is intended as a practical guide for the photographer to enable him to use his apparatus to better advantage; it does not profess to give complete scientific explanations of the laws underlying the construction of photographic lenses.

THE additions to the Zoological Society's Gardens during the past week include a Purple-faced Monkey (*Semnopithecus cephalopterus*) from Ceylon, presented by Mr. T. Jenkins; a Bonnet Monkey (*Macacus sinicus*) from India, presented by Mr. C. A. Denison; a Long-tailed Weaver-bird (*Chera progne*) from South Africa, presented by Major R. W. P. Lodwick; a Brambling (*Fringilla montifringilla*), European, presented by Mr. H. Munt; a Large Grieved Tortoise (*Podocnemis expansa*) from the Amazons, presented by Senhor Francisco Alves Vieira; four Gallot's Lizards (*Lacerta galloti*) from Teneriffe, presented by the Hon. Rupert Drummond, R.N.; two Smith's Dwarf Lemurs (*Microcebus smithi*) from Madagascar, two Derbian Zonures (*Zonurus giganteus*), four Leopard Tortoises (*Testudo pardalis*) from South Africa, four Spanish Salamanders (*Chiroglossa lusitanica*) from Spain, deposited; a Shining Parrakeet (*Pyrrhulopsis splendens*) from the Fiji Islands, purchased.

OUR ASTRONOMICAL COLUMN.

NOVA GEMINORUM.—Further observations of the magnitude, appearance, and spectrum of this Nova have been made, and the results communicated to No. 3861 of the *Astronomische Nachrichten*.

Prof. Millosevich estimated the magnitude of the Nova on March 26d. 9h. (M.T. Rome) as 7·3–7·5, and recorded the colour as "yellow."

Dr. Halm, of Edinburgh, observed the spectrum with a small spectroscope attached to the 15-inch refractor on March 26, 27 and 28, and was convinced at first glance that the object was of the Nova type. On March 27 he found a faint continuous spectrum crossed by bright bands, those in the green and blue parts of the spectrum, including Hβ and Hγ, being especially conspicuous. The red part of the spectrum was very faint, and, although a careful scrutiny was made, no trace of the C line of hydrogen could be seen, but on observing the spectrum again on March 28 a bright point was seen to occupy that position. Dr. Halm estimated the magnitude of the Nova as about 8·0, and recorded the colour as a "bluish purple."

Drs. Ristenpart and Guthnick, of Berlin-Friedenau, made several estimations of the Nova's magnitude at 8·8h. (Central Europe M.T.) on March 29, and found for their general mean value 8·55m.

Prof. Hartwig, of Bamberg, estimated that the Nova was 0·3m. fainter on April 1 than it was on March 26, and Prof. Ceraski, of Moscow, estimated the magnitude as 8·3 at 10.30 p.m. on March 27. The latter observer could see no particular colour in the Nova, as it appeared white to him.

SPECTRUM OF THE NEBULOSITY SURROUNDING NOVA PERSEI.—On account of the extraordinary changes of position and brightness in the nebula surrounding Nova Persei, Prof. Perrine, of Lick Observatory, thought it advisable to secure, if possible, a spectrum of the nebula, and for this purpose especially designed a spectroscope to be used with the Crossley reflector. The camera and collimator lenses were single quartz lenses of $1\frac{1}{8}$-inch aperture and 6 inches focal length; the prism also was quartz, and had a refracting angle of 50° 14′. A comparison spectrum of hydrogen was photographed on either side of the nebular spectrum.

A total exposure of 34h. 9m. was made on "condensation D" of the nebula on October 31, November 1, 2 and 4, and the resulting negative shows a very faint spectrum extending from Hβ to about λ 360, its length being about 0·11 inch. A second negative was obtained in order to demonstrate that the spectrum was not due to skylight, whilst a spectrum of skylight was obtained and proved to be quite different to the supposed nebula spectrum, so that it may be taken as proved that the spectrum obtained on the first negative is really due to the nebulosity.

Fully three-fourths of the light in the spectrum is condensed in the region extending from Hβ to Hγ; above Hγ the spectrum is very faint, and between λ 380 and λ 390 it is entirely absent. There appears to be a line almost coincident with Hδ, and another at λ 370, but they are so faint that it is impossible to certify their presence.

It thus appears that the spectrum of the nebulosity corresponds to that of the Nova during the first few days of the latter's greatest magnitude in February, 1901. The positions of the two suspected lines at λ 410 and λ 370 do not agree at all with the strongest lines in the latest spectrum of the Nova, and there are no traces of the lines at λ 387 and λ 397 obtained by Campbell and Wright, nor of the very strong line at λ 346 photographed by Mr. Stebbins (Lick *Bulletin*, No. 8). The spectrum of the nebulosity is certainly not the ordinary bright line spectrum of the nebulæ, and if the latter is present at all, it is in conjunction with another spectrum, probably continuous, extending

from λ 434 to λ 487. A spectrum of the Nova obtained on February 17, 1903, does not agree with the spectrum of the nebulosity at all.

Prof. Perrine arrives at the conclusion, from the evidence given by these spectrographs, that the results do not oppose the theory that the light of the nebulosity—as considered in that part of it called condensation D—is due to the reflection of the light emitted by the Nova *at the time of its greatest brightness*, although, in face of the contradictory evidence already published, he does not consider his conclusions strong enough to prove the reflection theory (Lick Observatory *Bulletin*, No. 33).

STELLAR PARALLAX.[1]

FOR three years, from 1893 to 1896, Mr. A. S. Flint, of the Washburn Observatory, has devoted himself indefatigably to the determination of stellar parallax, and his results, contained in the eleventh volume of that observatory's publications, form a very handsome contribution to this class of inquiry. Not only are these results of great interest in themselves, but they offer a larger collection of new material than has ever been made on a single occasion. We have not only the observations of nearly a hundred stars, but all arranged and discussed on one uniform plan, a not unimportant factor in their bearing on the cosmical problem to which such results are applicable. The stars are scattered variously over the sky from the Pole to about 30° S. declination, and have been selected to include stars of considerable proper motion, a number of Prof. Burnham's double stars which show proper motion, and some twelve binary systems.

