Nature

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"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

THURSDAY, MAY 3, 1906.

RADIOBES AND BIOGEN.

The Origin of Life: Its Physical Basis and Definition. By John Butler Burke. Pp. xiv+350; with illustrations. (London: Chapman and Hall, Ltd., 1906.) Price 16*s.* net.

MR. J. B. BURKE describes, under the name of "radiobes," minute bodies which appeared in sterilised bouillon when small quantities of radium chloride or bromide were brought into contact therewith.

"A minute quantity of the salt contained in a small glass tube, one end of which was drawn out to a fine point, was introduced into an ordinary test-tube containing bouillon. The test-tube was plugged with cotton-wool in the usual way with such experiments, and then sterilised at a temperature of 130° C. for about thirty minutes at a time. On cooling, as soon as the liquid had coagulated, the fine end of the inner tube containing the radium was broken by means of a wire hook in a side tube. The salt was thus allowed to drop on the surface of the gelatin. After twenty-four hours signs of growth were already visible."

The radiobes had appeared! They were at first like diplococci, and varied considerably in size from mere specks as seen with a $\frac{1}{12}$-inch lens. There is a lack of precise measurements.

"The growth is from the minutest visible specks, which develop into two dots, then into a dumb-bell shaped appearance, later a biscuit-shape, and later still more like frog's spawn, through various stages, as in the figures, until a shape is reached different from its previous forms, when it divides and loses its individuality, and ultimately becomes resolved into minute crystals."

Some of them show a nucleated structure, which may exhibit subdivision "as in karyokinesis"; they are stainable; they are credited with "assimilation"; there is a "stoppage of growth at a certain stage of development"; there is a peculiar segmentation, like that in yeast-cells, said to be quite different from any cleavage due to surface tension; and, finally, there is a disintegration. The author speaks of them as intermediate between crystals and bacteria, and as possessing $n-1$ of the n properties of living bacilli.

The author is somewhat vacillating in his description of his "radiobes," but he does not regard them as living things in the ordinary sense. They "obviously lie altogether outside the beaten track of living things" (p. 109), but they may bridge over the apparently insuperable gap between the organic and inorganic world (p. 110).

"Forms we have obtained are analogous to living types and may be called artificial forms of life, but they are not the same as life as we know it to-day: they may help, however, to fill in some of the gaps between living and dead matter" (p. 187).

"These bodies are neither crystalline nor colloid in disguise, though colloids, as aggregates, but something more: and crystals in their constituent parts. The point which distinguishes them from both of these is perhaps the fundamental principle which marks them out at once as possessing the elements of vitality in a primitive and most undeveloped state" (p. 112).

The author started with proteid material, which we know to be an essential constituent of organisms, which has not as yet been artificially synthesised, and he brought into contact with this a stimulus provocative of molecular change, namely, a radium salt; he thus obtained radiobes, and the interesting point is whether these do in any way approximate in their behaviour to simple organisms. As we have not studied radiobes we can only judge from the evidence the author adduces, and it seems to us entirely inconclusive. We find no convincing evidence of assimilation, cyclic development, or reproduction in the ordinary sense of these terms; and we do not think the author succeeds in showing that radiobes are essentially different from the minute aggregates or mimic cells produced by many other experimenters. We cannot bring ourselves to believe that little bodies which are soluble in water will throw light on the nature or origin of living organisms. The evidence of anything approaching the behaviour of an organism

seems to us so flimsy that we cannot but wonder at such a paragraph as this :—

"The structure and composition of such artificial cells is sufficient to enable them to perform the functions of organic life, as distinct from such simpler forms of vitality which we at first supposed inorganic matter to possess. Thus they can assimilate, grow, pass into higher types, subdivide, multiply, and finally, having gone through the whole cyclic process, disintegrate and lose their structure in the course of time, being sensitive all the while to external stimulation, both electrical and chemical, in various degrees" (p. 133).

The explanation of the author's apparent oscillation between scientific caution and imaginative hope is to be found in the fact that he has re-defined the ordinary biological terms. Life, for instance, is

"the specialised mode of motion of a complex system of molecules in a dynamically unstable state, so that there is a continuous or continual change, or flux of its substance, between the individual aggregates of molecules and their surroundings" (p. 49).

"An organism has a structure, a nucleus, and an external boundary or cell-wall, and its vitality may be described as being a continuous process of adjustment between its internal and its external relations" (p. 102).

There is metabolism in the phenomena of flames, fluorescence, and phosphorescence—"a physical process which is not merely analogous to, but essentially of the same kind as, even if incomparably simpler than, organic metabolism" (p. 179). It is this re-editing of the biological dictionary that enables the author to write regarding his radiobes :—

"We can say perhaps that we are witnesses at last to the first beginnings of life in its higher sense; but though apparently a case of abiogenesis, to our mind it seems to be a case of biogenesis, from the view of matter which we take, of biogenesis indeed carried to its logical extreme."

We sympathise with the author's vigorous protest against the libel implied in the phrase "dead matter," but we do not think the apartness of vital sequences is diminished by giving a more elastic definition to "life" and "metabolism." As to the bearing of radiobes on the problem of the origin of living creatures upon the earth, we do not think that it amounts to much, not only because Mr. Burke started with proteid material (the natural synthesis of which it is at least difficult to imagine), but also because it seems to us too short and easy a disposal of problems simply to suppose that the coordination and regulation of organic metabolism, the power of effective response, and other insignia of living creatures are secondary acquisitions gradually wrought out in the course of selection. Our business is to try to make the hypothesis of primitive abiogenesis more plausible, and we can only do this by condescending to discuss the detailed difficulties in a concrete fashion.

Mr. Burke's method is different; he elaborates a new theory of vitality which seems to us quite in the air.

"For anything we know there is no such thing as really dead matter, and there may be in all matter a certain amount of energy stored up which would entitle it to be regarded as possessing a certain amount of potential life" (p. 186).

He postulates original units of life, bio-elements, biogens, or ultimate nuclei, possibly consisting of cyanogen (as suggested by Pflüger's well-known hypothesis), more probably of something with a larger store of energy—"an element possessing many of the chemical properties of carbon and the radio-active properties of the more unstable elements."

"Life-activity is a phenomenon of matter as much as radio-activity, although really of a more complex kind, and the manner in which the energy is stored up in the ultimate nucleus is probably pretty much the same. Such nuclei may have existed, like the chemical elements themselves, throughout the universe for an almost indefinite time. To account for their formation would be the same as to account for the formation of the elements" (p. 166).

They may have existed in the nebula which formed the earth or they may have been borne to the earth by meteors, as has been previously suggested.

"The formation of cellular life as we see it to-day was the result of the subsequent interaction of this radio- or bio-element with organic compounds," and of course there was an elimination of failures when nature was trying her prentice hand at organism-making. One of these failures Mr. Burke may have been on the track of when he made his radiobes. In ordinary cell-life the bio-element persists as the vital spark, the nucleus within the nucleus, the *n*th or ultimate nucleus, the real source of vital energy. It is also the hereditary substance, and it "may be all of us that survives when we have shuffled off this mortal coil."

The author tells us much more about biogens than about radiobes, soaring in a region where verification and contradiction are alike impossible. He supports his theory by arguments from analogy, mainly drawn from his studies on the "physical metabolism" seen in the phenomena of fluorescence and phosphorescence, and he shows that the theory is the natural outcome of his discovery of radiobes, to which the bouillon supplies the soil or constituents, but the radium the seed or vital spark. It is difficult for a biologist to follow the details of this physicist's theory of vitality, *e.g.* when we read of two kinds of biogens—the "characterless nebulous biogen" which corresponds to an ovum, and the concentrated biogen which corresponds to a spermatozoon. But Mr. Burke's general view may be indicated by quoting a few more sentences.

"Life is as much a phenomenon of matter as electricity is. More clearly, life and matter are merely different phenomena of electricity, matter being merely the fossilised state of biogen, and life of the phenomena which take place in biogen in that stage through which electronic aggregations have to pass before they are converted into the crystalline forms of electrons which we call the chemical atoms of matter" (p. 192).

If this is what the author calls "more clearly," his standard of lucidity must be very divergent from that of the mean of the biological race. Biogen is

"nothing more or less than *matter in the process of becoming.*"

"Biogen may be regarded as the intermediate state between free electricity and condensed electricity which we call matter—the hiatus between electricity as we know it and matter as we know it; the missing link that bears

'The heavy and the dreary weight
Of all this unintelligible world.'"

We cannot follow the author further with his new "Naturphilosophie," but it is interesting to point out that, although he says life-activity is a phenomenon of matter, he is far from being a materialist. For matter, he tells us, is really *mind-stuff*, and "atoms are nothing more than ideas." We have always suspected that this would turn out to be the case.

As an interesting book on a perennially interesting theme "The Origin of Life" will probably soon pass into a second edition, and we therefore note a few errata. "Wiesmann" (p. 56), "Debois" (p. 175), "Luduc" (p. 208), "nucleosus" (p. 136), "mytosis" (p. 137), are obvious misprints. We suppose that the "chlorophyll" referred to thrice on p. 135 is a misprint for chromatin, but the author seems confused in his picture of a typical cell. Mitosis is not "the multiplication of the chromosome"; the centrosome is not "the inner portions of the nucleus, or nucleolus"; and we cannot speak of "the karyokinesis of the centrosome." There are several such errors indicative of haste, and there is a disconcerting lack of correspondence between some of the figures and the references to them in the text.

The author is so enthusiastic over his radiobes and *n*th nuclei that we almost wish we could believe more in the importance of either of them. The former seem to us very far from possessing $n-1$ of the n properties of the simplest living creature we know; the latter seem to us ingenious fictions too remote from everyday physiology to have even suggestive value. But these are merely our opinions, and it may be that Mr. Burke will, by more precise observations and more restrained theorising, justify the views of those who have hailed him as a pioneer and a prophet.

J. A. T.

PRINCIPLES AND PRACTICE OF POTTERY. La Ceramique industrielle. Chimie-Technologie. By A. Granger. Pp. x+644. (Paris: Gauthier-Villars, 1905.) Price 7 francs.

THIS is an excellent example of the technological handbooks which the young Frenchman and German find ready to their hands when they proceed from school or college to take up industrial work, and which, in so many businesses, the young Englishman just as conspicuously lacks. At the present moment there is no English book on pottery manufacture, other than indifferent translations of a French and a German book, to which a student of the principles of pottery manufacture can turn, and these deal most accurately with processes unknown or unused in England.

The volume in question is, as is perhaps inevitable, stronger on the theoretical than on the practical side. The first nine chapters, comprising about half the book, give a clear and logical account of the physical and chemical properties of the materials used in the preparation of pottery paste and glazes of all descriptions, together with laboratory methods of chemical analysis and such methods as have been devised for testing the degree of fineness, plasticity, and tensile strength of the various natural clays and clay mixtures, as well as a theoretical discussion of the behaviour of complex mixtures of silicates (clays and glazes) when fired at varying temperatures up to their fusion point. All this is put forward with that clearness of expression and logical precision of arrangement that seem to come so naturally to the French teacher.

The feeling cannot be resisted that the author, with the very best intentions, has covered too much ground. It would seem as if he had attempted to describe every known process, apart from its merits or demerits, with the result that the student is overwhelmed with methods, and at the same time left without a clue as to the suitability of particular methods in special circumstances. In the section on silicate analysis, for example, the ordinary methods of treatment are given for silicates soluble in strong acids, and the methods of attack with carbonate of soda, lime, baryta, oxide of lead, boracic acid, and hydrofluoric acid for the insoluble silicates, yet not one of the processes is described in such detail as would enable the student to conduct an analysis, and the refinements and corrections introduced into the ordinary methods of silicate analysis by Hillebrand, without which it is impossible to guarantee one's results, are never mentioned. In the same way, in the sections dealing with the various methods used by potters for determining the temperature of their kilns, a long account is given of Wedgwood's pyrometer, Seger cones, and all the later forms of electrical pyrometers, including the Féry radiation pyrometer, but there is no adequate discussion of the relative value of these different methods in the actual working of a pottery, the observations on the employment of pyrometers (pp. 257–261) being simply a one-sided account of the merits and demerits of Seger cones.

The second half of the book contains a reasonably detailed account of the processes of manufacture, firing, glazing, and decoration of bricks, tiles, terra-cotta, refractory pottery, stoneware, earthenware, and porcelain. Again the method is excellent, but, of course, too much has been attempted, and it seems obvious that the student would have been better trained or assisted by a more complete treatment of one or two sections only. From the English point of view, the greatest failure of the book is the ignorance shown of actual English methods in those branches of pottery manufacture where this country is supreme. Thus the account given of the manufacture of English earthenware is not merely incomplete, but is full of misapprehensions—even of mistakes. The mixtures said to be used for English bodies and glazes are such as no first-rate potter would dream of using; the description

of our ovens and kilns is singularly incomplete, and the statement is made that, owing to the nature of the English earthenware bodies, the firing of on-glaze decorations in the continuous kiln has been a failure, when, as a matter of fact, many of these kilns are in successful operation. The treatment accorded to our English bone-china is just as incomplete.

The accounts of French and German processes are naturally much better, not only because the author is better acquainted with them, but no doubt because so much more has already been published about them.

The author had the excellent idea of adding to his volume a vocabulary of technical terms in German, English, and French, and tables showing the relative importance of the industry in various countries. Unfortunately, the idea has been very imperfectly executed. In the vocabulary many of the English terms are such as no potter would use, while some few of them are nonsense; and the figures given as to the extent of the industry in various countries are so incomplete and incomparable as to be positively misleading. On the whole, however, the book must be described as excellent for its purpose; and the English potter might well wish that he had such a book to put into the hands of the young men who are likely to occupy responsible positions on his works.

WILLIAM BURTON.

THE SOIL AND ITS TILLAGE.

Agriculture Générale. Le Sol et les Labours. By Paul Diffloth. Pp. xii+490. (Paris: J. B. Baillière et Fils, 1906.) Price 5 francs.

THIS is the first book of a new French agricultural encyclopædia, which is being published in forty volumes, under the direction of M. G. Wéry, assistant director of the Institut National Agronomique. It is written by Prof. Paul Diffloth. The aim of the encyclopædia is expressed in an introduction by Dr. Paul Regnard, successor to the late M. Eugène Risler as director of the institute. It is to extract from the present teaching of agricultural science all that is available for immediate application by the practical farmer, making him acquainted at the same time with the scientific facts upon which actual practice is based.

Dr. Regnard pays a compliment to English agriculturists by stating that they have never accepted the notion which he attributes to his own countrymen that agricultural science is antagonistic to practical experience. We fear the compliment is not altogether deserved, and that French and English farmers have much in common in this respect; yet the remarkable progress in the direction of higher agricultural education during the past ten years in this country may be regarded as both cause and effect of the gradual disappearance of the idea that the practice of agriculture can derive no advantage from the labours and teachings of science.

With the love of logical analysis which characterises French scientific literature, M. Diffloth's work is divided and subdivided almost *ad infinitum*. An idea of its completeness may be gathered from a summary of these divisions. The book comprises two main branches, viz. "Agrologie" and "The Preparation of the Soil," the former being defined as the study of land in relation to agriculture and of the relationship which subsists between the nature of a soil and its produce. The first branch treats of the soil, the subsoil, their physical and chemical properties; water in relation to fertility, its distribution, rainfall, permeability, impermeability, water levels, wells, watercourses, &c.; the analysis of soils by processes physical, mechanical, geological, chemical, &c.; the relations of the soil with the plant, comprising the subjects of nitrification, denitrification, humus, fertility, and the nature of the soil suited to different plants. The second branch of the book, "The Preparation of the Soil," treats of cultivation, the clearing of land, peaty and brackish soils, and the improvement of soils by warping, tree planting, levelling, removal of rocks, stones; tillage operations, including digging, drainage, and the various systems of ploughing; semi-tillage, so called, consisting of scarifying, cultivating (in its technical sense), extirpation of weeds, &c.; harrowing, rolling; and, lastly, of manures and artificial fertilisers.

We do not remember ever before to have read any precise definition of what agriculture is. The author defines it as the art of obtaining from the soil the maximum of substances useful to man at the minimum cost. We do not quarrel with such a definition, though it represents the ideal rather than the actual.

Full justice is done to the part played by the soil in the sustenance of plants, and in particular to the nitrogen problem, which has been the subject of so much scientific investigation and discussion during the past twenty years. The author indicates briefly the discoveries made by de Saussure, Dumas, Boussingault, and others as to the action of carbonic acid of the air and of nitrogen in the soil in the nourishment of plants; the work of mineral salts as demonstrated by Berthier, Sprengel, and Liebig; the experiments of Schlœsing and Müntz showing the action of ferments in transforming organic nitrogen into nitric acid and of micro-organisms in nitrification; and, lastly, the experiments of Hellriegel and Wilfarth revealing the existence of bacteria in the nodules found on the roots of leguminous plants and the absorption by their agency of nitrogen from the free and unlimited supplies present in the air.

M. Diffloth refers to the great developments in France and other Continental countries of the principle of agricultural cooperation. Its successful application to Ireland is well known, and in Great Britain, too, it is now making some headway. The future of agriculture, writes the author, may be summed up in two words as living symbols of its progress and prosperity, "Science et Association." We agree that if "Practice with Science" have been the agricultural watchwords of the nineteenth century signs are not wanting that "Science with Cooperation" may be those of the twentieth.

The practical operations of French husbandry are carefully described, with their scientific significance;

but as they differ in many respects from the English, the chief interest of the book for English readers of French agricultural literature will lie in its admirable exposition of the scientific principles underlying practice. The book is well illustrated on the whole, but in some cases the photographic reproductions can hardly be regarded as truly illustrative. Otherwise we have nothing but admiration for the manner in which Prof. Diffloth in this first volume has given effect to the aim of the new French agricultural encyclopædia.

INORGANIC CHEMISTRY FOR STUDENTS.