The method of observation was that suggested and employed by Prof. Kapteyn, namely, the chronographic registration of the time at which the selected star and two others, one preceding and one following, crossed the wires of the meridian instrument. The total number of observations, fairly evenly distributed between the morning and the evening, was 3659, all of which were made by Mr. Flint, while he is also responsible for the heavy work entailed in the discussion. Unfortunately, in this method of observation it is necessary to employ screens, varying in density, in front of the object glass, to reduce the light of the more brilliant star to approximately that of the stars of comparison. Experience has shown that very considerable errors are liable to be introduced in the determination of difference of R.A. when this precaution is overlooked. The ultimate value of the work will depend much on the success with which the screens are applied, and this source of error is eliminated. In this place we cannot enter fully into the devices employed or the discussion applied to the results. We can only say that the author has not found it sufficient to trust to the mechanical devices alone, but has had to submit his parallaxes to a further discussion, in order to remove systematic errors, and we can very well understand that this section of the work will be most carefully scrutinised by any astronomer who proposes to follow in the footsteps of Prof. Kapteyn or Mr. Flint.

The result of this examination is to determine a correction which the author has applied, and seeks to justify, depending on the difference of magnitude and the right ascension of the star. This correction can become so large that it might make one hesitate to apply the method in isolated instances, or wherever there is insufficient material to permit an independent inquiry. The correction which Mr. Flint applies to his parallax, or to the crude value resulting from the solution of the ordinary equations of condition, is $\frac{1}{2}$DM. y; where $\frac{1}{2}$DM. is the difference between the apparent magnitude of the parallax star and the mean magnitude of the two stars of comparison, and y is given by the expression

$$y = +0''.067 + 0''.101 \cos. \text{R.A.}$$

If, then, the reduced light of the parallax star differed by one magnitude from the mean of the other two, a correction of $0''.168$ might result, and inasmuch as a difference of two magnitudes is not impossible, corrections of nearly four-tenths may be required, and in two instances $0''.36$ is actually applied. This amount is a little startling, and though it would seem ungracious to suggest more work when so much has been attempted and carried to a successful issue, one cannot but wish that the author had made some complete sets of observations, without the use of a screen at all. Then, in the case of such a star as β Cassiopeiæ with its comparison stars, the amount of the correction would be some seven or eight-tenths of a second, a quantity which could not have escaped detection. To those who have not been engaged in similar inquiries it may seem strange that the error in R.A. arising from the observation of two stars of unequal magnitude is not constant, and therefore disappearing in the parallax. It may seem strange, too, that this puzzling discrepancy should vary with the time of year, for that is what the term depending on the right ascension practically means, but it must be sufficient here to refer to the volume itself, where the author has treated the matter in considerable detail, and given his figures in the clearest manner.

W. E. P.

[1] Publications of the Washburn Observatory of the University of Wisconsin. Vol. xi. "Meridian Observations for Stellar Parallax." First Series. By Albert S. Flint, Assistant Astronomer. Pp. 435. (Madison, Wis.: State Printer, 1902.)

RIDGWAY'S AMERICAN BIRDS.[1]

MR. RIDGWAY is making good progress with his laborious task, the first part of this work (already noticed in these columns) having been issued in 1901. The remaining volumes (probably six in number) are in a forward state, and it is hoped may be published at the rate of two a year. The present bulky volume is devoted to four families of the Passeres, namely, the tanagers (Tanagridæ), troupials (Icteridæ), honey-creepers (Cœrebidæ), and wood-warblers (Mniotiltidæ).

The author's introductory remarks on the first of these groups afford a curious comment on the prevalent practice of dividing the Passeres into families. For the division between the tanagers and the finches (Fringillidæ) is stated to be an arbitrary one, and the former group, as now restricted, is confessedly more or less artificial. Indeed, it is suggested that the fruit-eating forms (Euphoniæ) may eventually have to be separated as a distinct family group. The author has already relegated to the Fringillidæ several of the genera included by Mr. Sclater among the Tanagridæ, while others he assigns to the Mniotiltidæ. Moreover, the possession of only nine primary quills being now regarded as an essential feature of the family, the aberrant genus Calyptophilus must obviously find a place elsewhere. Apart from the case of the last-mentioned genus, all this suggests that, however convenient the division into "families" of such an unwieldy group as the Passeres may be for working purposes, such divisions possess little title to be regarded as important morphological units.

In adopting the term "troupials" as the English equivalent of the family Icteridæ, the author is decidedly well advised, and it may be hoped that the practice will be adopted by future writers. In the definition of this family the author makes the general absence or slight development of the rictal bristles an important feature; but no reference to these structures is made in the main definitions of the tanagers and honey-creepers, in which they may or may not be developed. This, we think, is an omission, although we are fully aware of the importance of making definitions as concise as possible. The general plan of the "keys" appears, as in the first volume, excellent, and the plates illustrative of the beak, wing, tail, and foot-structures of the various groups described are equally satisfactory.

R. L.

[1] "Birds of North and Middle America." By R. Ridgway. Part ii. (*Bull.* U.S. Nat. Mus., No. 50.) Pp. xx + 834; 22 plates. (1902.)

A PERIODICAL OF PRECIOUS PLANTS.

UNDER the title of *Flora and Sylva*, a new monthly periodical has appeared, edited by Mr. Robinson, and devoted to the illustration and description of "precious" plants, fitted for cultivation in these islands. It is beautifully printed in large type on good paper which allows of the woodcuts being properly printed. The illustration of the palmate bamboo on p. 3 is full of life, and forms a pleasing

contrast to many of the blotchy "process" illustrations now so common.

The coloured illustrations are good of their kind, but it needs the patience of a Bauer to do justice to such exquisite flowers as those of the Calochortus, and in the present instance the artist evidently prefers effect to detail.

Mr. Nicholson's article on Magnolias is likely to be of permanent value, and Mr. Carl Purdy's revision of the genus Calochortus will be useful to those who have not ready access to the more complete monograph in the *Proceedings* of the California Academy of Sciences.

"Sylva" is represented by an article on the Corsican pine, concerning which so much has been written of late years. Alluding to the great variation which occurs among the pines, the author of the article says that the "wild type of a forest tree is the best, and that sports are worthless." This is a statement that appears to require some modification. In the first place, it is not easy to determine what is the wild type. If we take the Corsican tree as the type, are we to abandon as worthless the black Austrian, the Pyrenean, the Calabrian, the Pallasian, and the many other varieties of the Corsican pine? But perhaps the writer does not include these as "sports." At any rate, in their several ways they are as valuable as the form arbitrarily taken as the type.

Flora and Sylva promises to be a very attractive and useful addition to garden literature.

INTERACTION BETWEEN THE MENTAL AND THE MATERIAL ASPECTS OF THINGS.[1]

THERE are certain ambiguous terms, to the undiscriminating use of which some misunderstandings are due. One of these is the term "science," which may be used either as synonymous with the unbiased and reverent pursuit of truth by patient and accurate methods in all departments of knowledge; or as representing the generally accepted notions of naturalists at any one epoch, together with such positive and negative tendencies and extensions into more speculative regions as may be favoured by them. The distinction between these two dissimilar things is hardly sufficiently accentuated by the use of a large or a small initial letter for the word.

Another ambiguous word is "faith," which may signify intellectual credence attached to some doctrine, in which case an emphatic and militant definite article is sometimes prefixed to it; or it may denote a moral, *i.e.* emotional and conative attitude to the universe in general, irrespective of intellectual cognisance of specific facts.

A third is the term "prayer," which again may represent either a submissive and devotional passive attitude of the soul in presence of a higher power, or an active and energetic petition for certain benefits or privileges, and especially for aid and guidance in crises or emergencies.

And lastly, many ambiguities, I venture to think, attach to the term "God," of which I will only mention three.

First, it may signify the highest theoretical and practical conception of men at any given epoch on this planet; a use of the term appropriate to the science of theology. Second, it may mean the Ultimate and Infinite and Absolute, concerning which no human predication is possible, and of which no even initially adequate conception can be made. Third, there are signs of its coming to be used in a limited sense by certain not unphilosophic persons—whether justifiably or not—to denote a Being, a ruler, an administrator, who is striving to evolve order out of mental and moral chaos, and to bring gradually towards perfection a race such as is competent to inhabit the surface of planets; the manager, so to speak, of the process of evolution. A being infinite in comparison to ourselves, but still a being with potentialities ahead, and with the possibility of advance, conditioned therefore to some extent by what we are conscious of as "time."

All these ambiguous terms are liable to enter into our present discussion, which concerns, I take it, fundamentally the intercommunion and interaction between the divine and the human, chiefly in the regions of volition and of action on the physical world. The influence of the divine on the human has been variously conceived in different ages, and various forms of difficulty have been at different times felt and suggested; but always some sort of analogy between human action and divine action has had perforce to be drawn in order to make the latter in the least intelligible to our conception. The latest form of difficulty is peculiarly deep-seated, and is a natural outcome of an age of physical science. It consists in denying the possibility of guidance or of control, not only on the part of a Deity, but on the part of every one of his creatures. It consists in pressing the laws of physics to what seems their logical and ultimate conclusion, in applying the conservation of energy without ruth or hesitation, and so excluding, as it has seemed, the possibility of free-will action, of guidance, of the self-determined action of mind or living things upon matter, altogether. The appearance of control has been considered illusory, and has been replaced by a doctrine of pure mechanism, enveloping living things as well as inorganic nature.

And those who for any reason have felt disinclined or unable to acquiesce in this exclusion of non-mechanical agencies, whether it be by reason of faith and instinct, or by reason of direct experience and sensation to the contrary, have thought it necessary of late years to seek to undermine the foundations of physics, and to show that its much-vaunted laws rest upon a hollow foundation, that their exactitude is illusory, that the conservation of energy, for instance, has been too rapid an induction, that there may be ways of eluding many physical laws and of avoiding submission to their sovereign sway.

By this sacrifice it has been thought that the eliminated guidance and control can philosophically be reintroduced.

This, I gather, may have been the chief motive of an attack on physics led by an American, J. B. Stallo, in a little book called the "Concepts of Physics," which has at various times attracted some attention. But the worst of that book was that Stallo was not really familiar with the teachings of the great physicists; he appears to have collected his information from popular writings, where the doctrines were very imperfectly laid down; so that most of the book is occupied in demolishing constructions of straw, unrecognisable by professed physicists except as caricatures at which they also might be willing to heave an occasional missile.

The armoury pressed into the service of Prof. James Ward's attack is of weightier calibre, and his criticism cannot in general be ignored as based upon inadequate acquaintance with the principles under discussion; but still his Gifford lectures raise an antithesis or antagonism between the fundamental laws of mechanics and the possibility of any intervention, whether human or divine.

If this antagonism is substantial it is serious; for natural philosophers will not be willing to concede fundamental inaccuracy or uncertainty about their recognised and long-established laws of motion, nor will they be prepared to tolerate any the least departure from the law of the conservation of energy. Hence, if guidance and control can be admitted into the scheme by no means short of refuting or modifying those laws, there may be every expectation that the attitude of scientific men will be perennially hostile to the idea of guidance or control, and so to the efficacy of prayer, and to many another practical outcome of religious belief. It becomes therefore an important question to consider whether it is true that life or mind is incompetent to disarrange or interfere with matter at all, except as an automatic part of the machine, or rather except as an ornamental appendage or dependent accessory of its working parts.

Now experience—the same kind of experience as gave us our scheme of mechanics—shows us that to all appearance live animals certainly can direct and control mechanical energies to bring about desired and preconceived results, *e.g.* the Forth Bridge. Undoubtedly our body is material and can act on other matter, and its energy is derived from food, like any other self-propelled and fuel-fed mechanism; the question is whether our will or mind or life can direct our body's energy along certain channels to attain desired

[1] Read to the Synthetic Society in London on February 20. The paper is supplementary to a couple of articles on "Science and Faith," by the same author, in the *Hibbert Journal* for October, 1902, and January, 1903; and it states, for the purpose of discussion, the salient arguments on which those articles were based.

ends; or whether direction, as well as amount, of activity is wholly determined by mechanical causes.

Answers that might be given are:—

(*a*) That life is a form of energy, and achieves its results by imparting to matter energy that would not otherwise be in existence, in which case life is a part of the machine, and as truly mechanical as all the rest. I hold that this is false; because the essence of energy is that it can transform itself into other forms, remaining constant in quantity, whereas life does not transmute itself into any form of energy, nor does death affect the sum of energy in any known way.

(*b*) That life is something outside the scheme of mechanics, although it can nevertheless touch or direct material motion, subject always to the laws of energy and all other mechanical laws; supplementing them, but contradicting or traversing them no whit.

This I hold to be true; but in order to admit its truth we must recognise that triggers can be pulled—force exerted, and energy directed—without any introduction of energy from without; in other words, that the energy of operations automatically going on in any active region of the universe—any region where transformation and transference of energy are continuously occurring, whether life be present or not—that this energy can by means of life be guided along paths that it would not automatically have taken, and can be directed so as to produce effects that would not otherwise have occurred; and this without any break or suspension of the laws of dynamics.

That is where I part company with Prof. James Ward in the second volume of "Naturalism and Agnosticism," notwithstanding that I feel sure that Mr. A. J. Balfour agrees with him.