Outlines of Inorganic Chemistry. By Frank Austin Gooch and Claude Frederic Walker. Pp. xxiv+514. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1905.) Price 7*s.* 6*d.* net.

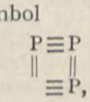
THE authors say in the preface that their aim is "to introduce the student to chemistry by consideration of the simplest and fewest things." Their intention is laudable enough, but it may be questioned whether their plan of entering into a long discussion of "the consecutive development of the principles upon which systematic chemistry rests," before taking up the descriptive part of the subject, is one which can be commended.

The first 233 pages of the book are entirely devoted to theoretical matters, and a wide range of subjects is included. Beginning with an exposition of the outward characteristics and quantitative laws of chemical combination, the authors pass on to discuss balanced actions, chemical equilibrium, and the phase rule. Then follows a short chapter on specific heats and thermochemistry, after which the student is "introduced" to atoms, molecules, ions, and electrons. Finally an attempt is made to teach him something about the kinetic theory of gases, the properties of solutions, the theory of valency, constitutional formulæ, physical isomerism, and stereochemical relationships. Whatever fault the reader may have to find with the mode of presentment in this part of the book, he will have no reason to complain of lack of variety. The authors have attempted too much, and have sacrificed clearness to the exigencies of space. The beginner will, we fear, be confused, and the more advanced student will find the treatment of the subject inadequate and superficial.

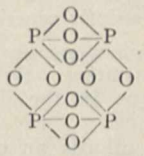
Without attempting any detailed criticism of these theoretical chapters, which would indeed serve no useful purpose, we may give one or two examples of what we think an unsatisfactory way of presenting ideas to the beginner. In speaking of chemical changes, the authors make use of the term "*factor*" to denote "substances which enter into reactions"; thus we read of "the change of the factor mercuric oxide into the elementary products mercury and oxygen by heat," and so on. Nor do we think their invention of the clumsy expression "*mass-unit weight*" of an element will at all help the student to grasp the idea of "*atomic weight.*" The beginner will probably be at a loss to understand why the compound NO is called "nitrogen dioxide," whilst CO is called "carbon monoxide."

The descriptive part of the book (493 pages), which is arranged in accordance with the periodic system, calls for little comment. Much valuable space is wasted on elaborate constitutional formulæ, the majority of which are advanced without the slightest attempt at proof or criticism. When, however, the authors do discuss such matters they are not always convincing, as the following example will show:—

"The possible constitution of phosphorus pentoxide may be made a matter of discussion. If we assign to phosphorus the symbol



suggested by the specific gravity of phosphorus in vapour condition, we might conceive phosphorus pentoxide, formed by the complete oxidation of phosphorus, to have a similar constitution.



Of the molecular weight of phosphorus in solid condition, or of phosphorus pentoxide, we have no knowledge, so we find it convenient to represent both substances by the simplest possible equivalent symbols, P and P_2O_5."

We thought that the once prevalent idea of the preferential combustion of hydrogen in hydrocarbon flames had long since been discarded; the authors however, still believe in it, for in discussing the luminosity of the acetylene flame they tell us that the gas "burns from an ordinary gas jet with a flame which is luminous, but very sooty from finely divided free carbon, the hydrogen burning first

$$2C_2H_2+O_2=2C_2+2H_2O."$$

In short, we find much in this book which would deter us from recommending it as a clear and trustworthy exposition of chemical facts and theories.

W. A. B.

OUR BOOK SHELF.

Collodion Emulsion. By Henry Oscar Klein. Pp. 95. (London: Penrose and Co., 1905.) Price 5*s.* net.

THE advent of gelatin plates has almost driven collodion out of the photographic world. The wet collodion process has all along retained its position in some kinds of photo-mechanical work, but collodion emulsions seemed to have no place left for them until a few years ago their advantages for certain technical purposes were insisted on, and the publishers and author of this volume did a good deal towards reintroducing them into this country on a commercial basis. As collodion emulsion can now be purchased the author has very little to say about the preparation of it; he only quotes two or three formulæ from other workers. The volume must be regarded as a guide to the practical user of commercial emulsions. Their applications in the making of ferrotypes, lantern slides, opals, and transparencies, and for photograph-

ing on wood are concisely described; but the principal part of the work, and by far the most important, deals with the colour sensitising of emulsions, and the applications of such sensitised emulsions to the production of negatives in the many methods of dealing with and reproducing colour that are now in vogue.

The applications of the newer sensitisers are described in many scattered communications, and often with very little discrimination between the practically useful and the merely theoretically interesting. Mr. Klein states that he has included only those that have passed the test of time and been found to be thoroughly practical. It is in this that the value of the work lies, and we think that it would have been better to have restricted the volume to this aspect of the subject. The occasional references to the underlying scientific facts will not help the practical man, nor would they if they were free from the errors that now disfigure them. A volume of practical instructions is not the place for a page or two of chemical equations or the expression of theoretical views that have often been called in question. However, these occupy but little space, and scarcely interfere with the use of the book as a strictly practical manual.

Der Gegensatz zwischen geographischer und nicht-geographischer Variation. By Karl Jordan. Pp. 59; with 73 figures in the Text. (Leipzig: W. Engelmann, 1905.)

THE present treatise affords an excellent example of the light that may be thrown on questions of biological interest by the scientific use of entomological data. Dr. Jordan here presents a valuable *résumé* of some of the most important results of the elaborate investigation of the chitinous sex-organs of insects, more particularly the Papilios and Sphingidæ, carried on by him for many years past at the zoological museum at Tring. These researches, the detailed results of which have already appeared in the pages of "Novitates Zoologicæ," are of high interest, not only to entomologists, but also to all students of the methods of evolution.

It must, however, be confessed that the author's interpretations are less acceptable than his facts. Starting from the position that "species" have a real objective existence, he endeavours to show that new species could only have arisen from geographically isolated variations, not from variations occurring side by side with the parent form. The main fact on which he relies is that while "individual" or "seasonal" variation of forms inhabiting the same locality is never accompanied by a variation in the sex-organs (with the single known exception of *Papilio xuthus*), the diverse geographical forms of a species are in very many cases found to be distinct from one another in sex-organs as well as in aspect. There is thus a correlation in the latter case which does not exist in the former, and which seems to the author to warrant the conclusion that these geographical forms only can occupy the position of incipient species. Some of the obvious objections to this view are dealt with by Dr. Jordan, others are left unnoticed.

A slight inaccuracy occurs on p. 177, where a figure of *Byblia goetzius* is said to represent *B. ilithyia*, while the true *B. ilithyia* bears the legend *B. anvatara*; both mistakes being repeated in the text. A more serious matter is the absence of any detailed reference to Mr. G. A. K. Marshall's work on this genus and his remarkable discoveries in the genus Precis. Some special recognition of these should have found a place, even in a treatise of general nature like the present. It will be gathered from what has been said that Dr. Jordan's conclusions are open to criticism. There can, however, be no doubt as to the value of the researches so ably carried on by himself and others in connection with the ample material of Mr. Rothschild's museum at Tring.

F. A. D.

Butter-making on the Farm and at the Creamery. By C. W. Walker-Tisdale and T. R. Robinson. Sixth edition, revised and enlarged. Pp. 162. (London: Office of the *Dairy World*, 1906.) Price 2*s.* 6*d.* net.

WE import into the United Kingdom perhaps twice as much butter as we make, and pay twenty millions yearly for it. Some, at least, of these millions would have been saved to the agricultural industry if our farmers and dairymen had given as much intelligent study to the principles of butter-making as, for instance, the Danes have done. Unfortunately, however, in such matters as the use of centrifugal cream-separators, the employment of pure bacterial cultures for "starters," and the general organisation of the industry, we did not lead the way; we were content to follow, and that, too, with somewhat halting footsteps. Even now the small butter-maker is often a sad empiricist. If cleanliness, for example, is an article of faith with him—and frequently it is not—he holds it as a dogma, not as reasoned knowledge.

The little book under notice may help in the recovery of some of those lost millions. It gives an outline of approved present-day practice in butter-making, though it does not purport to offer much in the way of theoretical explanation and discussion. Mainly it is an account of how best to conduct the operations of a small modern dairy. It is practical and simple; well suited for the elementary dairy-student, for the farmer's son who wishes to know something more than mere rule-of-thumb work, and for the private maker who supplies his own household from his own cows. The first few pages deal with the design, construction, and equipment of the dairy. Then cream is considered, and its separation and "ripening" are described, after which we pass to the churning and subsequent operations. A number of simple arithmetical examples are worked out to illustrate various points that arise. The last thirty pages deal, briefly and in a more technical manner, with the operations of a fully-equipped creamery, including "pasteurisation" and refrigerating.

The book does not profess to be much more than a useful note-book and practical guide, but as far as it goes it is excellent.

C. SIMMONDS.

The Deinhardt-Schlomann Series of Technical Dictionaries in Six Languages: English, German, French, Italian, Spanish, Russian. By Kurt Deinhardt and Alfred Schlomann. Vol. i. The Machine-Elements and Tools for Working in Metal and Wood. Together with an Appendix, edited by P. Stülpnagel. Pp. 403; 823 illustrations. (London: Archibald Constable and Co., Ltd., 1906.) Price 5*s.* net.

THIS volume is the first of a series intended to aid engineers and others in reading technical works in any of the principal modern languages. Terms of general importance only are included; they are classified into subjects and many are accompanied by an explanatory sketch. Formulæ and symbols, serving as they do the purpose of an international language, are introduced wherever possible. The translations have been tested in workshops and offices in the various countries represented; so the work ought to prove of service in reading technical literature. The convenient pocket size of the dictionary, the systematic arrangement of its matter, and the full alphabetical index of words in each of the six languages should gain for it a sphere of usefulness among technical students.

LETTERS TO THE EDITOR

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

Osmotic Pressure.

THE publication of a paper by Mr. Spens in vol. lxxvii. Proc. Roy. Soc., p. 234, in which he criticises a relation between the vapour and osmotic pressures of a solution which Mr. Hartley and I had deduced (see same volume), seems to be an opportune moment for directing the attention of physical chemists to the necessity for an agreement as to what is meant by the term osmotic pressure.

Mr. Spens, following Duhem, points out that the osmotic pressure, defined as the difference between the pressure on the solvent and the pressure applied to a solution to keep it in equilibrium with the solvent, when the two are separated by a semi-permeable membrane, varies according to the pressure on the solvent. He suggests using a definite pressure on the solvent, say its vapour pressure, as the standard.

I would point out that, by accepting this definition, one is necessarily bound to compare two solutions when they are under different conditions—not only on account of the different vapour pressures of different solvents, but also on account of the different pressures on the solutions themselves.

The following consideration will, I think, make this clear, and at the same time will suggest a more scientific standard.

There seem to be two methods of examining directly the osmotic phenomena of a solution.

(1) One, which I may call the osmotic "force" method, depends essentially on the determination of the rate at which the solvent will flow through a semi-permeable membrane into an infinite mass of solution when there is no pressure on the latter.

It is evident that if one knew the frictional resistance to the flow, the heat developed, &c., one could calculate the osmotic "force" in absolute units.

I would mention, in parenthesis, that Mr. Hartley and I have made some comparative experiments in this direction with results which were not entirely unsatisfactory.

(2) All other direct methods give what may be called equilibrium pressures; they depend on the measurement of the pressure necessary to bring about a balance between the solution and the solvent. These equilibrium pressures cannot, on account of the compression of the solution, be measured under the same conditions.

An example will show this plainly. The equilibrium pressure between a solution of 540 grams of cane-sugar in the litre of solution and the solvent (water) under atmospheric pressure is, in round numbers, 70 atmospheres. The equilibrium pressure for 750 grams in the litre is 134 atmospheres. In the actual measurements each solution had been compressed, in one case by 71 atmospheres and in the other by 135 atmospheres. The conditions were therefore not comparable.

If we could measure the osmotic "force" of these two solutions as in (1) then comparable results would be obtained, for in both cases the solution and the solvent would be under the same pressure (gravitational).

Up to the present, so far as I am aware, no serious attempts to measure the osmotic "force" have been made, but I would suggest that, pending these, the relation between the vapour and osmotic pressures of a solution as deduced by Mr. Hartley and myself may be useful for the purpose of comparing *the* osmotic pressures of different solutions.

This relation gives the osmotic pressure of a solution when it is under no pressure but its own vapour pressure. A knowledge of the vapour pressure, together with the density of the solvent, is all that is required for calculating that pressure; while to apply the standard that Mr. Spens proposes, it is necessary to determine the increment in volume of the solution when unit mass of solvent enters it, and in some cases it may be necessary to obtain the coefficient of compression of the solution.

The experimental work saved by the adoption of the standard here proposed is apparent when it is remembered that, owing to the want of suitable semi-permeable membranes, the measurement of equilibrium pressures is confined to but a few substances dissolved in water.

Foxcombe, near Oxford. BERKELEY.

The Eruption of Vesuvius.

YESTERDAY I ascended the cone of Vesuvius up to the crater, being, I suppose, one of the first climbers after the eruption. The ascent was made from Torre Annunziata without any difficulties, but care had to be taken to avoid the courses of the avalanches of stones and ashes rushing from the cone and spreading over the slopes more than half a mile from the foot of the cone.

I estimated the new crater to have a diameter of about 3000 feet; the bottom was not visible, but the walls could be seen to a depth of about 1000 feet. The inner walls are nearly perpendicular, partly overhanging, and I saw pieces of the very narrow crater edge breaking down, in this way still enlarging the crater. The very regular stratified construction of the crater walls was visible. The height of the crater edge is very different from what it was before the eruption, being greatest on the west side, and diminishing in irregular steps to the north and east. At the point to which I ascended the aneroid showed an elevation of 3760 feet. From this point, which was on the southern side, the Somma was clearly visible over the lower northern edge of the crater. This shape of the crater may account for the fact that the showers of lapilli and other fragmentary products which destroyed the villages of Ottajano and San Giuseppe were given a direction to the north and east over the Somma.

The crater now closely corresponds to the descriptions of the great crater formed in 1822, and described by Forbes and Scrope. From the throat of the crater I heard a constant roaring, and saw that white clouds of vapour filled the huge hollow, but I did not see any ejections of stones or dust.

On descending I visited the points where the lava streams started from the foot of the cone. The first lava reached the surface on the morning of April 4 a little west of the Casa Firenze, but it soon stopped. Another stream started from Casa Firenze, destroying the buildings, and flowed half the way toward Bosco-Trecase. The lava which damaged a part of Bosco-Trecase started on April 6 a little lower on the slope, and divided into two parallel branches. The quantity of lava during this eruption was on the whole comparatively small. No lava came from the crater. The general characteristics of the eruption are the immense amount of volcanic ash, lapilli, and other fragmentary material ejected, and this makes the eruption of April, 1906, very similar to that of the year 79 A.D.

Visiting the destroyed village Ottajano on April 19, I made the following curious observation. A great number of the window glasses are broken, but among the others there are many regularly penetrated or pierced by circular holes one or two inches in size. These holes are as common on the northern and eastern sides of the houses as on the other sides, and they can therefore not have been caused by the showers of lapilli, which only came from the south-west. Some people ascribed these holes to the very heavy lightning which accompanied the fall of the lapilli, but I am not aware that electrical discharges may produce such effects.

It may be of interest to note that when visiting the volcanic vents of the Phlegræan Plain to investigate if any kind of volcanic activity was shown in connection with the eruption of Vesuvius I heard that the emanation of steam from the Solfatara diminished greatly during the days of the strongest eruption of Vesuvius; normal conditions set in later. HJ. SJÖGREN.

Naples, April 23.

Lightning Flashes.

In your issue of January 14, 1886 (vol. xxxiii., p. 245), Mr. T. Mackenzie reported lightning from a bank of cloud to the clear sky, but, as it was quite dark, one cannot be certain that there were no indistinct outliers. In Hann's "Lehrbuch der Meteorologie" (ed. 1, p. 632) other cases of lightning from a cloud to the clear sky are referred to.

On the evening of March 26, at 6.30 p.m., before dusk had set in, there was a large thunder cumulo-nimbus cloud about eight miles north of Johannesburg. The summit of this cloud was very sharp against a clear dark blue sky. There was no false cirrus. Six flashes of lightning darted from near the summit of the cloud into the clear sky. The longest path was about ten degrees. One flash returned to the cloud, the others finished in the clear sky. Before dusk set in this phenomenon ceased to occur. All the flashes were directed to that part of the sky from which the cloud moved.

In a well-known book on meteorology we read "it is impossible to say whether a flash of lightning moves from a cloud to the earth or in an opposite direction," and further that the lightning is instantaneous. Hann does not confirm these statements, and it is time that they were modified in English text-books. Quite frequently I have observed lightning flashes leaving a cloud for the earth, but fading away before reaching it; the opposite phenomenon has not been observed. The paths of lightning shown by photographs taken in the Transvaal all indicate discharges from cloud to cloud, and from cloud to earth. The enclosed photograph, taken by Mr. T. N. Leslie at Vereeniging, is typical. Some flashes of lightning are instantaneous, the majority are not, but I do not think any exceeds a duration of a third of a second. The revolving wheel has been used, and shows that the duration is often certainly much longer than 1/40th of a second.

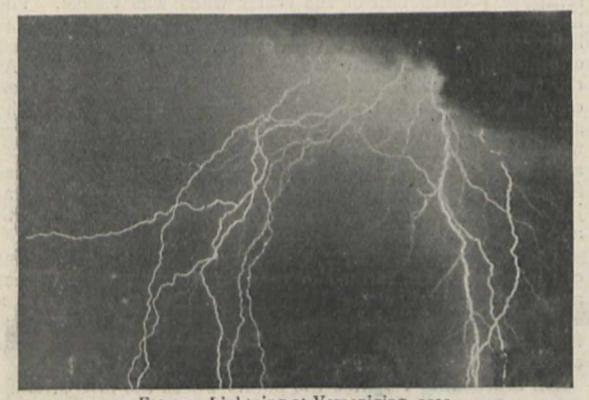


Fig. 1.—Lightning at Vereeniging, 1903.