Those who take his view must either throw overboard the possibility of interference or guidance or willed action altogether, which is one alternative, or must assume that the laws of physics are only approximate and incomplete, which is the other alternative—the alternative favoured by Prof. James Ward. I wish to argue that neither of these alternatives is necessary, and that there is a third or middle course of proverbial safety.

On a stagnant and inactive world life would be admittedly powerless; it could only make dry bones stir in such a world if itself were a form of energy; I do not suppose for a moment that it could be incarnated on such a world; it is only potent where inorganic energy is in constant process of transfer and transformation. In other words, life can generate no trace of energy, it can only guide it.

Guidance is a passive exertion of force without doing work; as a quiescent rail can guide a train to its destination, provided an active engine propels it. If a stone is rolling over a cliff, it is all the same to "energy" whether it fall on point A or point B of the beach. But at A it shall merely dent the sand, whereas at B it shall strike a detonator and explode a mine. Scribbling on a piece of paper results in a certain distribution of fluid and production of a modicum of heat; so far as energy is concerned, it is the same whether we sign Andrew Carnegie or Alexander Coppersmith, yet the one effort may land us in twelve months' imprisonment or may build a library, according to circumstances, while the other achieves no result at all. John Stuart Mill used to say that our sole power over Nature was to *move* things; but strictly speaking we cannot do even that; we can only arrange that things shall move each other, and can determine by suitably preconceived plans the kind and direction of the motion that shall ensue at a given time and place. Provided always that we include in this category of "things" our undoubtedly material bodies, muscles and nerves.

But here is just the puzzle; at what point does will and determination enter into the scheme? Contemplate a brain cell, whence originates a certain nerve-process whereby energy is liberated with some resultant effect; what pulled the detent in that cell which started the impulse? No doubt some chemical process, combination or dissociation, something atomic, occurred; what made it occur just then and in that way?

I answer, the same sort of prearrangement that determined whether the stone from the cliff should fall on point A or point B—the same sort of process that guided the pen to make legible and effective writing instead of illegible and ineffective scrawls—the same kind of process that determines when and where a trigger shall be pulled so as to secure the anticipated slaughter of a bird. So far as energy is concerned, the explosion and the trigger-pulling are the same identical operations, whether the aim be exact or random. It is vitality which directs; it is physical energy which is directed and controlled both in time and space.

I lay stress upon a study of the nature and mode of human action of the interfering or guiding kind, because from it we must be led if we are to form any intelligent conception of divine action. True, it might be possible to deny human agency or power and yet to admit the possibility of divine agency, though that would be a nebulous and at least inconclusive procedure; but if we are once constrained to admit the existence and reality of human guidance and control, we cannot deny the possibility of such powers and action to any higher being, nor even to any totality of things of which we are a part.

The point immediately at issue turns upon the distinction between "force" and "energy." These terms have been so popularly confused that it may be difficult always to discriminate them, but in physics they are absolutely discriminated. A force in motion is a "power," it does work and transfers energy from one body to another. But a force at rest—a mere statical stress, like that exerted by a pillar or a watershed—does no work, and alters no energy; yet the one sustains a roof which would otherwise fall, thereby screening a portion of ground from vegetation; while the other deflects a rain-drop into the Danube or the Rhine.

It will be said *some* energy is needed to pull a hair-trigger, to open the throttle valve of an engine, to press the button which shall shatter a rock. Granted; but the work-concomitants of that energy are all familiar, and equally present whether it be so arranged as to produce any predetermined effect or not. The opening of the throttle valve, for instance, demands just the same exertion, and results in just the same imperceptible transformation of fully-accounted-for energy, whether it be used to start a train in accordance with a time-table and the guard's whistle, or whether it be pushed over as by the wind at random. The shouting of an order to a troop demands vocal energy, and produces its due equivalent of sound; but the intelligibility of the order is something superadded, and its result may be to make not sound or heat alone, but history.

Energy is needed to perform any physical operation, but the energy is independent of the determination or arrangement. Guidance and control are not forms of energy, and their superposition upon the scheme of physics perturbs physical and mechanical laws no whit, though it may profoundly affect the consequences resulting from those same laws. The whole effort of civilisation would be futile if we could not guide the powers of nature. The powers are there, else we should be helpless; but life and mind are outside those powers, and can direct them along an organised course.

And this same life or mind, as we know it, is accessible to petition, to affection, to pity, to a multitude of non-physical influences; and hence, indirectly, the little plot of physical universe which is now our temporary home has become amenable to truly spiritual control.

My contention, then, is that whereas life cannot generate energy, it can exert guiding force, using the term force in its accurate mechanical sense; not "power" or anything active, but purely passive, directing—perpendicular to the direction of motion; the same kind of force which can constrain a stone to revolve in a circle instead of in a straight line; a force like that of a groove or slot or channel or "guide."

I do not see how this action of life can be resented, except by those who deny life to be anything at all. If it exists, if it is not mere illusion, it appears to me to be something the full significance of which lies in another scheme of things, but which touches and interacts with this material universe in a certain way, building its particles into notable configurations for a time—oak, eagle, man—and then evaporating whence it came. This language is vague and figurative undoubtedly, but, I contend, appropriately so, for we have not yet a theory of life—we have not even a theory of the

essential nature of gravitation; discoveries are waiting to be made in this region, and it is absurd to suppose that we are already in possession of all the data. We can wait; but meanwhile we need not pretend that because we do not understand it, therefore life is an impotent nonentity. I suggest that the philosophic attitude is to observe and recognise its effects, both what it can and what it cannot achieve, and realise that our theory of it is at present extremely partial and incomplete.

Summary.

The chief contentions are:—

(1) That the fundamental laws of physics, complete and accurate as they are, in no way exclude guidance of events by the agency of life or mind or other unknown influence.

(2) That common experience shows that living creatures do exert such guidance, and further, that they are amenable to non-material or spiritual influences from each other.

The dualistic form of this language is a necessity of expression, and inevitable for practical purposes; it is not intended to imply any ultimate or philosophic dualism. The writer finds himself unable, with his present knowledge, to use language appropriate to unification, which he regards as an aim rather than as an achievement.

OLIVER J. LODGE.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

AT a meeting of the Senate of Dublin University on April 18, the degree of doctor in science was conferred *honoris causa* on Sir William Abney, K.C.B.