Johannesburg, April 2. R. T. A. I.

Diurnal Variation of Ionisation in Closed Vessels.

Until Messrs. Campbell and Wood give us some more definite information as to the magnitude of the daily variation which they have found in the natural ionisation of air in closed vessels (Nature, April 19, vol. lxxiii., p. 583), it is somewhat premature to go into a detailed discussion as to how this discovery will affect theories of atmospheric electricity. Still, the letter in Nature of April 26 (vol. lxxiii., p. 607) on this question from Dr. O. W. Richardson calls for some remarks.

The facts are shortly:—(1) Messrs. Campbell and Wood discover that the natural ionisation of air in a closed vessel has a double daily period, the maxima being between 8 a.m. and 10 a.m. and between 10 p.m. and 1 a.m., the corresponding minima being at 2 p.m. and 4 a.m.; (2) the potential gradient in the lower atmosphere has, at most places, also a double period, the maxima being at about 8 a.m. and 8 p.m., and the minima at about 4 a.m. and midday. Thus, allowing for a certain amount of uncertainty in the exact determination of the times of the maxima and minima, we may say that the daily variations of the natural ionisation and the potential gradient are similar.

In order to discuss a possible dependency of these two factors, Dr. Richardson assumes that "the distribution of the earth's field reduces itself to a case very similar to that between two plane electrodes immersed in a gas and maintained at a constant difference of potential." It is more than questionable as to whether this assumption is justifiable or not, for in atmospheric electricity we are dealing with constant quantities of electricity, and not with constant potentials. But, rather than follow up this objection, I would prefer to look at the problem from a different point of view, and show that the exact contrary conclusions can be deduced.

In discussing this problem, it is usual to accept that there is a negative charge on the earth's surface, and that the corresponding positive charge is a volume charge distributed in the atmosphere. Now all the measurements which we have of the daily variation of potential gradient have been made within a few metres of the surface. Within these few metres there can be, relative to the charge on the earth, very little volume charge, so what our measurements actually refer to is the charge on the surface, the relation being $dv/dh = -4\pi\sigma$. The point to notice in this is that, with a given charge on the surface and the corresponding charge in the atmosphere above, the vertical distribution of the charge and the conducting state of the upper atmosphere do not in the slightest affect the potential gradient within a few metres of the surface. If the potential gradient changes there it can only be by a change in the surface charge on the earth.

If there is a penetrating radiation which, besides ionising the air in closed vessels, also ionises the air in the atmosphere, we should expect from Messrs. Campbell and Wood's experiments the ionisation of the air in *all parts* of the atmosphere to have a daily variation. Thus the air quite near the surface would twice a day be exceptionally conducting; one would expect that at these times there would be a greater loss of the surface charge, and so the remaining charge to be diminished, and with it the potential gradient. The consequence would be a daily variation of the potential gradient corresponding to the variation of ionisation, but the maxima of one corresponding to the minima of the other.

That such a relation does exist between the ionisation of the lower atmosphere and potential gradient has been shown by many observers situated in most parts of the globe. Thus from Messrs. Campbell and Wood's results one would expect minima of the potential gradient to occur at about 8 a.m. and 10 p.m.; this is the exact reverse of what really occurs.

Thus it would appear as if Messrs. Campbell and Wood have added one more to the many puzzling factors connected with atmospheric electricity.

Manchester University. George C. Simpson.

August Rainfall.

According to Greenwich experience, August has been a very dry month considerably oftener about sun-spot *maxima* than about *minima*. This fact may be of some practical interest.

Using Mr. Nash's table (from 1815), let us confine our attention to the three years about the eight maxima and the three about the eight minima, *i.e.* twenty-four years in each division.

The driest August in the *minima* division was in '55, with 1·40 inches. But in the *maxima* division there are ten cases of lower values, ranging from 1·25 inches down to 0·45 inch, viz. '38, '49, '59, '61, '69, '71, '82, '83, '84, '93. Since 1837 no three-year group of this division has been without at least one such very dry August, two have had two, and one three.

The total August rainfall in those twenty-four-year groups is, in the sun-spot *maxima* division, 50·25 inches, in the *minima* division 66·50 inches, the higher value thus showing an excess of 16·25 inches (nearly one-third of the lower).

The sun-spot maximum we are now near (1905?) has not been here considered, but I may remark that in 1904 we had one of those low August values (1·24 inches).

Alex. B. MacDowall.

AT THE HEAD OF LOCH FYNE.[1]

A LARGER number of contributors even than those mentioned on the title-page have conspired to make this memoir authoritative and complete. It is descriptive of Sheet 37 of the 1-inch geological map of Scotland, an attractive work published in 1903, in which the north-east and south-west lines of the Caledonian earth-folding predominate, and are followed out in the trend of the intrusive masses. The memoir is illustrated by excellent plates, one of which is here reproduced; and the fact that part of the ground is familiar to the tourist gives it an additional interest.

The region described is cut, from corner to corner, by the noble inlet of Loch Fyne. The parallel reach of Loch Awe lies in the north-west, and Loch Eck, banked out by gravel terraces from the sea, comes in near Loch Long in the south-east. The traveller by land usually enters the region by the steep and rugged fastnesses of Glencroe, and leaves it by Glen Aray, if he is willing to face the rain-swept moorland above which Cruachan towers in the north. The geological surveyors, however, have become familiar with a wide area practically untrodden by any visitor. Mr. Hill's appreciative introduction should be read with the aid of the hill-shaded Ordnance map, Sheet 37, one of the most beautiful products of a draughtsman who surely possessed a sentiment for landscape. The fundamental rocks of the district are metamorphic, and formed a part of the Caledonian continent, on which the Old Red Sandstone gathered; and Mr. Hill points out how denudation is removing the Devonian lavas and lake-deposits in the north-west, and is revealing, in the sculpture of the old continent, a highland much like that of modern days. The ice-flows of the Glacial epoch, however, have moulded the present surface in many of its details, have left erratic blocks in quaint positions on the hills, and have deposited moraines and banks of gravel across the edges of the ancient schists.

The metamorphosed series is mainly of sedimentary origin, with many bands of limestone. The albite-schists (p. 15), which are "highly micaceous or chloritic rocks with grains or crystals of clear secondary albite," are of special interest. Dr. Teall supplies an analysis, showing 3·2 per cent. of soda and an equal amount of potash. This allows 28 per cent. of the rock to be formed of albite. "Green beds," which are hornblendic, and yet are not the intrusive epidiorites so familiar in Dalradian areas, occur in a band south-east of Loch Fyne, and may have been derived clastically from some preexisting basic igneous series (p. 18). True sills of epidiorite occur, however, plentifully among the metamorphic rocks between Loch Awe and Loch Fyne. In the same region there are numerous later intrusions of quartz-porphyry and other igneous rocks, probably post-Silurian in age. "Kentallenite," described in detail by Mr. Hill in 1900 (Quart. Journ. Geol. Soc., vol. lvi., p. 531), and first known from the Appin promontory, occurs here and there, as a link between

FIG. 1.—The summit of the Pass of Glencroe, with Loch Restil. The rugged hill scenery is formed by the Ben Bheula schists. From "The Geology of Mid-Argyll."

[1] "The Geology of Mid-Argyll." By J. B. Hill, with the collaboration of B. N. Peach, C. T. Clough, and H. Kynaston, with petrographical notes by J. J. H. Teall and J. S. Flett. Pp. vi+166. Memoirs of the Geological Survey, Scotland. (Glasgow, for H.M. Stationery Office: J. Hedderwick and Sons, Ltd., 1905.) Price 8s.

the masses rich in alkalies and the biotite-peridotites. Mr. Kynaston (p. 102) regards this rock, with the granites and diorites of the north-west area, as contemporaneous with the Ben Cruachan granite, that is, as later than the Lower Old Red Sandstone lava-flows. The regional metamorphism of the older rocks of mid-Argyll is not due to these numerous intrusive masses, nor to any concealed dome of granite. It increases in intensity from north-west to south-east, and also along the strike of the ancient sedimentary series in a north-easterly direction, so that comparatively unaltered rocks of the "Loch Awe group" (p. 76) pass, outside the limits of Sheet 37, into schists of a very pronounced degree of crystallisation. Local thermal alteration tends to mask both the original clastic structures and the subsequent foliation (p. 39).

The form of the lake-floors in connection with the passage of ice across them is interestingly discussed in chapter xiii. At the time of maximum glaciation, the upper portion of the Loch Fyne ice moved out westward towards the Sound of Jura, the general south-westerly course being resumed as the ice thinned down again and became guided by the topographic features. It is held that Loch Awe at one time drained southward, when the level of its waters was nearly 200 feet higher than at present.

The economic resources of the district, which are neither conspicuous nor generally accessible, are referred to at the close of the memoir. If petrographic details naturally predominate in such a work, they only testify to the scientific thoroughness with which the Geological Survey is encouraged to explore the Scottish highlands.

THE EGYPTIAN HEAVEN AND HELL.[1]

IN his "Egyptian Heaven and Hell" Dr. Wallis Budge has contributed another work to his already long list of books dealing with the subject of ancient Egyptian religions. It appears in three-volume form in the useful little series of "Books on Egypt and Chaldæa," written by Dr. Budge and Mr. L. W. King, and published by Messrs. Kegan Paul. Those who are interested in the subject are familiar with Dr. Budge's edition of the "Book of the Dead" in the same series. These volumes form a companion work, being an edition of the two subsidiary collections of funerary texts, "The Book of the Am-Tuat (that which is in Hades)" and "The Book of the Gates," which accompanied the great "Chapters of Coming Forth into the Day," the "Book of the Dead" proper. As in the former work, Dr. Budge gives the text, translation, and illustrations from the original papyri.

The two subsidiary books differ somewhat in purpose and scope from the "Book of the Dead" itself. The latter is a collection of spells and "words of magic power" to be learnt by the dead in order to win their way past the dangers of the unseen world into the presence of Osiris. The individual dead man, identified with Osiris, "the Osiris N," is the central figure of every chapter of the "Book of the Dead." "Chapter so-and-so. I, the Osiris so-and-so, say," and so on. But in the Book of That which is in Hades, and in the Book of the Gates, the dead man is not the principal figure. In fact, in the first-named (hereinafter called "The Book of the Tuat") he hardly appears at all; the book is merely a description of the other world as it appears to the beatified spirits who follow the bark of the sun-god in its passage through Hades (the Tuat) from west to east, from his setting to his rising. During the night the dead sun-god, known as Auf ("his limbs," *i.e.* the carcass of the sun), sails through the regions of the underworld to give light to the dwellers therein, and during his voyage the souls of the blessed rise up and join themselves to his boat. It is a weird conception, and the description of these regions of the dark beyond, as given in Dr. Budge's book, is still more weird. The Tuat is divided into several distinct Tuats, each corresponding to one of the great Egyptian necropoles, Abydos, Thebes, Sakkara, and Heliopolis. Each has its peculiar features, and appears to be tenanted by demons and spirits with unpronounceable names and of strange appearance, some of whom are good and help the bark of the god on its way, while others are bad and seek by every means in their power to oppose its progress. These are vanquished in succession as the sun passes their territories. The "Book of the Gates" is so called on account of its chief feature being the successive mention of the gates of the Tuats, each of which has its demon-guardian, who is passed by means of the appropriate spell. In it the

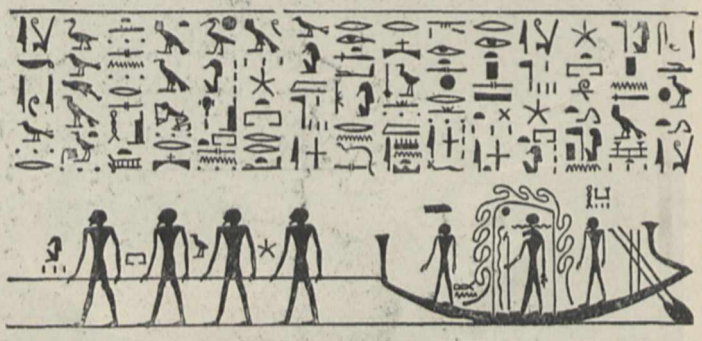


FIG. 1.—The Boat of the Sun towed by Gods of the Tuat. From "The Egyptian Heaven and Hell," vol. ii., The Book of Gates.

god Osiris appears, but not to the extent to which he appears in the "Book of the Dead," the chapters of which seem to have originally emanated from the original seat of his worship at Busiris in the Delta. Indeed, the "Book of the Tuat" may be a much later invention of the Theban priests, designed to divert the attention of the faithful from the northern Osiris to the sun-god of Thebes. It is homogeneous in plan, which the "Book of the Dead" is not. Dr. Budge gives a parallel version of both subsidiary books in his third volume, so that they can conveniently be compared. In the same volume are to be found his introduction and a most compendious index.

The pictures of these two books are extremely remarkable. Their general appearance will be well known to those who have visited the tombs of the kings at Thebes, or have seen the wonderful alabaster sarcophagus of King Seti I. in Sir John Soane's museum in Lincoln's Inn Fields. Under the eighteenth and nineteenth dynasties the walls of the royal tombs were decorated with scenes from the "Book of the Tuat" and "Book of the Gates," so that the dead monarchs could see in pictures at least the weird forms which the imagination of the

[1] "The Egyptian Heaven and Hell." By E. A. Wallis Budge, Litt.D. Vol. i., The Book Am-Tuat, pp. viii+278; vol. ii., The Book of Gates, pp. viii+306; vol. iii., The Contents of the Books of the Other World described and compared, pp. xviii+232. (London: Kegan Paul and Co., Ltd., 1906.) Price 6s. net each volume.

Egyptians conceived as inhabiting the tomb-world; and occasionally sarcophagi were ornamented in the same manner. Some of the best illustrations in Dr. Budge's book are taken from the sculptures of Seti's sarcophagus.

The conceptions of the rewards and punishments

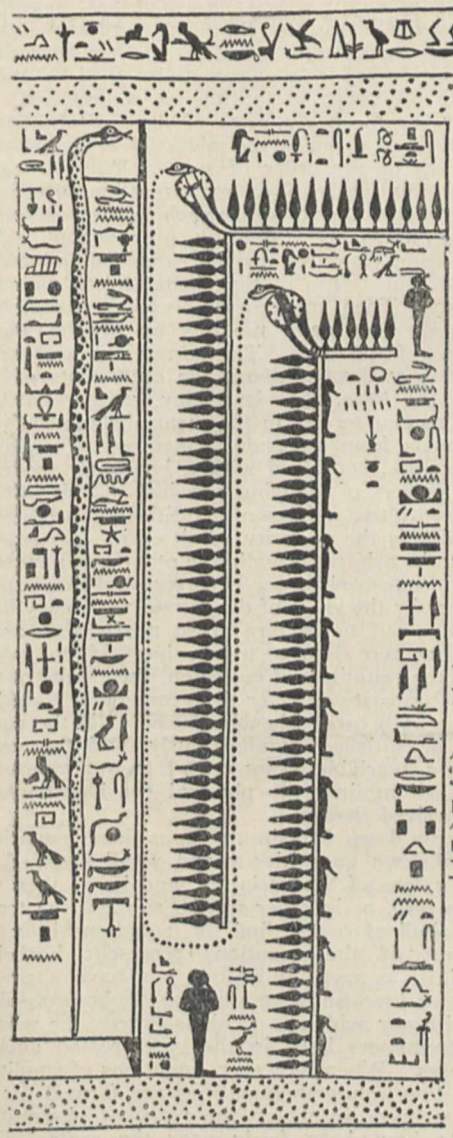


FIG. 2.—The Gate of the Serpent Agebi. From "The Egyptian Heaven and Hell," vol. ii., The Book of Gates.

of the dead in the next world as given in these two books are also well worth the attention of the anthropologist.

ANCIENT ECLIPSES.

THE results of recent discussion of ancient eclipses may for convenience be divided into three sections. The conclusion of each section depends upon the truth of the conclusions of the preceding sections, but not vice versâ, that is to say, the results of the last section may be rejected without in the least impairing the validity of the earlier conclusions. The results are as follows:—

(1) If an astronomer had been asked a year ago by a historian or a chronologist whether the tables of the sun and moon accurately accounted for the recorded phenomena of ancient eclipses, he could only have replied that the tables failed altogether to account for the solar eclipses; that they had been empirically altered so as to account for the observed *times* of certain lunar eclipses; and that the question whether the tables so altered accounted for the *magnitudes* of the same lunar eclipses had not even been examined. There seemed to be no possible modification of the tables that would bring them into harmony with the recorded solar eclipses, and it was therefore the received opinion that the historical accounts of these were untrustworthy. The first result is that two slight modifications of the existing tables will cause them to satisfy the records.

The modifications in question may be stated as follows:—Define the nodical month as the mean period between one passage of the moon from south to north of the ecliptic and the next passage, and define the nodical year as the mean period between one passage of the sun from south to north of the plane of the moon's orbit and the next passage, purely periodic variations being left out of account. Then the eclipses show that the rate of change of length of both the nodical month and nodical year as given in the tables must be altered.

(2) The second section of the results is concerned with the question, "In order to alter the rate of variation of the nodical year, are we to alter the acceleration of the node or of the sun?" Now the motion of the node depends upon theory, and the same theory which accounts for its motion at the present time will suffice to calculate its motion at any time during the last few centuries. The motion of the sun, however, is purely a question of observation. Unknown causes may easily be conceived as altering its motion. The second result is therefore to ascribe an acceleration to the sun's motion to account for the variation in the nodical year inferred from ancient eclipses, or in other words, we may leave out the word "nodical" in our statement and say, "The ancient eclipses indicate certain definite rates of change in the lengths of the month and year."

(3) We lastly require some physical explanation of the sun's acceleration. Here there are many possibilities. The æther may offer a sensible resistance to the passage of the earth; or an electro-magnetic theory of gravitation may compel us to take account of the small, but not infinitesimal, ratio between the velocity of a planet in its orbit and the velocity of light; or again, electrical theories of matter somewhat modify the old conception of mass, and with it the fundamental equations of motion on which planetary theory rests. But the explanation tentatively put forward at the April meeting of the Royal Astronomical Society is as follows:—Let us suppose the acceleration of the sun to be due to a change in the length of the day caused by tidal friction. The tides check the rotation of the earth, lengthen the day, and therefore apparently increase all diurnal movements by the same fraction of their whole amounts. Introducing numbers for greater definiteness, let us suppose that in a century the day increases in length by a two-hundredth part of a second of time. Then in a century the sun's apparent rate of motion will increase by one part in seventeen million, which is exactly the change indicated by the eclipses. If, however, the moon's apparent rate of motion also increased by one part in seventeen million the acceleration would be ten times larger than that indicated by the eclipses.

But if the tides are checking the diurnal rotation of the earth, it follows from the principle of conserva-

tion of angular momentum that the moon must be receding from the earth, and absorbing the spin lost by the earth. This implies that the moon is really moving more slowly. It is impossible to make accurate calculations, for the action of the tides on an earth with oceans and continents of irregular shape cannot be computed, and it is impossible to say how the tidal action varies for different positions of the moon in its elliptic orbit. Hence we cannot say how far the action of the tides is distributed between changes in the length of the month and changes in the eccentricity of the moon's orbit. But it seems a plausible hypothesis that the large eccentricity of the moon's orbit was evolved somehow, presumably by tides, and that the eccentricity is therefore increasing, and calculation shows that if the rate of increase assigned to the eccentricity be about one-hundredth of a second of arc a century, the consequent change in the absolute angular velocity of the moon is such as to cancel nine-tenths of the apparent decrease in the length of the month, leaving the remaining one-tenth in agreement with the change inferred from ancient eclipses. This explanation, it should be clearly understood, only shows that certain correlated quantities are of the right order of magnitude: it is unable to prove or disprove an exact numerical relation.

In the remaining part of this article the basis of the conclusion of the first section is examined. That is the foundation, which must be rendered secure before interest can attach to any superstructure.

Let us select a definite eclipse, for instance, the eclipse of Thucydides in the first year of the Peloponnesian War. The record states that stars appeared. It is certain on the other hand that the eclipse, at the most, could only have been annular. There is therefore a strong presumption that Athens was not far from the central line of the eclipse, or in other words, at the time of conjunction in longitude as seen from Athens, the difference of apparent latitudes must have been small. The hypothesis that Athens was the place of observation has been objected to. This however is the natural interpretation of the passage in Thucydides; let us adopt it for the present and see where it leads. For Athens, therefore, let the difference of apparent latitude for the instant of apparent conjunction in longitude be computed from the present tables. The result is so large as absolutely to negative the possibility that stars could have been seen. Reserving the hypothesis that the record is untrustworthy as a last refuge in case of trouble, let us suppose for the present that the tables require alteration.

What kind of alteration is permissible? It has been argued in *Ast. Nach.*, No. 3682, on physical grounds, that only one unknown quantity may be introduced. Now against physical reasoning of this kind, strong objections may be urged. It proceeds necessarily on the assumption that the general nature of the problem of the apparent motions of the sun and moon is fully understood. It absolutely limits the investigation to the numerical determination of quantities connected with a preconceived theory, and it prevents, at the outset, the attainment of results of a new character. Now as the preconceived theory was entirely based upon two centuries of observation, there is no improbability in our knowledge being widened, when the period of observation is largely increased. In the whole of astronomy there is not a single case of a theoretical value of a secular term, that is to say, a term proportional to the square of the time, being confirmed by observation. This is because the series of modern observations is not yet long enough. Is it not possible that one or two centuries hence the observed values of these terms will lay bare a whole series of new phenomena? Physical considerations of the kind alluded to absolutely prevent the achievement of such a result. They may advantageously be replaced in the following manner by considerations of a purely geometrical character.

It being, for a time at least, granted that the eclipse of Thucydides suggests that the existing tables require large modifications, geometrical considerations tell us, that in order to diminish by 200″ or thereabouts the difference of latitude at conjunction, we must alter the mean distances of the sun and moon from the node as given by the tables for the year −430 by quantities of the order of 2000″. The only geometrical alternative is to assume alterations ten times as large in some other quantity such as the position of the perigee, and this alternative may be put aside. Now the mean distances can be expanded in powers of the time, the origin of time being taken near the present day. Then modern observations forbid the correction of the mean motions or of the terms independent of the time. The corrections are therefore necessarily thrown about the coefficients of the square of the time, that is to say, upon what are called the secular terms, in the mean distances of the sun and moon from the node. Geometrical considerations therefore, combined with a becoming modesty as to our powers of applying physical considerations, present us with two unknown quantities for correction, one of which is the quantity admitted in *Ast. Nach.*, No. 3682 to be arbitrary, while the other is a new one.

If the preconceived theory is correct and the records are trustworthy the value of the second variable will on solution turn out to be zero or so nearly zero as to suggest that zero is the true value. If no values satisfy all the equations of condition, then some of the records are untrustworthy or the geometrical considerations have been carelessly thought out. If the equations can be satisfied simultaneously, and the value of the second variable is not zero, a very strong case is established against the physical considerations of the preconceived theory.

If we write down five simultaneous linear equations in two unknown quantities x and y, all satisfied by the same values of the variables, and if we then put y equal to zero, or in other words, rub out the terms in y, we shall of course find the equations in x are inconsistent. If the equations represent historical data, and if, as men of science, we have a proper contempt for literature, we shall no doubt proceed to quarrel with our evidence. This is exactly the way in which astronomers have in the past treated ancient solar eclipses. When, however, equations of condition involving two unknown quantities are formed for all the solar eclipses in which the place of observation appears to have been fairly near the central line, whereas modern tables give residuals of the order of 200″, that is to say, make the apparent differences of latitude at conjunction in longitude of the order of 200″, values can be found for the unknown quantities, which will make all the residuals less than 50″; in other words, whereas the present tables would leave about ten per cent. of the sun's diameter visible, the alterations proposed never leave so much as two per cent. visible.

Let it be here stated that no solar eclipse is an exception to the above statement. The conclusions rest, not upon the evidence of a majority but upon the unanimous evidence of all eclipses used. A list of these is given in Monthly Notices, lxv., p. 861, and a reference is given on p. 867 to the eclipse of Agathocles. The eclipse of Thales has not been

worked up as it occurred a hundred years before the birth of Herodotus; its evidence, whether for or against, is held to be inadmissible.

A confirmation of these results is supplied by the lunar eclipses of the Almagest. On working them up, it is found that the residuals are so large as to show that they are entitled to far less weight than the solar eclipses. Their value lies in the fact that the separate determinations from the lunar eclipses group themselves round the values derived from solar eclipses. The lunar eclipses are given in Monthly Notices, lxvi., pp. 6–7; they are nineteen in number, and in only ten cases is a numerical estimate of the magnitude recorded. These ten cases alone therefore test the newly-discovered fact which, in language that becomes appropriate only if the second section of results is admitted, states that the earth's orbital motion is subject to a secular acceleration of 4″. Now of the ten lunar eclipses available, seven give accelerations lying between 2″ and 6″. It is therefore hard to believe that zero and not 4″ is the correct value. The times of the lunar eclipses are equally striking in their confirmation of the result. Nearly thirty years ago a correction was introduced into Hansen's Tables based upon these eclipses. The main question is one of evidence. It is no use to point out in the third section of this paper how certain changes may be accounted for, if they are not shown to exist. On the other hand, no objections to a particular explanation of the physical reason can weaken the case for the observed fact that these changes are taking place. What is sufficient evidence? Two eclipses would suffice, if they had been described with a wealth of detail that established complete confidence in the records. A hundred eclipses of the actual sort would probably satisfy the most sceptical, even though the place assigned were always "tacitly assumed (to be) the capital where the record was made, or the place where the poet or historian lived." The smaller number of eclipses, which it has alone been possible to produce, should suffice to make a case almost if not completely amounting to certainty. P. H. COWELL.

VARIATIONS OF DOMESTIC POULTRY.[1]

THE book under notice is one of an original character. It is an attempt to describe all the different races of domestic poultry that exist in various parts of the world, and as such is not without its value, as it gives us a description of the races of fowls as they exist, not only in Asia, but in the various States of Europe and the United States of America. The book treats almost solely of the races of fowls from a fancier's point of view. The plumage and external characters which would be noticed in a show-pen are those that are dwelt upon, and as a scientific treatise the work cannot be regarded as having any special value, and would be unfairly treated if it were regarded from the same standpoint as Darwin's "Variation of Animals under Domestication."

The illustrations, which are very numerous, are not original, but taken from the fancy poultry journals, where the birds are drawn with the usual exaggeration of the points valued by the fancier, and bred for securing prizes. The consequence is that some of them are good and others quite the reverse, but the plumage in many is exaggerated. To scientific ornithologists this history of the location of colour in the different parts of the plumage of birds, and the fixture of the patterns in the races, is one of considerable interest. To those acquainted with the details of poultry breeding it is well known that any variation of the colour or texture of feathers which appears in any particular specimen can, by careful selection of the offspring, for a series of generations, be readily perpetuated, and by crossing with other varieties almost any pattern or disposition of colour can be obtained, and what is called a new breed formed. This is illustrated by the engraving, which we borrow from the work, of a German race at present but little known in this country, called the Lakenfelder. In this the colours are transposed from their general position, and a remarkable looking fowl is produced, which is correctly represented in the engraving.

It is of much scientific interest to trace the extent of the variation which can be induced by careful breeding. In the fowl, these variations have been almost exclusively confined to the plumage, which in some instances has been increased to an enormous extent, as in the production of quill feathers 8 inches long on the feet of the show Cochin, and the general

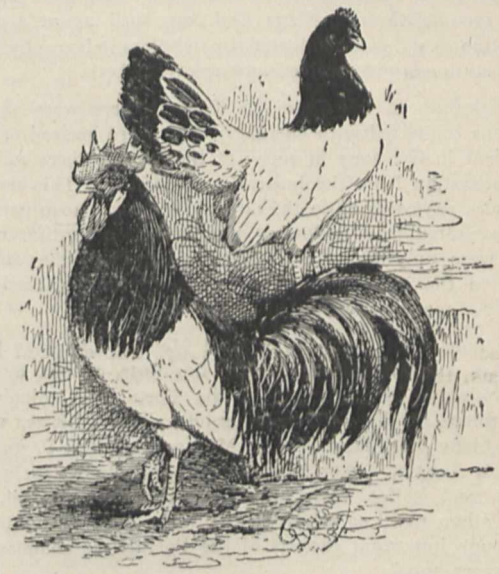


FIG. 1.—Lakenfelders. From "Races of Domestic Poultry."

increase of the plumage to a great extent, so that the modern show Cochin does not at all resemble the original birds brought from Shanghai. In other cases the plumage has been partially abolished, as in the Nackthälse or Transylvanian naked necks, in which the head and neck are entirely denuded of feathers, and the skin assumes the red colour of the comb. These variations are permanent, and are intensified by long-continued breeding. The production of spangles or dark markings at the end of the feathers, of bordered margins of black on a light ground in the whole of the body feathers, and of regular transverse bars across each feather of the plumage, have all been accomplished and perpetuated by careful selection.

The various breeds of ducks, geese, and turkeys are also treated of.

The work contains in an appendix a very elaborate and useful list of the names of the races in all the European languages, which will prove of great value to all investigating the subject of variation.

W. B. TEGETMEIER.

[1] "Races of Domestic Poultry." By Edward Brown. Pp. xi+234; illustrated. (London: Edward Arnold, 1906.) Price 6*s*. net.

NOTES.

THE gentlemen's conversazione at the Royal Society will be held on Wednesday next, May 9.

THE summer meeting of the American Chemical Society will this year be held in Ithaca, N.Y., on June 28–30.

IT is announced that the German Government has issued invitations for an International Conference on Wireless Telegraphy to meet on June 28.

THE sixth International Congress of Applied Chemistry was opened at Rome on April 26 by the King and Queen of Italy in the presence of the Diplomatic Body, the members of the Cabinet, high officials of the State, and about two thousand delegates. Speeches were delivered by Prof. E. Paternò, president of the congress, Signor Boselli, Minister of Public Instruction, Prof. O. Witt, and delegates of the chief nations represented at the congress. The British delegates are Prof. W. A. Tilden, F.R.S., Prof. W. N. Hartley, F.R.S., and Dr. J. J. Dobbie, F.R.S.

A REUTER telegram from New York states that the new French liner *La Provence*, when 1800 miles from Poldhu and 1700 miles from Cape Cod, on April 25 at 2 p.m., simultaneously communicated by wireless telegraphy with both stations, and received answers from both.

ACCORDING to the *Chemiker Zeitung* there were 183,532 persons connected with chemistry who were insured against accident in Germany in 1904; of these, 1535 cases received compensation from the insurance companies. This number includes 109 cases of death, 14 completely and 1040 partially incapacitated from following their vocation in life, whilst 372 were only for a time unable to work; the amount paid to the injured or the relatives of the deceased was nearly 2,200,000 marks.

IN honour of the International Medical Congress to be held in Lisbon this year, there has been opened a small exhibition of the products of the Portuguese colonies in the rooms of the Colonial Museum. The exhibits, which are chiefly from Cape Verde, Mozambique, the Portuguese Indies, Angola, Timor, and Guinea, deal almost exclusively with wool, coffee, cocoa, and india-rubber; palm oil, &c., and other raw materials of the fatty and oil industries, although important exports of the Portuguese colonies, are not represented.

ARRANGEMENTS are being made to hold a "Country in Town" exhibition at the Whitechapel Art Gallery in July. The object of the exhibition is to show East Londoners what can be done to bring into the neighbourhood something of the beauty of nature. It is proposed to show living things, pictures and models, materials and appliances, plans for the improvement of certain areas in London, and exhibits explaining city life in Japan and other countries. Contributions towards the necessary expenses are asked for, and these may be sent to the Rev. Canon Barnett at Toynbee Hall, E.

THE ninth annual meeting of the Childhood Society will be held on Tuesday next, May 8, at the residence of the president, Earl Egerton of Tatton. Sir Edward Brabrook, C.B., will deliver an address. The chief object of the society is to promote the study of educational methods and of the environment of children during school life, best suited to ensure satisfactory mental and physical development of children. The society numbers among its members representatives of educational science, teachers, medical experts, and others interested in the investigation of mental and physical conditions of childhood.

EARTHQUAKE shocks have again been common during the past week. Reuter's messages show that on April 25 a disturbance was felt at 3.15 p.m. at San Francisco, and lasted nearly a minute. This shock was also felt at Oakland and Berkeley. On April 26 shocks were felt at Salinas, 100 miles south of San Francisco, at 8 p.m. and 9.50 p.m., and these were followed by a third on April 27 at 2 a.m. Each of these three disturbances lasted about four seconds. A later telegram reports that earthquakes were felt at Salinas every day from April 18 to 27. On April 27, too, four disturbances of increasing intensity were felt at Dresden, and on April 28 in Schönberg, Brambach, and other places in the Vogtland district. Two slight shocks were felt at San Francisco on the morning of April 30.

IT is arranged that the International Association for Testing Materials, which holds its congresses about every three years in industrial centres in various countries, shall this year meet in the Academy of Science at Brussels on September 3–8. The King of Belgium has accorded the congress his patronage, while Prince Albert of Belgium will be one of the honorary presidents, as also will the Ministers of Finance, Railways, War, and Trade, and the Mayor of Brussels. Among the papers to be read will be one on the industries of Belgium, by Baron E. de Laveleye and M. Camerman. It is expected that a considerable number of members and delegates from this country will be present at the congress. Mr. J. E. Stead, F.R.S., Middlesbrough, is the English secretary of the association.

AT the annual general meeting of the Institution of Civil Engineers, held on April 24, Sir Alexander B. W. Kennedy, F.R.S., was elected president of the institution. The council has made the following awards for papers read and discussed before the institution during the past session:—A Telford gold medal to Mr. J. A. Saner, a Watt gold medal to Mr. G. G. Stoney, and a George Stephenson gold medal to Dr. T. E. Stanton; Telford premiums to Mr. Leonard Bairstow, Mr. H. S. Bidwell, Mr. J. J. Webster, Mr. Cathcart, Mr. W. Methven, Mr. H. A. Mavor, Sir Frederick R. Upcott, K.C.V.O., C.S.I., and a Manby premium to Mr. D. E. Lloyd-Davies. The presentation of these awards, together with those for papers which have not been subject to discussion, and will be announced later, will take place at the inaugural meeting of next session.

IN Tennyson's "Palace of Art" occur the lines:—

> "She saw the snowy poles and Moons of Mars,
> That mystic field of drifted light
> In mid Orion, and the married stars."

This at first sight looks like a literary parallel to Swift's well-known fortuitous forecast of the discovery of the Martian satellites, and Mr. J. S. Stevenson, writing from Blairavon, Norwood, Ceylon, points out that Prof. H. H. Turner quotes it in "Modern Astronomy" as having been written in 1835. This, however, appears not to have been the case; for Mr. Stevenson, on reference to the biography of the late poet laureate by the present Lord Tennyson has found the note, "The 'Moons of Mars' is the only modern reading here, all the rest are more than half a century old." Scientific discovery was thus not anticipated by Tennyson in the mention of Martian satellites.