AT the graduation ceremony of the University of Glasgow on Tuesday, the honorary degree of LL.D. was conferred *in absentia* on Sir William Gairdner, emeritus professor of medicine in the University; and the same degree was received by Sir Norman Lockyer, K.C.B.; Dr. Thomas Oliver, professor of physiology in the University of Durham; and Mr. Philip Watts, Director of Naval Construction at the Admiralty.

AT a meeting of the governors of the North Wales University College, held on April 15, it was announced that subscriptions amounting to more than 15,000*l.* towards providing additional buildings had been promised, among the subscribers being the King and the Prince of Wales. It was also stated that the Drapers' Company had offered 600*l.*, payable in three annual instalments, towards the maintenance of an electrical engineering department.

THE Technical Education Board of the London County Council is offering for competition five senior county scholarships, together with several senior exhibitions. The scholarships are of the value of 90*l.* a year, and are tenable, in ordinary circumstances, for three years at universities, university colleges, or technical institutes, whether at home or abroad. They are confined to persons who are resident within the administrative county of London, and whose parents are in receipt of an income of not more than 400*l.* a year from all sources. The scholarships are open to candidates under twenty-two years of age on June 1, preference being given to candidates who are under nineteen years of age. No examination is held for these scholarships and exhibitions, which are awarded on consideration of the past record and future promise of the candidates. Candidates who desire to apply for the scholarships and exhibitions can obtain application forms from the secretary of the Technical Education Board, 116 St. Martin's Lane, W.C. These forms must be returned not later than Monday, May 11.

FOLLOWING the suggestion of the executive committee of the Nature-Study Exhibition Association, contained in their official report, that the work of the Association would in future be carried out more satisfactorily by local organisations, certain delegated members of the Middlesex Field Club and of the Selborne Society are arranging to hold this year in London a Home Counties Nature-Study Exhibition. Lord Avebury is the chairman of the committee, and already the list of patrons is very representative. The honorary secretary, Mr. W. M. Webb, will be glad to receive at 20 Hanover Square, W., donations towards the expenses of the exhibition.

THE governing body of the Royal Agricultural College, Cirencester, has decided, in consequence of the recommendation of the recent report on British forestry, to remodel and largely develop the teaching of forestry at the college in connection with the estate management branch of the curriculum. It has been resolved to create a new chair, to be entitled the chair of estate management and forestry, and to appoint thereto a special professor or lecturer who shall be required to devote all his time to the duties of the chair, and who shall have had good experience, not only of the management of woods in this country, but also of the continental system of sylviculture followed in the State and Communal forests of France and Germany.

THE Berlin correspondent of the *Times* states that on October 1 the courses of instruction are to be begun at the new military technical college which is to be established in Berlin. Not more than fifty officers, who must be of such an age that they will not attain the rank of captain while seconded for these instructional courses, will, in the first instance, be summoned to the capital. They will have to show a sufficient knowledge of mathematics and physics, and must produce proofs of their general military efficiency. The full course will last three years, but officers will have to satisfy the authorities at the end of each year that it is desirable that they should continue their studies. In connection with the military subjects of the courses of instruction, lectures will be given on mathematics, physics, mechanics, electricity, chemistry, metallurgy, and surveying.

THE Senate of the University of London has approved the following scheme of courses in advanced botany, extending over the years 1903–6, drawn up by the Board of Studies in Botany. The general idea is that each course should deal with a definite branch of botanical knowledge or with the more general aspects of the science, and should extend to about ten lectures:—1903–1904—The plant in relation to the soil, Mr. A. D. Hall; the Lycopsida, Dr. D. H. Scott, F.R.S.; the metabolic processes of plants, Prof. J. Reynolds Green, F.R.S. 1904–1905—Botany and its present problems, Sir William Thiselton-Dyer, F.R.S.; the Ascomycetes, with especial reference to the typical fructifications, Mr. V. H. Blackman; respiration, Prof. J. B. Farmer, F.R.S.; the Tubifloræ, Dr. A. B. Rendle. 1905–1906—Gymnosperms, Prof. F. W. Oliver; the British flora in its ecological relations, Mr. A. G. Tansley; Bryophytes, Prof. J. B. Farmer, F.R.S.

REPRESENTATIVES from the principal universities and colleges of New York State recently met at Columbia University to determine the basis upon which the award of the two Rhodes scholarships for New York State should be made. It was decided, says *Science*, to entrust the administration and award of the scholarships to a committee of three, to be elected by the heads of the colleges for men. The committee will consist of President Butler, President Schurman, and Chancellor Day. The conference decided that the conditions regulating the award shall be as follows:—The candidates for the scholarships to be eligible shall have satisfactorily completed the work of at least two years in some college of liberal arts and sciences in the State. Except in extraordinary circumstances, the upper age limit shall be twenty-four years at the time of entering upon the scholarship at Oxford. To be eligible, the candidate shall be a citizen of the United States and unmarried.

SCIENTIFIC SERIAL.

Journal of Botany, April.—Two brief notes by Mr. G. West and Mr. J. Cryer refer to a Polygala identified as *amarella*, Crantz, which was collected on the Great Scar Limestone near Grassington.—For the East Riding of Yorkshire Mr. W. Ingham publishes a list of mosses and hepatics.—A new fossil fungus, a species of Cercosporites, is described and figured by Mr. E. S. Salmon. It was obtained from the "disodile" beds in Sicily.—Mr. S. Moore, in the identification of some plants, chiefly Compositæ, from the Transvaal, Griqualand West and British East Africa, has found several new species, for which descriptions are given.—Mr. E. S. Linton supplies a list of "Kent Rubi," and Mr. W. G. Smith has a note on a new species of Collybia.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society.—"A New Form of Self-restoring Coherer." By Sir Oliver **Lodge**, F.R.S. Communicated verbally March 12, received in manuscript March 18.

The essential part of the receiving instrument now always employed in the system of Hertzian telegraphy, which Dr. Muirhead and the author had brought out and always now employed, and which their assistant, Mr. E. E. Robinson, had helped to work out, might be described as a development of the mercury form of coherer described some years ago by Lord Rayleigh, and again in a modified fashion by Mr. Rollo Appleyard. In Lord Rayleigh's form this consisted of a pool of mercury cut across with a paraffined knife, and the two half pools connected to a battery and key. As soon as the key was depressed so as to throw a few volts on to the intervening film of oil, the electrostatic pressure seemed to squeeze the oil out, and the pools of mercury became one. The pressure exerted by a few volts on a film of barely soap-bubble thickness is very considerable, and comparable to a ton per square inch.