THE Paris correspondent of the *Times* made the following announcement in a message on Monday night:—"The Prince of Monaco formally announced to the French Minister of Education to-day his decision to establish in Paris the Oceanographic Institute that he has founded. He will endow the institute with the magnificent museum

now existing at Monaco, including its laboratories, collections, aquaria, &c. The Prince has set apart 4,000,000 francs (160,000*l.*) for the maintenance of the institute. It will be established on grounds recently bought by the University of Paris with the assistance of the Prince in the rue Saint-Jacques and the rue d'Ulm. The scientific direction of the institute is vested in an international committee of specialists in oceanography. The French Government has expressed its formal thanks for this really princely gift."

THE first of a series of four lectures on atmospheric circulation and its relation to weather was delivered by Dr. W. N. Shaw at the University of London on Tuesday, May 1. Dr. Shaw referred to the valuable contributions to meteorology in the last fifty years by Dr. Buchan, Abercromby, and Clement Ley, and he pointed out that, so far as the forecasting of the weather is concerned, no great advance has been made in recent years, and that it is necessary to take into consideration the atmosphere in the upper regions and to deal with the general circulation as a whole. Great advance has been made recently in that way by the use of kites and balloons, and the direction of the air currents in the higher regions can be determined from the records of the barometer, thermometer, and hygrometer obtained in those ascents. Some very interesting diagrams were thrown on the screen, showing the circulation at a height of 4000 metres, from charts constructed by M. Teisserenc de Bort, and also showing the results of international upper-cloud observations as deduced by Dr. Hildebrandsson for various parts of the globe.

THE contents of Irish Fisheries Scientific Investigations, 1904, No. 6 (1905), includes a paper on "plankton" collected at light-stations, by Dr. L. H. Gough, and hydrographical observations made at the same. In connection with the plankton, it is noticeable that when this comprises a large number of copepod crustaceans, the vegetable organisms are much less numerous than usual, and *vice versâ*.

THE four articles in the April issue of the *Zoologist* are equally divided between birds and fishes. In recording the rare birds seen in Norfolk during 1905, Mr. John Gurney again notices the occurrence of quite a number of avocets on Breydon Flats. The birds of Derbyshire, as observed in 1904–5, form the subject of an article by the Rev. Mr. Jourdain. Mr. L. E. Adams describes his own observations on the mode of flight of flying-fishes, while Prof. McIntosh discusses certain Japanese food-fishes.

SIX new fishes from Japan, described by Messrs. Jordan and Seale, form the subject of No. 1445 of the Proceedings of the U.S. National Museum; while the succeeding number of the same journal (No. 1446) is devoted to descriptions of new American Palæozoic ostracod crustaceans, by Messrs. Ulrich and Bassler. In No. 1447 of the Proceedings Mr. J. W. Gidley describes the skull of a ruminant allied to the musk-ox from Pleistocene strata in New Mexico. The new generic name Liops is proposed for this ruminant, which is of special interest on account of its southern habitat.

THE trustees of the Indian Museum, Calcutta, according to the report for the past financial year, have decided to charge an admission-fee of 8 annas on Sundays between the hours of 3 p.m. and 5 p.m., in order to give the educated classes an opportunity of studying the contents of the galleries under more favourable opportunities than has been hitherto possible. As a rule, the galleries are absolutely crowded with members of the illiterate class throughout the time when they are open to the general public. It is proposed greatly to enlarge the museum, at an estimated cost of 2½ lakhs of rupees—a sum apparently already at the disposal of the trustees.

MR. F. A. LUCAS, curator of The Museum, Brooklyn Institute of Arts and Sciences, Brooklyn, N.Y., desires to direct attention to a photograph of Laysan Island, issued several years ago, showing on the beach a large turtle, and, what is more important, a large seal, which appeared to be of the genus Monachus. He points out that if this seal really belongs to the genus Monachus, the fact is of great scientific interest, as it would make the seal circumtropical. Mr. Lucas would be glad to know if anything has been published regarding this seal, specimens of which he believes were taken to Europe.

A PAMPHLET has reached us containing an address delivered by Dr. Paul Kronthal before the Berlin Psychological Society in October of last year on the idea of the soul (Jena: Gustav Fischer). The lecturer, continuing the investigation of which notice has already been taken in these columns, elaborates his account of the soul as the sum of reflexes. This definition, he claims, does justice to all the facts, *e.g.* of inheritance of physical characteristics, of mental disease, of memory, and the like. He occupies several pages with a discussion of the freedom of the will, a conception which, it appears, is abandoned by all consistent theologians, men of science, historians, and jurists. But it appears also from the later half of the lecture that to define the soul as the sum of reflexes satisfies only natural science; from the standpoint of metaphysics we must speak of the soul as sensation. Apparently, too, the metaphysical view leads directly to solipsism, and the metaphysical world consists of abstractions like love, hate, joy, sorrow, good, bad. The world of the scientific man, on the other hand, is made up of five entities, which at first sight appear very real as compared with these abstractions, but which are ultimately admitted to be five metaphysical ideas—time, space, matter, energy, number. It is further admitted that the fundamental law of causality is for natural science undemonstrable. Dr. Kronthal concludes his somewhat paradoxical lecture with two dicta—that the honourable metaphysician must grant that the conceptions of natural science are the more justifiable, and that no thoughtful man of science can deny that the conceptions of natural science are in the last resort only matters of faith.

A CATALOGUE of microscopical objects and accessories has been received from Mr. R. G. Mason; a special feature is made of geological and stained botanical sections that can be mounted by purchasers. A section of limestone sent as a sample of the mounted objects shows a variety of Foraminifera, and is otherwise a desirable specimen, also a double-stained section of pine stem is a thoroughly satisfactory preparation.

THE second number of the *Journal of Economic Biology* contains papers on the effects of metazoan parasites on their hosts, by Messrs. Shipley and Fearnsides; on the bionomics of grain weevils, by Mr. F. J. Cole; on the deposition of eggs and larvæ in *Œstrus ovis*, by Mr. W. E. Collinge; and on the ox-warble flies, by Mr. A. D. Imms. The reviews and current literature, with notes, which complete the number are a valuable feature of the journal.

A SERIES of identifications of Philippine plants is published in Publication No. 35 of the Bureau of Government Laboratories, Manila. Mr. H. N. Ridley has worked out the Scitamineæ, describing three new species of Amomum; Mr. C. B. Clarke has named the Acanthaceæ; Dr. E. Häckel has identified a collection of grasses; and Mr. E. D. Merrill contributes some notes on Cuming's Philippine plants, as well as the fourth series of diagnoses of new or noteworthy plants. Among the latter are two new species of Rhizophoraceæ, a Gynotrochea growing in forest at an altitude of 4000 feet, and a Pellacalyx, also new species of Eugenia and of Saurauia.

THE original habitat of the coconut palm has often been the subject of speculation. In a paper read before the Ceylon branch of the Royal Asiatic Society, Mr. J. Ferguson, tracing the early history of the cultivation of the coconut palm in Ceylon, accepts the general dictum that the plant is not indigenous, and attributes its origin to nuts washed up by the sea. It is recorded that, at the instigation of a Singhalese king, a plantation was formed on the south coast as early as the middle of the first century, and subsequently King Prákrama Báhu the Great also interested himself in extending its cultivation.

IN the Journal of the Royal Horticultural Society (vol. xxix., part iv.) Mr. E. S. Salmon describes a white mildew disease that has been prevalent on shrubs of *Euonymus japonicus* in the south of England. From the mycelium on the surface of the leaf, hyphæ are produced that pierce the cuticle of the epidermis and form haustoria in the epidermal cells, thus enabling the fungus to maintain its parasitic life. The mycelium persists on the leaves through the winter, so that perithecial resting spores are not required and are not formed. The disease can be checked by collecting and burning in the winter all leaves that bear the white patches of hibernating mycelium; also treatment with sulphur or other fungicides is recommended.

THE paper on ramie read by Mrs. E. Hart before the Society of Arts, and printed in the Journal of the Society (April 6), is interesting, not only as it indicates some of the difficulties that had to be overcome in spinning and weaving, but also because it bears out the opinion that, given cooperation between producer and manufacturer, the cultivation, preparation, and weaving of ramie can be profitably undertaken. In the matter of decortication, Mrs. Hart advocates hand-stripping in preference to machines wherever cheap labour can be obtained, and recommends that the degumming process should be carried out under expert supervision in the mills. The fabrics that have been woven of pure ramie, warp and weft, vary from the lightest gossamer to a heavy cloth.

IN Hawaii, root disease of the sugar-cane produced by a species of the basidiomycetous fungus Marasmius—not improbably *Marasmius sacchari*—is so prevalent that a Bulletin (No. 2 of the Division of Pathology and Physiology) has been issued to provide information on the subject. The writer, Mr. L. Lewton-Brain, traces the connection between the fungus that attacks primarily the growing point of the root and the symptoms, similar to those caused by drought, of rolled-up leaves, matted leaf-sheaths, and undeveloped roots; also he indicates how the plant can be strengthened by judicious irrigation and by liming the soil. A variety possessed of a certain power of resistance to the disease has been found in the Yellow Caledonia, but a variety that is perfectly immune has yet to be discovered.

THE *Naturwissenschaftliche Wochenschrift* (vol. v., No. 8) contains a long paper by Dr. W. R. Eckardt on the climatic conditions of past geological times. The author deals specially with the climate of the Carboniferous and Tertiary periods, and concludes that the explanation of all changes of climate is to be sought in variations in the distribution of land and sea.

WE have received a copy of the tide tables for Charlottetown, Picton, and St. Paul Island, C.B., for the year 1906, issued by the Department of Marine and Fisheries of the Dominion of Canada. The tables are based on direct observations made at eleven localities in the south-western portion of the Gulf of St. Lawrence and in Cabot Strait. It has been ascertained that the tides can best be deduced from St. Paul Island, for which continuous records extending over four years are available.

DR. WALTHER VON KNEBEL contributes a paper to the *Naturwissenschaftliche Rundschau* (vol. xxi., No. 12) on the hot-spring areas of Iceland. A careful comparison of the conditions occurring in the regions of geysers and of solfataras leads the author to the conclusion that only a small part of the water ejected by the geysers is "juvenile," the bulk of it coming from the ordinary ground water. Geysers occur, in effect, where ground water is abundant and volcanic action relatively feeble, and solfataras where volcanic action is more vigorous and the amount of ground water deficient.

WE have received a copy of the meteorological records for 1905, published in the second annual report of the Agricultural Department of the British East Africa Protectorate, which extends, roughly speaking, from 5° N. to 5° S. latitude, the sea coast north of the equator forming part of the Italian Somaliland. The report contains rainfall observations at a large number of stations, and general observations at eight stations, several of which exceed 6000 feet in altitude. The work is a valuable contribution to meteorological knowledge, and will be found most useful when arrangements can be made for dealing with the meteorology of all our colonies according to some regular and properly organised plan. A good beginning was made in this direction by the Meteorological Council in a work entitled "Climatological Observations at Colonial and Foreign Stations, I., Tropical Africa," published in 1904, from tables prepared by Mr. E. G. Ravenstein. This work contained results from several of the stations included in the report of the Nairobi Agricultural Department.

IN his last report as secretary of the Smithsonian Institution of Washington, the late Dr. S. P. Langley dealt with the work of the Astrophysical Observatory for the year ending June 30, 1905. The evidence of solar variability is not in the report considered as conclusive. However, two lines of investigation have become very prominent in the work of the observatory, and these will almost certainly lead to a conclusion regarding this important question. The first of these is the almost daily bolometric examination of the large solar image formed by the great horizontal telescope, for the purpose of detecting changes in the transparency of the solar absorbing envelope. This work depends so little on the transparency of the earth's atmosphere that it can be done almost as well in Washington as at a station more favoured as regards atmospheric transparency. The year's work did not give evidence of very marked variations either in the transparency of the sun's envelope or in the supposedly dependent mean temperature of the earth, but, on the contrary, the results of

the observations continued most of the time near the mean in both respects. The second line of investigation is the determination of the total solar radiation outside our atmosphere, by observations with the bolometer and pyrheliometer at a station situated in a relatively clear and cloudless region and at a considerable altitude. This work is being done on Mount Wilson, in southern California, and it seems that the estimates it is hoped to obtain there will be so close an approximation to the truth that if a notable variation of solar radiation outside our atmosphere occurs the results will show it.

THE much-debated *n*-rays form the subject of a short note by Dr. P. Stefanelli in the *Rendiconto* of the Naples Academy, xi., 12. Referring to Meyer's experiments on the decrease of phosphorescence in sulphide of lime when placed in the glass receiver of an air pump, Dr. Stefanelli considers the effects to be attributable to the fall of temperature produced by the expansion of the air, and not to depend on the existence of *n*-rays for their explanation.

IN NATURE of January 11 (vol. lxxiii., p. 246) Mr. C. E. Benham pointed out that Swedenborg in his "Principia," published in 1733, constantly regarded both heat and light as ethereal undulations. Mr. I. H. H. Gosset, of St. Aubyns, Hove, now informs us that, as a matter of fact, in the year 1719, fourteen years before he published his "Principia," Swedenborg wrote a treatise "On Tremulation," in which he advanced the theory of ethereal undulations as applicable to our vital forces, light, heat, sound, &c.

IN the *Philosophical Magazine* for April, Prof. Alfred W. Porter discusses the inversion points of the Joule-Kelvin effect for a fluid passing through a porous plug. The paper is a simple and straightforward deduction from the laws of thermodynamics. The condition that an infinitesimal difference of pressure on the two sides of the plug should give rise to no "cooling" or "heating effects" is given by the equation $Tdv/dT - v = 0$, and when the pressure-volume-temperature equation is given, this condition determines a curve in the p,T or v,T diagram formed by the inversion points. Prof. Porter's paper is mainly taken up with examining the form of this curve corresponding to various assumed equations of state, such as that of van der Waals or Dieterici. From the form of the curves it is shown that in general two inversion temperatures exist for the same pressure, between certain limits of pressure; in the case of van der Waals's equation, the maximum limit is nine times the critical pressure. Finally, the author points out that the experimental study of these inversion curves affords a very valuable method of testing the relative validity of different equations of state. Theoretically also a knowledge of the inversion curve and the equation of state referred to any given thermometric scale afford sufficient data to determine the relation between that scale and the absolute temperature.

ACCORDING to the annual report of the Badische Anilin- und Soda-Fabrik, the price of artificial indigo is now one-third less than that of the natural product, the yield of which was last year so small that the requirements of the eastern markets could not be satisfied.

IN the *Far Eastern Review* (vol. ii., No. 9), a monthly engineering journal published at Manila, Shanghai, and Yokohama, Mr. A. C. Hobble gives some excellent illustrations of the largest hydroelectric installation in southern Asia, at the Cauvery River Falls, in Mysore. There is a fall of 400 feet. Power is transmitted at a pressure of 35,000 volts over duplicate 3-phase lines a distance of 92 miles to the Kolar gold mines.

IN the *Chemiker Zeitung* we read of a serious laboratory accident to Dr. Franz Wartensberger, a German chemist, who is credited with having discovered a new explosive considerably more violent than dynamite, and to whom it is said that the American Government offered to pay one million dollars for the explosive, provided its discoverer were able to suggest a suitable method of firing it electrically instead of using a fuse. As Dr. Wartensberger was experimenting with this idea in mind an unexpected explosion is supposed to have taken place, and he was so badly hurt that it is doubtful whether he will recover.

THE ash of the Vesuvius eruption contained, according to Prof. Zinno's analysis, various quantities of silica, alumina, lime, magnesia, iron, and manganese; traces of ammonium chloride were frequently found, but these may possibly have been formed after the ash had fallen. No indications of either free sulphur or of free acid were detectable. The deposit of the ash is held to have been beneficial to vegetation rather than the reverse, especially in the growth of vines, grass, and vegetables, a fact that has been observed on other occasions.

IN an interesting note to the *Chemiker Zeitung* for April 21, Dr. M. C. Schuyten, of Antwerp, directs attention to the differences of temperature which are observable in chemical drying cupboards. Dr. Schuyten was led to consider the question experimentally from the fact that mercury phenyldimethylpyrazolone bromide was found to melt in a drying cupboard when the thermometer did not register a temperature so high as its melting point. The temperature of the air in the cupboard was observed in the great majority of cases to be very much less than that of the walls and shelves; a volatile liquid placed in a vessel in direct communication with the case evaporated much more quickly than when suspended by threads. From the numerical data given variations of 20° C. and more are noticeable.

WE learn from the *Chemist and Druggist* that the Committee on Ways and Means, which sat at Washington on March 30, authorised a favourable report on the Free Alcohol Bill, which removes the internal revenue duty from denaturised alcohol for use in the arts and sciences. The Bill has the approval of Commissioner Yerkes, and it is estimated that the annual loss in revenue will not exceed 100,000*l*., and may not be more than 60,000*l*. It is held that the Bill will be of great benefit to manufacturers, and will afford an enlarged market for farm products from which alcohol is made. The sale of denaturised alcohol as a beverage or for liquid medicinal purposes is forbidden by the measure.

THE following particulars of two prizes offered by the French Government may prove of interest to industrial chemists:—(i.) The methylation of alcohol (prize of 20,000 francs). (1) The smell and taste of the proposed methylating addition must be such as to preclude the use of methylated alcohol as a drink; (2) the smell of the methylating addition must, however, not be so objectionable and strong as to prove harmful to those engaged in the manufacture of or in industries using methylated spirits, that is to say, the use of such bodies as acetylene, asafœtida, garlic, &c., is not permitted; (3) the method of methylating adopted may not leave any deposit on the wick or on any part of the lamp, if likely to interfere with the process of burning, as, for example, sea salt, sodium sulphate, alum, tincture of aloes, &c.; (4) the methylating additive may not be separable by fractional distillation; (5) it may not contain any substance which will attack the metallic parts of

lamps or motors, *e.g.* ammonia, nitrobenzene, sulphuric acid, carbon bisulphide, &c.; (6) nor may it be poisonous; (7) further, its cost must not be so high as to prejudice the use of methylated spirits for industrial purposes or household use; (8) its presence in methylated alcohol must be easily detectable; (9) it must possess advantages over that now in use in France, and not permit of any swindling of the Excise. It might be remarked that the discovery of a methylating additive which shall fulfil all the foregoing conditions is a matter of great difficulty; indeed, four years ago the Russian Government offered a prize of about 50,000 marks for a similar purpose, without, however, as yet having had a satisfactory entry. (ii.) The use of alcohol for illuminating purposes (prize of 50,000 francs). In this the competitors are allowed full scope as to the proposed system to be followed in order that alcohol may be used for illuminating purposes under the same conditions as petroleum. Suggestions, together with the necessary apparatus and methods of using, are to be sent to the Chef du Service des Laboratoirs du Ministère des Finances, 11 rue de la Douane, Paris.

IT was pointed out recently by a correspondent of the *Times* that though in the manufacture of pig-iron before 1880 England was preeminent, and the product was 50 per cent. more than that of the United States and Germany combined, yet ten years later the former country produced more than England, and the United States and Germany together twice as much. In 1903 Germany produced more than England, while the United States alone produced twice as much as England. In 1880 England produced 45 per cent. of the world's make, Germany 15 per cent., the United States 14 per cent. In 1903 the United States produced 39 per cent., Germany 20 per cent., and England only 19 per cent. With steel the case is even worse. Since 1880 steel has replaced wrought iron in nearly all manufactures, and in 1830 the United States and Germany manufactured about 30 per cent. less than England. In 1888 the United States equalled England. In 1893 Germany nearly equalled, and the United States largely exceeded England. About 1898 Germany's manufacture was much greater than that of England, and America's manufacture three times as great. These figures show that during the last twenty-five years England has receded from a position of great preeminence to the lowest place among the three great steel-producing countries. On the other hand, between 1900 and 1905, the importation of iron and steel into England increased very largely, the importation in 1905 being 1,435,000 tons, as against 741,402 tons in 1900.

MESSRS. E. DENT AND CO. have lately introduced a new astronomical clock which should find its way into many observatories where an accurate instrument is required at a moderate cost. For the sum of 21*l.* they supply a clock with a 10-inch dial, dead-beat escapement, and wooden rod seconds pendulum in a solid mahogany case; and after examining the instrument we have no hesitation in pronouncing it a marvel of cheapness.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN MAY:—

May 1–6. Epoch of Aquarid meteoric shower (Radiant 338° − 2°).
2. 17h. Mercury at greatest elongation, 26° 46′ W.
4. 10h. 4m. Minimum of Algol (*β* Persei).
5. 13h. 33m. to 14h. 3m. Moon occults *γ* Virginis (mag. 3·0).
6. 2h. Venus in conjunction with Mars. (Venus 0° 5′ S).
May 11. 15h. Venus in conjunction with Jupiter. (Venus 1° 11′ N.).
15. Venus. Illuminated portion of disc = 0·921. Of Mars = 0·990.
18. 0h. Mars in conjunction with Jupiter. (Mars 1° 6′ N.).
20. 23h. Ceres in conjunction with Moon. (Ceres 1° 6′ S.).
24. 5h. Mars in conjunction with Moon. (Mars 4° 57′ N.).
,, 11h. 46m. Minimum of Algol (*β* Persei).
25. 3h. Venus in conjunction with Moon. (Venus 4° 51′ N.).
27. 8h. 35m. Minimum of Algol (*β* Persei).

COMETS 1906*a* AND 1906*c*.—The results of a number of observations of comets 1906*a* and 1906*c*, made at the Royal Observatory at Arcetri during February and March, are recorded in No. 4083 of the *Astronomische Nachrichten* by Prof. Abetti.

The same journal also contains the following set of elements, and an ephemeris extending to May 8, for comet 1906*c*, computed by Herr E. Strömgren from places determined on March 19 (Nizza), 22 (Glasgow, Mo.), and 29 (Arcetri).

Elements.

$T = 1906$ Feb. 20·7555 M.T. Berlin.
$\omega = 274° 46′·4$
$\Omega = 71° 47′·7$ } 1906·0
$i = 84° 36′·8$
$\log q = 9·84916$

THE TOTAL SOLAR ECLIPSE OF JANUARY, 1908.—For the information of those astronomers who intend to observe next January's eclipse, Dr. Downing has prepared a number of astronomical details for the observations at two islands in the Pacific which are favourably placed.

These two stations are Hull Island (long. = 172° 13′ W., lat. = 4° 30′ S.) and Flint Island (long. = 151° 48′ W., lat. = 11° 26′ S.), now the properties of Lever's Pacific Plantations Company, Port Sunlight, Cheshire, with whom intending observers should communicate.

As the errors of the moon's tabular places now amount to sensible and apparently increasing quantities, Dr. Downing warns observers that the calculated times of the several phases may differ sensibly from the observed times. To obviate the possible inconvenience arising from this source, he gives the number of seconds before the commencement of totality that the cusps will subtend specified angles (Monthly Notices R.A.S., vol. lxvi., No. 5).

RADIANT POINT OF A BRIGHT METEOR.—In No. 4083 of the *Astronomische Nachrichten* Dr. Jiří Kaván publishes an account of a bright meteor observed at Prague at 6h. 21m. (M.E.T.) on October 1, 1905.

From observations of the altitude and azimuth, Dr. Kaván has deduced the following positions for the beginning and end points of the meteor's path:—

Beginning ...	$\alpha = 293°·1$ ...	$\delta = -2°·6$
End ...	$\alpha = 273°·4$ ...	$\delta = -11°·1$

The duration of the meteor's flight was 2 to 2·5 seconds, and the colour of the object was green.

LUMINOUS PARTICLES IN THE CHROMOSPHERE.—The details of the equipment employed by Dr. Deslandres, in his experiments to determine whether the chromosphere contains luminous liquid or solid particles, are described in No. 14 (April 2) of the *Comptes rendus*. The results of the experiments were briefly described in these columns on April 19 (vol. lxxiii., p. 592).

NEW CATALOGUE OF DOUBLE STARS.—In No. 93 of the Lick Observatory Bulletins, Prof. R. G. Aitken publishes the detailed measures of 350 new double stars, A 901 to A 1250 inclusive. The stars contained in the present catalogue are similar in character to those published in Prof. Aitken's previous lists; 267 of them, or 76 per cent. of the entire number, have apparent distances less than 2″, 31 of them less than 0″·25, while only 9 approach the limit of 5″. Some of the pairs consist of closer components to Struve and Herschel stars, and most of them were observed with the 36-inch refractor.

EXPLORATIONS IN THE HIMALAYAS.

THE paper read by Mrs. Bullock Workman before the Royal Geographical Society in November last is published in the February number of the *Geographical Journal*. An account is given of the exploring work carried out by Dr. and Mrs. Bullock Workman during 1903 in the region of the Karakoram mountains lying south-west of the Hispar glacier, or between that glacier and the Indus. This region is cut off from the Hispar glacier by a practically continuous ridge, and is crossed by glaciers moving from north and north-west, the chief being the Chogo Lungma, Alchori, Hoh Lumba, and Sosbon glaciers. The work of the expedition consisted chiefly in the examination of the Hoh Lumba and Sosbon glaciers, and in ascents of Mounts Chogo (21,500 feet) and Lungma (22,568 feet), near the head of the Chogo Lungma glacier.

The narrow Hoh ravine runs northward from the junction with the Braldo River, and is ascended along the precipitous cliffs of nude mountains. It is filled by old glacial débris several hundreds of feet deep, the river cutting its way often at a great depth. Some four miles up is Pirnar Tapsa, a small grazing ground, and two miles beyond is Nangma Tapsa, a similar spot at an elevation of 11,595 feet. Immediately above this is a huge terminal moraine, of which we are able to reproduce a photograph. The snout of the glacier is about a mile further up, and the total length from the snout to the source on the "col des Aiguilles" is twelve miles. The expedition found much evidence that the glacier has retreated somewhat rapidly of late years.

FIG. 1.—Nangma Tapsa and the huge terminal moraine of the Hoh Lumba, forming a large hill about 500 feet high; its age is indicated by the tree growth covering its surface.

OSMOSIS AND OSMOTIC PRESSURE.

NO problem is of greater importance in modern physical chemistry than the determination of the true nature of osmosis and of osmotic pressure. Although for some considerable period this problem has to most chemists appeared solved, several recent investigations have thrown doubt upon the validity of van 't Hoff's hypothesis that the osmotic pressure developed in solutions is purely a kinetic phenomenon. The experiments of Battelli and Stephanini in this connection have already been referred to in NATURE (vol. lxxii., p. 541). Some remarkable results which have been obtained by Prof. Louis Kahlenberg are now described in the Transactions of the Wisconsin Academy (March) and the *Journal of Physical Chemistry* (vol. x., pp. 141–209); these, if subsequently verified, will invalidate van 't Hoff's theory, and, what is of even greater importance, destroy the basis of the theory of electrolytic dissociation, developed by Arrhenius, upon which modern physical chemistry so largely depends.

Prof. Kahlenberg's experiments would indicate that the osmotic pressure developed in the case of any solution depends essentially on the nature of the membrane used, even when this is practically semi-permeable, as well as on the nature and concentration of the solution. Strictly speaking, there is no definite osmotic pressure characterising a solution of given concentration at a definite temperature; the pressure depends on the septum employed. It is recalled to mind that van 't Hoff's conception really rests on the measurements of osmotic pressure made by Pfeffer, that these measurements were few in number and were obtained with one membrane only, and that several recent direct measurements of osmotic pressures have given values not in accord with the gas laws. It is stated that in order to obtain a definite value for the osmotic pressure it is absolutely necessary that the solution within the osmometer should be well stirred, a precaution that has hitherto been omitted in all measurements. The measurements obtained by the author, observing this precaution, did not agree in any case with the gas laws.

The magnitude as well as the direction of the osmotic pressure are, according to Prof. Kahlenberg, determined by the power of the membrane to "imbibe" the solvent and solute, and by the mutual solubilities of the substances dealt with. Cases of abnormal dialysis are adduced in support of this theory. Thus a colloid, copper oleate, dissolved in pyridine, will diffuse through a rubber membrane, whilst a crystalloid, cane sugar, remains behind. Again, when a solution of camphor and cane sugar in pyridine is subjected to dialysis through the same membrane, the camphor diffuses through it, and the cane sugar is again left behind. In this case two crystalloids are separated completely by dialysis. Such facts are not reconcilable with the ordinary views of diffusion. Some suggestive remarks by the late Prof. Raoult, contained in a letter to Prof. Bancroft, in criticism of van 't Hoff's theory are now published for the first time.

MARINE BIOLOGY ON THE WEST COAST.[1]

THE report for 1905 on the Lancashire Sea Fisheries Laboratory at the University of Liverpool and the Sea Fish Hatchery at Piel is a somewhat thicker volume than was the report for 1904, and contains some interesting papers.

Besides the introduction and general account of the work by Prof. Herdman, and a report upon the classes, visitors, &c., at Piel by Mr. Andrew Scott, it contains eleven scientific papers, two of which are from Prof. Herdman's pen, while Mr. James Johnstone is responsible for five and Mr. Andrew Scott for four, one of which he contributes jointly with Mr. Thomas Baxter. The papers are upon the same lines of work as have been carried on in previous years, but the one upon mussel transplantation, by Messrs. Scott and Baxter, describes for the first time an experi-

[1] No. xiv. Report for 1905 on the Lancashire Sea Fisheries Laboratory at the University of Liverpool and the Sea Fish Hatchery at Piel. Drawn up by Prof. W. A. Herdman, F.R.S., Hon. Director of the Scientific Work, assisted by Mr. Andrew Scott and Mr. James Johnstone. Illustrated. (Liverpool, 1906.)

ment commenced some years ago, which has given interesting results. The removal of mussels from overcrowded beds and the laying down of new grounds and the re-stocking of old ones has proved eminently successful, and the increased rate of growth of transplanted individuals is very marked.

From the report on the sea-fish hatching at Piel we learn that more than a million plaice larvæ and nearly twelve million flounder larvæ were liberated during the breeding season, and a similar report upon the sea-fish hatching at Port Erin shows that five million plaice larvæ were liberated off the Isle of Man, but we look in vain for any word which will show us that the liberation of these fry during several years has produced any effect upon the fisheries of the district.

An interesting paper upon trawling observations, by Mr. James Johnstone, contains a section upon the food of plaice, dabs, and other fishes, and we gather that the results so far obtained tend to show that the plaice and the dab are not competitors for food, although living upon the same ground; that whereas the former feed chiefly upon molluscs, the latter prefer Ophiurids and Crustacea, although they are less particular as to the nature of their food than are the plaice. Mr. Todd's observations as to the food of these species in the North Sea seem to bear out the omnivorous tendency of the dab, but they also seem to show that the chief food of both species in that region consists of molluscs.

Mr. Johnstone also contributes a paper on the marked fish experiments, in which he sets out the migrations of the plaice in the district, as shown by the re-capture of marked specimens. He finds that the fish tend to move along the shore lines during the winter months, and to migrate off-shore during the summer months, which facts appear to agree with the results so far determined as to the migrations of this species in the North Sea.

Mr. Andrew Scott's report on the tow-nettings for the year contains a large amount of material, but the author has not drawn conclusions therefrom, so that the paper is somewhat heavy reading.

Prof. Herdman's paper upon the oligodynamic action of copper, dealing with the possibilities of purifying infected shell-fish by immersion in distilled water which has been in contact with copper-foil, is extremely interesting, but is in the nature of a preliminary statement, as he is about to investigate the whole question in conjunction with Prof. B. Moore.

The volume is illustrated, including a useful series of plates of copepods, trematodes, &c., in connection with Mr. Andrew Scott's "Faunistic Notes."

FRANK BALFOUR BROWNE.

PHYSIOLOGICAL EFFECTS OF MENTAL ACTIONS.

THE most recent number of the *Beiträge zur Psychologie und Philosophie* (Band i., Heft 4) contains two articles, one by the editor, Prof. Martius, on the theory of the influence exerted on pulse and respiration by mental stimuli, while the other, by Mr. C. Minnemann, discusses pulse and respiration as studied in the subjects of genuine, first-hand emotion. Prof. Martius starts with pointing out the contradictory opinions held by other investigators regarding the effect of attention, of joyful or painful emotions on pulse and respiration. This diversity he regards as partly due to the neglect of several precautions, and he proceeds to study, amongst other points, those fluctuations of the pulse which are in direct correspondence with respiration periods. He then examines the plethysmographic method, and comes to the conclusion that variations of volume registered by it are partly due to movements of the limb under investigation, and that the method cannot be used at present to secure any definite results regarding the circulation of the blood.

Elaborate details and analyses are next given of his experiments on five human subjects; they are classed thus:—(1) effects on the pulse of artificial alterations in respiration (*e.g.* deepening, acceleration, retardation of breathing); (2) effects of bodily activity on pulse and respiration; (3) effects of mental activity; (4) effects of bodily pain; (5) effects of taste and smell (whether pleasant or unpleasant; (6) effects of moods (of joy and depression) artificially induced, *e.g.* by hearing witty stories, recalling the contents of certain poems, or the like.

With regard to many points Prof. Martius thinks that definite conclusions are at present impossible; all that he regards as established is the presence of a series of types of general emotional or "affective" states, and especially the distinction of the two types of activity and rest. But the methods described are insufficient to characterise definitely for us special emotions like those of fear or sympathy. It seems established, too, that joy and sorrow do not possess definite complexes of symptoms by which they can be separated from one another, and further, bodily and mental activity produce the same appearances. Hence while the will and the intellect are not to be regarded as one, they cannot be separated, and we can never analyse the products of intellect merely into sensations and feelings. The other article follows the same lines and reaches a similarly safe conclusion, that we can read out of the experiment curves nothing but the most general characteristics of emotional states, viz. excitement or repression.

DISCOVERY OF SEVEN THOUSAND ROMAN COINS.

A COARSE earthenware jar containing upwards of seven thousand "third brass" Roman coins was recently unearthed by the ploughshare on the farm of Mrs. Wheatley, Stanley, near Wakefield. In very early times the bed of the river Calder, which has a remarkable sweep at this point, was deepened by the ancient Britons or Romans, and an embankment made with the sand; in this the jar, with its contents, was deposited 1500 years ago.

The coins all belong to the Constantinian group; to Constantine the Great, to his mother Helena, his step-mother Theodora, his four sons, Crispus, Constantine, Constantius, and Constans, Licinius his brother-in-law, with his wife Constantina and their son Licinius, and to Delmatius. The reverses are chiefly of the "Gloria Exercitus" type.

One-half, of nearly five thousand coins, which I have carefully examined is, in about equal quantities, of the "Urbs Roma" type, with wolf and twins on the reverse, and "Constantinopolis," with a Victory on the reverse with spear and shield, standing on the prow of a vessel; these latter were struck to commemorate the founding of Constantinople A.D. 330. There are twelve represented of the twenty-four mints of issue known to us, among which are Carthage, Alexandria, Antioch, Rome; but most are from Treves in Germany, the residence of the governor of the west, Lyons, and Constantina, now Arles in France.

Very few of them, if any, have ever been in circulation. They are most likely a portion of a military chest concealed during a threatened raid or invasion. It is remarkable that ten or twelve years ago a find of seventeen thousand was made in the Forest of Dean, covering the same period, of exactly the same types, with a similar redundancy of certain coins and a scarcity of others. A series of the Stanley coins has been presented to the museum of the Leeds Philosophical and Literary Society, and are now on exhibition.

AQUILA DODGSON.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The date of the fellowship examination in chemistry at Merton College has been altered from September 25 to September 18. Candidates are asked to send their names to the Warden on or before September 1, and to call on him on September 17, by which date they should submit to him any dissertations or papers, or evidence of research they have done.

During the vacancy of the Linacre chair of comparative anatomy, Mr. Edwin S. Goodrich, fellow of Merton College, has been appointed to act as deputy-professor.