Needle points dipping in oil and mercury were tried as practical coherers, the points being pulled out electromagnetically every time a signal arrived. Rotating forms of contact for automatic decoherence were also tried in various forms, and ultimately the method took the form of a rotating sharp-edged steel wheel, about half an inch in diameter, constantly touching a pool or column of mercury on which was a thin layer of oil. No effective contact occurs between the wheel and the mercury, notwithstanding the immersion, because of the film of oil; but the slightest difference of potential applied to the two, even less than one volt, is sufficient to break the film down and complete a circuit, which, however, the rotation of the wheel instantaneously breaks again. A spark is so sudden that for its purposes the wheel is for the instant virtually stationary, and yet the decohesion is so rapid that signals can be received in very rapid succession. The definiteness of the surfaces and of the intervening layer make the instrument remarkably trustworthy, and the thinness of the insulating film makes it very sensitive. In fact a single cell of a battery cannot be employed as a detector, because it is of too high a voltage for the film to stand. A fraction of a volt is employed, by a potentiometer device—usually something like one-tenth of a volt—and it is adjusted to suit circumstances. The battery acts through the coherer direct on a low resistance recorder, and the record on the strip shows every character of the arriving pulses, and exhibits any defect in the signalling. Provided that every joint and contact, except the one intended to be filmed, is thoroughly good, the coherer in this form is so definite and satisfactory that it becomes safe to say that the only outstanding defects are those which occur at the sending end. The signals are picked up and recorded precisely as they are emitted, as has been tested by intercalating a siphon recorder in a much diluted tapping circuit at the sending end, so as to get a record with which to make comparison. The traces obtained at the two ends are identical to a surprising degree.

The mercury level has an adjustment which is easily made. One precaution is to keep the rim of the wheel clear of dust, which is done by a cork or leather pad pressed lightly against it by a spring.

The instrument is not at all sensitive to tremor, and requires no particular delicacy of adjustment. The wheel has to be positive, the mercury negative.

A telephone in circuit, through a transformer or otherwise, affords an easy method of occasionally discriminating the signals by ear. The speed of the wheel gives another convenient adjustment to suit various circumstances.

A simple laboratory form of the instrument, driven by a thread from Morse clockwork, can be placed in circuit with a simple form of potentiometer and a siphon recorder, and used for Hertz-wave investigation purposes. It is connected with the collecting areas through a transformer, the coils of the recorder being in that case shunted by means of a condenser, so as to allow the full effect of the impulse to be felt at the film without having to overcome anything of the nature of a choke coil or other obstruction, in cases where sensitiveness is desirable.

Royal Astronomical Society, April 8.—Prof. H. H. Turner, president, in the chair.—Prof. **Sampson** gave an account of the Almucantar erected under his supervision at the Durham Observatory, and described the instrumental errors, and methods of adjustment of the instrument, and the observations made with it during 1902.—The **Astronomer Royal** exhibited photographs of the recent sunspots, and curves showing the terrestrial magnetic disturbances which had accompanied the outbreak of solar activity. In the course of the discussion Prof. Turner showed a photograph of solar faculæ, &c., taken by Prof. G. E. Hale with the spectroheliograph at the Yerkes Observatory.—Mr. F. A. **Bellamy** read a paper on the new star in Gemini found by Prof. Turner from an examination of astrographic plates taken at the Oxford University Observatory. There was no trace of the star on plates taken February 21 and 28, but on March 16 it appeared as of the seventh magnitude. Prof. Pickering had since examined the plates taken at Harvard Observatory, and found an image of the star on a photograph of March 6, though there was no trace of it on earlier plates. On March 6 the Nova was of the fifth magnitude· it had therefore considerably diminished in brightness when found at Oxford, and appeared to be still slowly becoming fainter. The spectrum showed many bright lines.—Father **Goetz** gave an account of observations proposed to be made at a new observatory to be established in Bulawayo, Rhodesia, and of which he was about to take charge.—Prof. Michie **Smith** described the new observatory at Kodaikánal, in southern India, illustrated by photographs of the observatory and its surroundings, and gave a brief account of the observations being made there.

Entomological Society, April 1.—Prof. E. B. Poulton, F.R.S., president, in the chair.—Mr. M. **Jacoby** exhibited specimens of *Rhagiosoma madagascariensis*, Heyd., from Madagascar, and *Carpophagus Banksiae*, McLeay, and *Mecynodera coxalgica*, Boisd., from Australia. In appearance they presented many characteristics not usually associated with Phytophagous Coleoptera.—Mr. C. P. **Pickett** exhibited specimens of *Dilina tiliae* bred from Essex pupæ, showing the effects of forcing.—Mr. W. J. **Lucas** exhibited lantern slides of the specimen of *Hemianax ephippiger*, and of the Orthetrum species attacked by an Asilid fly, shown by Mr. R. McLachlan at the last meeting.—Dr. T. A. **Chapman** read contributions to the life-history of *Orina* (*Chrysochloa*) *tristis*, var. *smaragdina*.—Mr. F. **Enock** read a paper, illustrated with lantern slides, on the life-history of *Cicindela campestris*.—Sir George **Hampson** read a paper on *Apoprogonia hesperioides*, a remarkable new lepidopterous insect from Zululand. He said that the genus must be referred to the Euschemonidæ, which is represented by the single species *Euschemon rafflesiae*, Westw., from Australia. In what quarter of the globe the family originated it was impossible to say, but the appearance of the species in question suggested that it was a survival of the scattered remnant of the Antarctic fauna. It was, however, most remarkable that the genus should occur in Africa and Australia alone.

Royal Meteorological Society, April 15.—Captain D. Wilson-Barker, president, in the chair.—Mr. F. J. **Brodie** read a paper on the prevalence of gales on the coasts of the British Islands during the thirty years 1871–1900, being a continuation of a paper on the same subject which he communicated to the Society last year. The total number of gales dealt with during this period was 1455, the yearly average being 48·5, of which 10·6 were severe. The present paper deals with (1) the number of gales experienced on the west, north, south, and east coasts respectively, (2) the prevalence of gales at different times in the year, and (3) the mean direction from which gales blow on various parts of our coasts.—A paper on the duration of rainfall, by Mr. J. **Baxendell**, was read by the secretary. In this paper the author refers to various patterns of self-recording rain-gauges, and points out the defects inherent to them, and also states that it is hardly possible to determine from them the rate at which rain falls, especially in very small quantities. From a Halliwell's self-recording rain-gauge which had been in operation at Southport during 1902, the total duration of rainfall for the year was 640·1 hours. The author showed that the hourly duration values give a

striking curve of diurnal variation, the early morning maximum being most pronounced; the afternoon one is also present, but is much less protracted and of far less amplitude than the former. Minima occur about mid-day and in the evening. The author concluded by giving an account of Halliwell's float pattern self-recording rain-gauge.