New College has resolved to raise the college contribution to the stipend of the Wykeham professor of physics to 650*l.* a year, thereby increasing the total income of the professorship to 800*l.* a year.

H. W. Normanton, of Batley Grammar School, has been elected to a natural science postmastership at Merton College. A. H. Simpson, of Rugby School, has been elected to a natural science scholarship at Corpus Christi College.

CAMBRIDGE.—The striking success of the Appointments Board in procuring appointments for young graduates at Cambridge is shown by the following figures:—in 1902 the number of appointments obtained was 67; in 1903, 93; in 1904, 102; in 1905, 134. These appointments fall mainly into the following classes:—appointments under various public authorities at home and abroad, industrial and technical appointments, administrative appointments on railways, appointments for scientific work of various kinds, and lectureships in university colleges.

Major E. H. Hills, C.M.G., R.E., late head of the Topographical Department of the War Office, will deliver a public lecture on the geography of international frontiers, at the Sedgwick Museum, on Saturday, May 5.

The governing body of Gonville and Caius College, Cambridge, proposes in the summer, if suitable candidates apply, to make an election to the Wollaston research studentship in physics. The value of the studentship will be 120*l.* a year. It will be tenable in the first instance for one year, but may be prolonged for a second year. Candidates for the studentship must be more than twenty-one and under twenty-five years of age on the first day of October, 1906. The studentship is open to students of all British, colonial, and American universities. Applications should be made before July 21 to the Master (the Rev. E. S. Roberts).

The Gilbey lecturer on the history and economics of agriculture gives notice that he will lecture on "The Relations of Rent, Profits and Wages in Agriculture, and the bearing on Rural Depopulation," on Tuesday, May 15, and the three following days.

By the bequest of Dr. E. H. Perowne, the late Master of Corpus, a fine collection of specimens of amber has been acquired by the Sedgwick Museum.

ON Commemoration Day, Wednesday, May 9, after the presentation of graduates at the University of London, there will be a reception at Bedford College for Women from four to seven o'clock.

PROF. T. W. RICHARDS, professor of chemistry at Harvard University, has been designated by the German Government as Harvard visiting professor at the University of Berlin for the academic year 1906–7.

THE fiftieth anniversary of the foundation of the University of Melbourne was celebrated last week. Congratulatory addresses were presented by representatives of British and other universities.

IT is proposed to form an association of past students of the Technical College, Finsbury. With this end in view a meeting of old students will be held at the college on May 8. Sir Owen Roberts will preside. Any old student who has not received a notice of this meeting is requested to communicate with Mr. J. W. G. Brooker, Durlstone, Brockley Park, Forest Hill, S.E.

PROF. WALTER NERNST, director of the chemical physics institute, Berlin, is to deliver a course of lectures on experimental and theoretical applications of thermodynamics in Yale University, Connecticut. He will also give the Silliman lectures, founded in memory of Benjamin Silliman, father and son, the former of whom was connected with Yale so far back as 1805, and is best known to European people as the founder of *Silliman's American Journal of Science and Arts*.

UNDER the doubtfully appropriate title of "Technical Overtraining in Germany," attention is directed in the Journal of the Society of Arts for March 30 to what is undoubtedly a real danger. It is not a question of overtraining in the sense that the courses of the technical colleges are of too high a scientific standard, but the danger lies in the great increase in the number of technically trained students, an increase which makes the supply greatly in excess of the demand. A survey of the figures given, which are largely based on the report of the American Consul at Mannheim, shows that in such branches of technical instruction as building, for example, there has been an increase of, say, 200 per cent. in ten years in the output of the technical colleges, whereas in such subjects as medicine and theology there has been a considerable falling off in the number of students. As the writer of the note points out, "The consequence of this over-production in technical resources is a constantly diminishing rate of wages."

THE Government of India has decided, says the *Pioneer Mail*, to make to the Punjab University for the next four years an annual grant of 20,000 rupees. The main purpose of the grant is to assist in the improvement and efficiency of the constituent colleges in those respects in which an inspection by the University showed them to be defective. The Government of India has decided that no part of the grant shall be devoted to the improvement of the Government colleges. In addition to this grant, another of 10,000 rupees a year for four years has been assigned to the Punjab University by the Government of India. This sum is to be regarded as a consolidated grant to be applied primarily to the inspection of colleges and to strengthening the administration of the University. The Government of India has made a further grant of 30,000 rupees a year for four years for building purposes and for the equipment of the new Senate hall and the University library.

SPEAKING on Saturday last at the opening of a new grammar school at Farnham, the Archbishop of Canterbury remarked that secondary education in England has not made progress during the last fifty years commensurate with that made by those forms of education that are both above and below it. He believes that the explanation lies in a certain unwillingness to bring this kind of education under central government and organisation. He does not believe that either the German or French people are more anxious as a whole for higher education than we are in England, but they will consent to what English people will not consent to, viz. a kind of drilling on the subject which will bring about a uniformity that can better promote progress than the more lax, scattered, and independent efforts which the people of this country in their national nature prefer to the more hide-bound and red-tape systems. The Education Bill recently introduced in Parliament, if it passes into law, will give English people an opportunity which they have never had before of taxing themselves ten times as much for secondary education. No one will be forced to do it, but everyone will be able to do it, and those who have been pining to be able to give more largely to the cause of secondary education will, if the Bill becomes law, have an opportunity of doing so.

THE paramount importance of secondary education in any national system designed to educate the children of all social grades becomes more recognised every year by those in authority. The presence of the President of the Board of Education at the opening of the new county school at Acton on April 28, and of Sir William Anson, late Parliamentary Secretary to the Board of Education, at Sutton Coldfield on April 27, on a similar occasion, are indications of this recognition. Speaking at Acton, Mr. Birrell said the only difference of a philosophical character between elementary and secondary education turns upon the lengths of time available for each. There is naturally a distinction between children who remain at school only to the age of fourteen and those who stay until sixteen or seventeen years of age. The great thing for the nation to accomplish is the wise selection of those children who are fitted to benefit from a prolonged educational course, and to see that they get it, irrespective of their rank or position in life. Sir William Anson, dealing with the question of the curriculum in secondary schools, said he does not think it is possible ever to revert to the old type of classical school. He went on to say that the claims of science are nowadays never likely to be disregarded, but the study of languages should not be neglected. He remarked, in conclusion, that the overloading of the curriculum of secondary schools with subjects which might be postponed to a later stage is a mistake.

IT appears from an article by the special correspondent of the *Times* at Palo Alto, published in Tuesday's issue, that the Leland Stanford Junior University at Palo Alto

suffered great damage by the earthquake on April 18. A massive gateway of stone at the main entrance to the University grounds is now a ruin, and the great dragons which surmounted it lie broken to pieces on the ground. An immense memorial arch has been wrecked, and a fine marble memorial to Henry Lathrop, Mrs. Stanford's brother, has been demolished. The museum has been seriously damaged, the whole roof of the art gallery having fallen in, and part of the roof of the other wing. The entire centre of the building devoted to the department of chemistry is a wreck. The gymnasium, just completed and never used, is an absolute ruin, and another large new building, the library, also just completed and about to be dedicated, is in the same condition. The building devoted to zoology and physiology is not much damaged. The president of the University, Dr. D. S. Jordan, who was at home at the time of the earthquake, believes that the shock of April 18 was not only one of the severest, but also one of the longest duration on record. The *Times* correspondent learns also that the narrow-gauge railway to Santa Cruz has been so badly damaged that it will be months before trains can again be run. There are many tunnels on this line, and in various instances these tunnels, which formerly were straight lines, are now corkscrew-shaped. At San Jose a flower garden was turned into a lake of mud from which a dozen geysers burst into activity after the earthquake.

THE current number of the *University Review* contains an inspiring article on "Science and the Public" by Major Ronald Ross, F.R.S., professor of tropical medicine in the University of Liverpool. Insistence is laid on the fact that science is almost exclusively the work of individuals, and that, though willing enough to benefit by the discoveries and inventions of men of science, the public is in no sense imbued with the scientific spirit. Instead of cultivating the absolutely impartial judgment demanded by science, the public encourages the habit of mind eulogised by Tennyson, "believing where we cannot prove," and forgets there is nothing meritorious in such conduct, but much that is the reverse. The essay proceeds to show that to this willingness to ignore science and scientific methods may be traced the credulity of the public which leads it to subsidise quack medicine, to ignore beneficent discoveries like that of Jenner, to hamper scientific research by unintelligent anti-vivisection societies, and generally to proclaim its adherence to the policy of "muddling through." An instance is given by Major Ross from his own experience which shows how slightly as yet the mass of mankind has been influenced by scientific methods. More than seven years ago it was demonstrated that malaria is conveyed from man to man by a group of gnats, and several obvious and practicable modes of prevention were suggested in consequence of the discovery. But when these measures were urged upon the public and governments of our tropical colonies, the so-called educated white people scoffed at the whole discovery, without troubling to ascertain the facts, and the governments, with the exception of a few, took no action which could for a moment be called adequate. The magnitude of the offence may be gathered when it is remembered that half the people in the tropics suffer from the disease every year; but in view of recent events it is easy to see that the world will be dominated eventually more and more by the disciplined and scientific peoples, and those nations which reject science will be set aside.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 25.—"An Electrical Measuring Machine." By Dr. P. E. **Shaw**. Communicated by Prof. J. H. Poynting, F.R.S.

The principle of the measuring machines in general use is that one face of the gauge rests against one jaw, fixed, of the machine, whilst the other jaw is moved forward by a screw until it touches the other face. These machines may be called mechanical-touch machines in contradistinction to the new machine called the electric-touch machine. This depends on the same general principle as the electric micrometer used by the author in several researches.

Objections to the mechanical-touch methods are:—(1) they involve strain in the machine of a much larger order than in the electric method; (2) they are less sensitive; (3) it is impossible to measure between point and point. To measure between points or rounded points is essential in accurate metrology, especially for gauges with flat ends; for when each jaw has a flat face and each end of the gauge has also a flat face, each of these four faces having errors in planeness and parallelism, the resulting measurements must be erroneous. If, however, measurement be taken between small spheres on the screw ends, no assumptions as to planeness and parallelism are made, and such errors vanish from the results.

The electric measuring machine consists of (*a*) two headstocks containing micrometer screws; (*b*) a table to carry the gauge; (*c*) a massive slide bed, on which run the headstocks and table. The gauge to be measured is clamped on the table, and is set true with respect to the micrometer screws by two rotations and two translations provided in the table. This adjustment is made by special electric-touch methods devised for the purpose. To make a measurement of the gauge the left screw is brought into electric contact (indicated by a telephone) with the gauge; then the right screw is brought into electric touch with it, and when current passes through from one measuring point to the other the two divided heads on the micrometer screws are read. To turn the graduated head the screw system is not actually touched by the hand, but is worked by an outside hand-pulley and string.

Special care is taken in the design of the machine to avoid periodical screw error and backlash.

A careful calibration by wave-lengths of several millimetres of the screws shows where they are specially uniform, and therefore fit for use.

Results are obtained for all kinds of gauges. For bar gauges with flat ends, measurements taken at many places reveal considerable variation in thickness, so that irregular contour curves, roughly centred in the centre of the gauge faces, can be drawn showing that the ends are far from being plane or parallel. These errors in bar gauges have not been previously pointed out or measured. The author contends that all bar gauges should be measured by this method and the errors registered, so that, even if the errors are not corrected, by re-scraping or otherwise, they will be known and allowed for.

Cylindrical and spherical gauges are also tested; these are shown to be much more nearly perfect than bar gauges.

A further use of the machine is in the measurement of non-conducting bodies, such as glass plates, the thickness of which can be measured with great accuracy.

Readings are taken with ease and certainty to 1/250,000th of an inch, and one-quarter of this can be obtained if specially desired.

March 1.—"An Experimental Inquiry into the Factors which determine the Growth and Activity of the Mammary Glands." By Miss J. E. **Lane-Claypon**, D.Sc., and Prof. E. H. **Starling**, F.R.S.

So far as the authors' experiments go, they show that the growth of the mammary glands during pregnancy is due to the action of a specific chemical stimulus produced in the fertilised ovum. The amount of this substance increases with the growth of the fœtus, and is therefore largest during the latter half of pregnancy. Lactation is due to the removal of this substance, which must therefore be regarded as exerting an inhibitory influence on the gland cells, hindering their secretory activity and furthering their growth. It is probable that the specific substance is diffusible, and will withstand the boiling temperature.

The authors do not, however, claim that these conclusions are firmly established. A final decision can only be given by a research carried on under more favourable conditions. In fact, a farm is required where the authors could have at their disposal 500 rabbits, and could arrange for a plentiful supply each day of rabbits about the middle of pregnancy.

Zoological Society, April 10.—Mr. H. Druce, vice-president, in the chair.—The fresh-water fishes of the island of Trinidad: C. Tate **Regan**. The author's remarks were chiefly based on a collection made by Mr. Lechmere Guppy, jun., and presented by him to the British Museum.

The collection was accompanied by natural history notes and by a series of beautifully executed water-colour drawings. Forty species of fresh-water fishes were now known from the island; these were enumerated in the paper, and four of them described as new to science.—The collection of Alcyonarians made by Mr. Cyril Crossland at Zanzibar in 1901–2: Prof. J. A. **Thomson** and W. D. **Henderson.** Specimens of sixty-five species or varieties were contained in the collection, of which twenty-seven were described as new.—Cyclopia in osseous fishes, as observed in several advanced trout embryos: Dr. J. F. **Gemmill.** A detailed account of the anatomy of the specimens was given, and a comparison made with Cyclopia in mammals. The author's views were also put forward regarding the mode of origin of this condition in fishes.—Cases of supernumerary eyes, and local deficiency and re-duplication of the notochord, in trout embryos: Dr. **Gemmill.**—Descriptions of three new varieties of butterflies of the genus Heliconius: P. I. **Lathy.**

Faraday Society, April 10.—Prof. A. K. Huntington in the chair.—Electrothermics of iron and steel: C. A. **Keller.** The author deals with the present position of his processes; he describes the electrical steel plant which Messrs. J. Holtzer and Co. have just installed in their works at Unieux (Loire). This is a 1500 h.p. plant, and will utilise in a single furnace the current from a 20,000-ampere Westinghouse alternator. The furnace, which rests on a steel cradle and can be tilted, weighs about 50,000 kilos.; the various mechanical and electrical controls are obtained by hydraulic motors. The steel obtained from a Siemens-Martin furnace will be run into the electric furnace immediately after the oxidising melt, and for the remaining operations of deoxidising and refining the current exclusively will be used.—Note on the rotating electric steel furnace in the Artillery Construction Works, Turin: Ernesto **Stassano.** The furnace described and illustrated in the paper is being installed by the "Forni Termoelettrici Stassano" Company for the Italian War Office. It is of the author's well-known arc type, and absorbs 140 kilowatts, yielding 2400 kilos. of steel in twenty-four hours. The current is a rotary one with 80 volts between each phase. The consumption of electrodes is less than 5 kilos. per ton of steel, and the cost of renewing the refractory covering of the furnace 10 francs per ton of metal made. The furnace is principally used for refining pig-iron and smelting scrap. The product ordinarily made is used for artillery projectiles.—Note on recent developments in the Gin electric steel furnace: Gustave **Gin.** The author's canal-type of furnace is now installed at the Plettenberg Works, Westphalia, of which illustrations are given in the paper, but it is not stated which particular type of furnace has there been experimented with. The following types are described:—(1) furnace with canals and chambers; (2) combination furnace; (3) induction furnace.—Notes on the cleaning of work by means of the electric current: H. S. **Coleman.** The work to be cleaned (usually preparatory to electro-plating) is suspended in a hot solution of equal quantities of brown Montreal potash and sodium hydrate contained in a wrought-iron tank. The work and the tank are connected to a dynamo, and the tank used as the anode for five to ten minutes, the voltage being about 2·5. The current is then reversed for a short time, until the surface of the work is clear and bright. The operation is repeated as many times as may be necessary.

Royal Meteorological Society, April 18.—Mr. R. Bentley, president, in the chair.—Some so-called vagaries of lightning reproduced experimentally: A. **Hands.** The author, in the course of an extended investigation into the effects of lightning, has come across many cases that have been called vagaries, but which on a close inspection have proved to be extraordinary only in the erroneous way in which they were described, and, had they been correctly reported, would have appeared perfectly consistent with preconceived ideas—in fact, could have been foretold in every case if the conditions that led to those effects had been known before the events occurred. The author reproduced experimentally several so-called vagaries of lightning, showing by means of rough models the conditions under which they occurred.—The value of a projected image of the sun for meteorological study: Miss C. O. **Stevens.** By this method it has been ascertained that where the direction of movement of the atmosphere is tangential to the limb of the sun, the phenomenon of "boiling" displays a coursing or rippling character, and that where it is perpendicular to the limb of the sun, the character of the movements of distortion is that of springing in and out of the area of the sun's image. Both these elements of movement are continuous even in the absence of all visible cloud, and it is possible, not only to detect, but also to distinguish between overlying invisible atmospheric strata.