Mathematical Society, April 16.—Dr. E. W. Hobson, vice-president, in the chair.—Mr. C. S. **Jackson** exhibited the logo-logarithmic slide-rule constructed from a design prepared by Colonel Dunlop and himself, and gave an account of the history of the invention. In principle it goes back to the early part of the nineteenth century.—The following papers were communicated:—Prof. A. **Lodge**, Relations between points (in a plane) having conjugate complex coordinates. This is an addition to a paper read at the meeting in January, 1903.—Prof. A. E. H. **Love**, Note on exact solutions of the problem of the bending of an elastic plate under pressure. The method given by Michell in *Proceedings*, vol. xxxi., yields exact solutions of the problem, which can be determined completely when the plate is bent by uniform pressure applied to one face, or by pressure varying uniformly over the face, and the (clamped) edges are circular or elliptic. For any form of clamped edge the deflexions produced by such pressures are determined by the same differential equations and boundary conditions as arise in the ordinary approximative theory. The principles on which the ordinary theory is founded are true to a certain order of approximation only. The small corrections which must be made do not affect much the calculation of the strength of the plate to resist bending, but they account rationally for the existence of the shearing stresses and of the tension (analogous to that of a membrane) by which the pressure is balanced. Under uniform pressure the median plane of the plate is unstrained, but under varying pressure this surface undergoes a small extension.—Mr. E. T. **Whittaker**, On those functions which are defined by definite integrals with not more than two singularities. Among the functions included in this class are the Bessel functions, the error-function, the logarithm-integral, the cosine-integral. A definite integral containing two numerical parameters is discussed, and it is shown how, by specialisation of the parameters, the above-mentioned functions and many others can be obtained. The functions defined by the definite integral satisfy a linear differential equation of the second order which is a generalisation of Bessel's equation; they possess asymptotic expansions, and are connected by recurrence-formulæ and integral-formulæ analogous to those which hold in the case of Bessel functions. Attention is drawn to new functions included in the class defined by the general definite integral.—Mr. H. **MacColl**, On the validity of certain formulæ. The paper contains a criticism of certain formulæ in the algebra of logic.—Mr. A. **Young**, On covariant types.—Mr. R. F. **Gwyther**, On the deduction of Schlömilch's series from a Fourier series, and its development into a definite integral. The paper presents a demonstration of the connection of Schlömilch's expansion of an arbitrary function in a series of Bessel functions of order zero with Fourier's expansion of the same function in terms of cosines. Both expansions can be represented by the same surface integral, and the one is transformed into the other by change of the variables in the double integral.—Messrs. H. W. **Richmond** and T. **Stuart**, The inflexion-conic of a trinodal quartic curve. It is known that the six points of inflexion of a trinodal quartic curve lie on a conic. The paper contains two simple proofs of this theorem, and the equation of the conic is obtained explicitly in various systems of coordinates.

EDINBURGH.

Royal Society, February 16.—Lord M'Laren in the chair.—Dr. J. **Beard** communicated a paper on the embryology of tumours, in which, after a critical examination of the theories which had been brought forward, he gave a detailed description of his own views. The continuity of germ cells from generation to generation was now becoming generally accepted among embryologists. The fertilised egg did not, however, give rise directly to an embryo, but rather to a set of germ cells, every one of which had the power, with appropriate environment, of developing into an embryo. The number of germ cells in a particular species was always some power of two; for example, eight in the frog, thirty-two in the lamprey, 128 in the dog-fish, &c. Of these one went to form the embryo, and the remainder migrated or wandered about in the embryonic body to furnish the foundation of the reproductive products. A certain percentage would get hopelessly wandered, and never find their way to the normal position. It was in these aberrant or "lost" germ cells that Dr. Beard found the origin of tumours. In short, a tumour was a more or less reduced, more or less incompletely differentiated sterile Metazoan organism. It started by the abnormal development of a vagrant germ cell, and growing under conditions unfavourable to the complete and normal differentiation of all its parts, it unfolded and developed those things for the growth of which the nidus was suitable, the rest degenerating. Exactly as identical twins were the offspring of two sister or brother germ cells identical in ancestry from the same primitive germ cell, so any animal and a tumour within it stood in the same relation of ancestry from one primitive germ cell.—Sir John **Murray** communicated some preliminary observations on seiches in certain Scottish lochs, and exhibited a seichometer with which he hoped in the coming season to get a more definite and precise record of these oscillations.—Prof. **Chrystal** then gave an account of the theory of seiches, touching on the work that had been done by the Swiss and American investigators, and developing the mathematical theory in a form convenient for application. The theory was illustrated by a series of experiments in a rectangular trough, carried out with great skill by Mr. E. Maclagan Wedderburn, the characters of the uninodal and binodal seiches and the influence of a shelving bottom being well brought out.—A short paper was presented by Prof. **Anglin** on the equation of a pair of tangents to a conic.

DUBLIN.

Royal Dublin Society, March 17.—Mr. Samuel Geoghegan in the chair.—On the petrological examination of paving sets, by Prof. J. **Joly**, F.R.S. By examination of the worn surfaces of many different sorts of paving sets, in conjunction with petrological examination of the rock, it is found possible to connect the qualities of the set with the nature and relative amounts of the mineral constituents present in the rock. The petrological examination of the rock now becomes a very sure guide in the examination of an untried set; its degree of durability and roughness under wear can be foretold with a high degree of certainty.—Mr. William **Tatlow** exhibited and described an aluminium rectifier for alternating electric currents, and a three-phase rotary converter.

PARIS.

Academy of Sciences, April 14.—M. Albert Gaudry in the chair.—On certain algebraic surfaces for which the integrals of the total differentials reduce to algebraical logarithmic combinations, by M. Émile **Picard**.—On the discussion and integration of differential equations of the second order with constant coefficients, by M. E. **Vallier**.—The catalytic decomposition of alcohols by finely divided metals; primary alcohols, by MM. Paul **Sabatier** and J. B. **Senderens**. The reactions previously described for ethyl alcohol have been extended to higher alcohols of the same class, and it has been found that, with reduced copper between certain limits of temperature, the alcohol is split up into the corresponding aldehyde and hydrogen, without any secondary reactions of importance. With reduced nickel the reaction is more violent, the aldehyde formed being further acted upon.—The sounds emitted by sand in motion, by M. **Lortet**.—On the projection of matter round the electric spark, by M. Jules **Semenov**. From the experiments described it would appear that gases and vapours, traversed by a spark, are thrown out by it in all directions, as a consequence of the sudden elevation of temperature. The direction of the current does not appear to have any effect upon the sense of this projection.—The action of radio-active bodies on the electric conductivity of selenium, by M. Edmund von **Aubel**. The radio-active bodies examined acted upon selenium in a manner resembling light or the Röntgen rays, but the effect is produced much more slowly.—On the electric and magnetic dichroïsm of liquids, by

M. Georges **Meslin.**—An experimental contribution to the physiology of death, by MM. N. **Vaschide** and Cl. **Vurpas.**—On the principal alimentary Leguminosæ of the French colonies, by M. **Balland.**

ST. LOUIS.

Academy of Science, April 6.—Prof. F. E. Nipher reported that he had apparently succeeded in producing a distortion of a magnetic field by means of explosions. The apparatus used was a transformer consisting of concentric coils wound upon brass tubes. The outer tube was five inches in diameter and six feet long, wound with more than four thousand windings of No. 16 wire. This coil was traversed by a continuous current from a storage battery. Within this, and separated from it by an air-space of an inch, is a secondary coil of equal length, having more than twenty-five thousand windings of No. 25 wire. This coil is connected to a D'Arsonval galvanometer. Within the tube on which this coil is wound is a smaller brass tube within which a train of black gunpowder is laid. This tube is open at both ends, and has practically no recoil when the explosion is made. When hung by a bifilar suspension on cords ten feet in length, the recoil is about an inch. When the exciting current is small compared with the capacity of the battery, the galvanometer reading is very steady. When the train is exploded, a sudden and marked throw of the galvanometer results, which could be accounted for by an increase in the permeability of the long explosion chamber. The deflection reverses when the field is reversed. The hot gases liberated in the explosion are all diamagnetic, and tend to decrease the observed effect. In two cases the galvanometer deflection was in the opposite direction from that stated above, and this is being further inquired into. When seven tubes between the two coils are simultaneously exploded, only slight effects can be obtained, and these deflections are wavering, or to and fro, in character. A wire was threaded through the inner combustion tube, through which a current of three amperes was passed. This circuit was opened and closed with no visible effect. The galvanometer circuit is shielded by tin-foil, which is also connected with the explosion tube, and grounded. Sparks an inch long to the tin-foil produce no result. When the explosion tube is removed from the transformer, and taken near the galvanometer or the storage battery, no deflection is produced by the explosion. An explosive mixture of gases from water electrolysis under atmospheric pressure produces a much less violent explosion, and produces a correspondingly less effect. The scale reading of the galvanometer changes by more than twenty divisions with the heaviest explosions, and an exciting current of 0·6 ampere. With smaller explosions or feebler currents, the effect is diminished. No deflections can be produced by striking the table upon which the transformer rests, nor by striking the transformer itself, even when it moves slightly under the blow. The secondary and primary coils are held rigidly in fixed position with respect to each other. Arrangements have now been made to place the explosion tube in the focal line of a parabolic cylinder of metal, the galvanometer coil being in the focal line of a similar mirror. Either or both are to be surrounded by an exciting coil. This line of research was suggested by Young's account of his observation of five solar outbursts in 1872, which were each accompanied by sharp fluctuations in the magnetic tracings at Kew and Stonyhurst.

DIARY OF SOCIETIES.

THURSDAY, APRIL 23.

ROYAL INSTITUTION, at 5.—Hydrogen: Gaseous, Liquid and Solid: Prof. Dewar, F.R.S.

SOCIETY OF ARTS, at 4.30.—The Province of Sind: Dr. Herbert M. Birdwood.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Distribution Losses in Electric Supply Systems: A. D. Constable and E. Fawssett.—A Study of the Phenomenon of Resonance in Electric Circuits by the Aid of Oscillograms: M. B. Field. *And, if time permit.*—Divided Multiple Switchboards: An Efficient Telephone System for the World's Capitals: W. Aitken.

FRIDAY, APRIL 24.

ROYAL INSTITUTION, at 9. Some Recent Investigations on Electrical Conduction: The Hon. R. J. Strutt.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Bacterial Sewage-Disposal Works, at Ash, Dover: H. S. Watson.

PHYSICAL SOCIETY, at 5.—An Electrical Thermostat: H. Darwin.—Dimensional Analysis of Physical Quantities and the Correlation of Units: A. F. Ravenshear.—Note on the Dimensions of Physical Quantities: R. J. Sowter.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Address by the president, J. H. Wicksteed.—The Education of Engineers in America, Germany and Switzerland: Prof. W. E. Dalby.

MONDAY, APRIL 27.

SOCIETY OF ARTS, at 8.—Mechanical Road Carriages: W. Worby Beaumont.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Four Years' Arctic Exploration in the *Fram*: Captain Otto Sverdrup.

INSTITUTE OF ACTUARIES, at 5.—On the Valuation of Staff Pension Funds. Part II. Widows' and Children's Pensions: H. W. Manly; With Tables by H. Foot.

TUESDAY, APRIL 28.

ROYAL INSTITUTION, at 5.—The Blood and some of its Problems: Prof. Allan Macfadyen.

SOCIETY OF ARTS, at 7.30.—Visit to the Whitefriars' Glass Works.—Modern Table Glass: Harry Powell.

ANTHROPOLOGICAL INSTITUTE, at 8.15.—The Classification of the Materials of Anthropology: E. N. Fallaize.—Measurements of the Colonial Coronation Contingent: J. Gray.—Implements used by West Australian Natives in Manufacture of Glass Spear-Heads: H. Balfour.

WEDNESDAY, APRIL 29.

SOCIETY OF ARTS, at 8.—Automatic Wagon Couplings on British Railways: T. A. Brockelbank.

GEOLOGICAL SOCIETY, at 8.—The Age of the Swiss Alpine Lakes: Dr. C. S. DuRiche Preller.—On a Shelly Boulder-Clay in the so-called Palagonite-Formation of Iceland: Helgi Pjetursson.

THURSDAY, APRIL 30.

ROYAL SOCIETY, at 4.30.—Croonian Lecture: The Cosmical Function of the Green Plant: Prof. K. A. Timirjazev.

ROYAL INSTITUTION, at 5.—Hydrogen: Gaseous, Liquid and Solid: Prof. Dewar, F.R.S.

FRIDAY, MAY 1

ROYAL INSTITUTION, at 9.—Recent Advances in Stereochemistry: Prof. W. J. Pope.

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