Mathematical Society, April 26.—Prof. A. R. Forsyth, president, and subsequently Prof. W. Burnside, vice-president, in the chair.—Perpetuants and contra-perpetuants: Prof. E. B. **Elliott.** It is proposed to apply a method, based on the use of symmetric functions and of certain differential operators, to the discovery of complete systems of perpetuants of given partial degrees in assigned sets of coefficients, which shall be equivalent in their aggregate to those which have been arrived at by the systematic examination of symbolic products. Contra-perpetuants are introduced in connection with Hermite's doctrine of reciprocity between degree and extent in systems of seminvariants when this doctrine is correlated with the theory of perpetuants.—A set of intervals about the rational numbers: A. R. **Richardson.** A definite construction is given for associating a set of intervals with the rational numbers, in such a way that all the rational numbers are included in the intervals, and certain definite sets of irrational numbers are excluded from all the intervals.—Some theorems connected with Abel's theorem on the continuity of power series: G. H. **Hardy.** The paper deals with the generalisation, for series of which the terms are continuous functions of a variable, of certain well-known theorems relating to power series. The convergence of Σa_n is sufficient to secure the uniform convergence of $\Sigma a_n f_n(x)$ in an interval in which all the functions $f_n(x)$ are continuous, and these functions diminish in value as n increases; a similar theorem holds also if Σa_n diverges, but is of the type which can be summed by averages.—The canonical forms of the ternary sextic and quaternary quartic: Prof. A. C. **Dixon.** The forms are the sums of ten sixth, or fourth, powers, as the case may be. Processes are given for carrying out the reductions to these forms, and it is shown that in each case there are two solutions.—The accuracy of interpolation by finite differences: W. F. **Sheppard.** The paper deals with the relative accuracy of the ordinary advancing-difference formula and the central-difference formulæ in regard to the two sources of error which arise (1) from omitting the remainder in the series by which the values of a function are calculated, (2) from the fact that tabulated values of a function are only approximate.—The geometrical interpretation of apolar binary forms: C. F. **Russell.** The paper is concerned with geometrical constructions which may be regarded as generalisations of the construction of the fourth harmonic point of three given points in a definite order. For two apolar forms of the same order, analogous to two quadratic forms harmonically related, the construction is linear.—Two cubic-curves in triangular relation: Prof. F. **Morley.**—The question of the existence of transfinite numbers: P. E. B. **Jourdain.**—A question in the theory of aggregates: Prof. A. C. **Dixon.**

PARIS.

Academy of Sciences, April 17.—M. H. Poincaré in the chair.—The president announced the death of Prof. Langley, correspondant of the academy.—The evaluation of the foco-facial distances of microscopic objectives: L. **Malassez.** A comparison of two experimental methods with the results of a formula developed by the author in previous papers.—Pure ferro-molybdenums: contribution to the study of their constituents: Em. **Vigouroux.** Alloys of iron and molybdenum containing varying proportions of the two constituents were submitted to treatment either with dilute hydrochloric acid or an acid solution of cuprous chloride. The insoluble residues from fourteen separate alloys were analysed, and the following four compounds of iron and molybdenum isolated in a pure state:—Fe_2Mo, Fe_3Mo_2, $FeMo$, $FeMo_2$. The physical and chemical proper-

ties of each of these are given.—A characteristic reaction of ethyl glyoxylate: the action of ammonia on this ether and its derivatives: L. J. **Simon** and G. **Chavanne.** By the action of ammonia on ethyl glyoxylate a substance $C_4H_9N_3O_4$ is formed. This is blue-black in colour, and possesses very powerful tinctorial properties, and hence may form a useful test for this ester. The composition of this substance has not yet been established.—The acid properties of starch: E. **Demoussy.** Starch possesses all the characters of a feeble acid, comparable with carbonic acid, and resembling in this respect the other carbohydrates. It forms compounds with metallic hydroxides which are dissociable by water, and can absorb small quantities of neutral salts. These properties probably play a part in the absorption of mineral matters by plants.—The state of colouring matters in crystals coloured artificially: P. **Gaubert.** It has been shown in previous papers that there are two cases in the artificial colouring of crystals; in the first case the crystal is only coloured when the solution from which the crystal is depositing is nearly saturated with the colouring material; in the other case the crystal is coloured, whatever the dilution of the colouring material. The present paper gives details of measurements made on crystals of the latter class, phthalic acid, with methylene blue in solution. It was found that the ratio of the concentrations of the methylene blue in the liquid and crystals was practically constant, although the absolute concentration of the methylene blue was made to vary within wide limits. Similar results were found with methylene blue and crystals of urea nitrate.—The Vesuvian origin of the dry storm observed at Paris on the morning of April 11: Stanislas **Meunier.** A microscopical examination of the dust deposited during this storm showed it to be identical in nature with the dust from Vesuvius in 1822.

DIARY OF SOCIETIES.

THURSDAY, MAY 3.

ROYAL SOCIETY, at 4.—Election of Fellows.—At 4.30.—On a Static Method of Comparing the Densities of Gases: R. Threlfall, F.R.S.—The Stability of Submarines: Sir William H. White, K.C.B., F.R.S.—The Action on Bacteria of Electrical Discharges of High Potential and Rapid Frequency: A. G. R. Foulerton and A. M. Kellas.—The Action of Pituitary Extracts upon the Kidney: Prof. E. A. Schäfer, F.R.S., and P. T. Herring.

ROYAL INSTITUTION, at 5.—The Digestive Tract in Birds and Mammals: Dr. P. Chalmers Mitchell.

CHEMICAL SOCIETY, at 8.30.—The Relation between Absorption-Spectra and Chemical Constitution, part v.: The *iso*Nitroso-compounds: E. C. C. Baly, E. G. Marsden, and A. W. Stewart.—The Action of Tribromopropane on the Sodium Derivative of Ethyl Malonate, part ii.: W. H. Perkin, jun., and J. L. Simonsen.—Brazilin and Hæmatoxylin, part vii., Some Derivatives of Brazilein: P. Engels, and W. H. Perkin, jun.—Pipitzahoic Acid: J. M. Sanders.—The Constitution of the Hydroxides and Cyanides obtained from Acridine, Methyl-acridine and Phenanthridine Methiodides: C. K. Tinkler.—The Constitution of Ammonium Amalgam: E. M. Rich and M. W. Travers.—Action of Light on Potassium Ferrocyanide: G. W. A. Foster.

LINNEAN SOCIETY, at 8.—Origin of Gymnosperms (*Continuation of Discussion*): Dr. D. H. Scott, F.R.S.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—Some Observations on Bacterial Tank Operations: Dr. W. O. Travis.

FRIDAY, May 4.

ROYAL INSTITUTION, at 9.—The Steam Turbine on Land and at Sea: Hon. Charles A. Parsons, C.B., F.R.S.

GEOLOGISTS' ASSOCIATION, at 8.—The Erosion of the Batoka Gorge of the Zambesi: G. W. Lamplugh, F.R.S.

MONDAY, MAY 7.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—From the Victoria Nyanza to Kilimanjaro: Col. G. E. Smith, R.E.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Some Notes on the Gutzeit Test for Arsenic: J. Goode and Dr. F. Mollwo Perkin.—The Separation of Brucine and Strychnine. Influence of Nitrous Acid in Oxidation by Nitric Acid: W. C. Reynolds and R. Sutcliffe.—Absorption of Gallic Acid by Organic Colloids: W. P. Dreaper and A. Wilson.

VICTORIA INSTITUTE, at 4.30.—The Zodiac: its History and Biblical References: Rev. A. B. Grimaldi.

TUESDAY, MAY 8.

SOCIETY OF ARTS, at 8.—Damascening, and the Inlaying and Ornamenting of Metallic Surfaces: Sherard Cowper-Coles.

UNIVERSITY OF LONDON, at 5.—The Atmospheric Circulation and its Relation to Weather: Dr. W. N. Shaw, F.R.S.

ROYAL INSTITUTION, at 5.—Glands and their Products: Prof. W. Stirling.

WEDNESDAY, MAY 9.

SOCIETY OF ARTS, at 8.—Bridge Building by Means of Caissons, including Remarks upon Compressed Air Illness: Prof. Thomas Oliver.

GEOLOGICAL SOCIETY, at 8.—The Eruption of Vesuvius in April, 1906: Prof. Giuseppe de Lorenzo.—The Ordovician Rocks of Western Caermarthenshire: D. C. Evans.

THURSDAY, MAY 10.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: "Adsorption" and "Occlusion": the Law of Distribution in the Case in which one of the Phases possesses Rigidity: Prof. M. W. Travers, F.R.S.—Cyanogenesis in Plants, part iv., Phaseolunatin in Common Flax (*Linum usitatissimum*); part v., The Occurrence of Phaseolunatin in Cassava (*Manihot Aipi* and *Manihot Utilissima*): Prof. W. R. Dunstan, F.R.S., Drs. T. A. Henry, and S. J. M. Auld.—A Variety of Thorianite from Galle, Ceylon: Prof. W. R. Dunstan, F.R.S., and B. Mouat Jones.—The Mechanism of Carbon Assimilation in Green Plants: the Photolytic Decomposition of Carbon Dioxide *in vitro*: F. L. Usher and J. H. Priestley.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Long Flame Arc Lamps: L. Andrews (Adjourned Discussion).

FRIDAY, MAY 11.

ROYAL INSTITUTION, at 9.—Some Astronomical Consequences of the Pressure of Light: Prof. J. H. Poynting, F.R.S.

PHYSICAL SOCIETY, at 8.—The Effect of a Rapid Discharge on the Throw of a Galvanometer: A. Russell.—Exhibition of Lippmann Capillary Dynamo and Electromotor: Prof. H. A. Wilson.—Exhibition of an Apparatus for demonstrating the Movements of the Diaphragms of Telephonic Transmitters and Receivers and the Current flowing into and out of the Cable during Speech: W. Duddell.

ROYAL ASTRONOMICAL SOCIETY, at 5.

MALACOLOGICAL SOCIETY, at 8.—Notes on the Subgenus Malluvium: E. A. Smith, I.S.O.—Notes on some Species of the Genus Mitra, with the Description of *M. Brettinghami*, n.sp: E. A. Smith, I.S.O.—On some Land- and Fresh-water Mollusca from Sumatra, part ii.: Rev. R. Ashington Bullen.—Notes on a Collection of Nudibranchs from the Cape Verde Islands: C. Crossland and Sir Charles Eliot, K.C.M.G.—Notes on Indian and Ceylonese Species of Glessula: Col. R. H. Beddome.

CONTENTS.

SUPPLEMENT TO "NATURE."

SUPPLEMENT TO "NATURE."

LOCALISATION OF CEREBRAL FUNCTIONS.

Histological Studies on the Localisation of Cerebral Function. By Dr. A. W. Campbell. Pp. xx+360. Published by aid of a subsidy from the Royal Society. (Cambridge: University Press, 1905.) Price 18*s.* net.

THIS important monograph is a very valuable contribution to neurological science, for the following reasons:—(1) It further establishes a correlation between histological structure and physiological function in the brain. (2) It furnishes a complete descriptive atlas of admirable illustrations of the cell and fibre structure of the human cerebral cortex, whereby neurologists will be enabled, by adopting Dr. Campbell's methods, to examine pathological states of the cerebral cortex and compare the same with the normal. (3) It deals with certain important pathological conditions of the cerebral cortex bearing upon the subject of correlation of function and structure in a fuller, more precise and detailed manner than has hitherto been attempted, viz. amyotrophic lateral sclerosis, tabes dorsalis, amputation of limbs, and deaf-mutism. (4) It adds to our knowledge, by a complete comparative survey of the cell and fibre structure, of the cerebral cortex in the following mammals:—cat, dog, pig, anthropoid apes, and man.

The author in a short introduction refers to the work of some previous observers, and claims that he has pieced together the disjointed knowledge of the histology of the cerebral cortex by a complete survey of its cell and fibre architecture. It is excusable for one who has devoted a number of years to its study to make the following statement:—"the microscopist will probably succeed in defining and rubbing the corners off the boundaries of the productive field" which experimental and clinico-anatomical observations have shown to be correlated with precise functions, which, however, have not, as the author says, come from the "pens" of the physiologists or from "an honoured *coterie* of observers following in the footsteps of Broca," but from an army, of whom, in England, Hughlings Jackson was the leader.

We doubt very much whether present methods of histology will throw any new light, beyond that which has been already shed by Flechsig, on the higher functions of the cerebral cortex; in fact, that Dr. Campbell should have used six out of eight brains from persons of unsound mind dying in Rainhill Asylum, with the assurance that they in no way differed from the normal, is not very hopeful in this respect.

Chapter i. deals with material and methods. The essential feature was the systematic examination of every part of the cortex according to a definite plan of dividing the hemisphere into fifty or sixty blocks; these were numbered, and sections from each block of the uniform thickness of 25 μ were taken at intervals of 1 mm. and subsequently stained for cells and fibres by two well known methods, then mounted. Microscopic drawings were then made to scale, the low power at a magnitude of 80/1 and the high power at 480/1.

Dr. Campbell, having thus acquired a topographical knowledge of the cell and fibre structure of the human cortex, has applied that knowledge to a comparative histological survey of the brain of the anthropoid apes, and of certain pathological conditions of the cerebral cortex.

Chapter ii. consists of general histological considerations on medullated fibre arrangement and cell lamination. It may be noted that the author has made seven layers of cells; it would probably have been better had he restricted the term layers to those which are laid down in the developing embryo.

Chapter iii. deals with the pre-central or motor area. Bevan Lewis and Clarke, in a valuable communication to the Proceedings of the Royal Society, 1878, mapped out the motor area by the presence of the large Betz cells, which they showed were found only in the ascending frontal convolution and a small co-terminous portion of the para-central lobule. Dr. Campbell confirms these observations, and shows that the same distribution of the large cells occurs in the anthropoid apes. Moreover, the distribution of these cells coincides absolutely with the field which Sherrington and Grünbaum have found respond to unipolar faradisation, thus affording the connecting link necessary to apply the stimulation experiments on the anthropoid apes' brains to the localisation of the motor area in man. Strong confirmatory evidence of the localisation of volitional muscular movements residing in the pre-central area is afforded by the examination of the brain in two cases of amyotrophic lateral sclerosis, a disease limited to the motor system of neurons. The author describes a wholesale disappearance of giant cells of Betz in this region. He asserts that in the same brain the post-central gyrus entirely escaped affection.

In three cases of amputation of the leg and a like number of cases of amputation of the arm, in which the central convolutions were examined in a series of sections, alterations were discovered limited in distribution to fields agreeing closely with the leg and arm areas delimited by experimental observation. At the level of the superior genu the annectant gyrus or buttress, which is relatively devoid of "giant cells," seems to be an important guide to the point where the trunk area intervenes between those of the arm and leg.

Chapter iv. is on post-central and intermediate post-central areas. This area is readily defined in the anthropoid ape and man, and is limited in its distribution to the post-central or ascending parietal gyrus and its para-central annexe; the floor of the fissure of Rolando is the anterior boundary. Its cortical structure is different from that of the pre-central area; it exhibits structural features similar to that of known sensory areas (the visual and auditory). Dr. Campbell therefore denies its motor function. But, it may be asked, would histological studies have been listened to any more now than when Bevan Lewis described the distribution of the motor cells had it not been that experimental observations on anthropoid

apes showed that it did not respond to unipolar excitation, and that partial ablation gave rise to no interference with movement? The author makes a good deal of the fact that he has examined three cases of tabes dorsalis, and observed profound cortical alterations concentrated in this area. He would argue, therefore, that correlated systems of sensory neurons were alone affected. Without denying the probability of this fact, which has been put forward by previous authorities, it may be doubted whether the evidence is altogether satisfactory, for two of the cases were admitted tabo-paralysis, and the other was not free from suspicion.

Chapter v. deals with the visual area. There are two definite and distinct areas, named by Bolton visuo-sensory and visuo-psychic. The distribution of the first corresponds to the line of Gennari, and occupies especially the region of the calcarine fissure; it is therefore often spoken of as the calcarine, or more properly the striate area. Campbell confirms Bolton's work on the visuo-sensory area, and delimits the second definable visuo-psychic area, which forms a skirt to the first, and practically covers the remainder of the occipital lobe. It is characterised by a remarkable wealth of nerve fibres and curious large pyramidal cells. In the chimpanzee and orang analogous areas were demonstrated, but it was found that they extended much more widely on the lateral surface of the hemispheres. It is curious that Dr. Campbell has not observed that in a very considerable percentage of lunatics' brains the visuo-sensory (striate) area extends from 10 mm. to 30 mm. on to the external surface. Moreover, Eliot Smith has shown that this condition exists in a very considerable percentage of the brains of Egyptians.

Connected within the sylvian fissure, and occupying the transverse temporal gyri, is a small but important field characterised by coarse fibres and large pyramidal cells. This the author calls *audito-sensory*; the skirt of cortex circumjacent he terms audito-psychic. These two areas correspond with the primordial and intermediary myelogenic areas mapped out by Flechsig. The author remarks that the remainder of the temporal lobe is characterised by a poverty in cells and fibres of large size.

The angular gyrus is not endowed with any specialised architecture, although clinico-anatomical evidence shows that it has a special function connected with word vision. Dr. Campbell does not even consider the cortical localisation of impressions coming from the semi-circular canals by the external auditory nerves, although he describes cortical changes in a case of deaf-mutism.

The author admits that although histological researches of previous observers leave hardly anything further to be learnt concerning the morphology of the cell and fibre elements resident in the cortex of the limbic lobe, "yet the exact cortical localisation of the olfactory and gustatory centres is sadly wanting." The lobus pyriformis is probably the principal cortical centre, although not the sole one, governing the olfactory sense. Its structure is characterised by superficially placed clusters of stellate cells, and a tendency on the part of projection fibres to reach the surface.

The cell and fibre architecture of the hippocampal area and cornu ammonis show characteristic features, and yet the functions of these parts are obscure. Neither do we know the function of the gyrus fornicatus; but the author decides against its being concerned with common sensation by the fact that there is a total absence of large fibres and large cells found in other sensory regions.

Histological observations show that the cortex of the parietal lobe possesses all the cell laminæ of, and a similar arrangement of nerve fibres to, the intermediate post-central area, but it differs in containing a smaller number of special large pyramidal cells and of large medullated fibres. The boundaries of this region, however, are not very definite or its characteristics very clear. Is it a fact that "a homologous area can be traced phylogenetically throughout the *vertebrate* series," or does the author really mean mammals?

The intermediate pre-central area is characterised by a similarity of structure to the pre-central area in the fact that there are large cells and coarse, medullated fibres, but they are greatly reduced in numbers. He also points out that the stellate cells are much less abundant than behind the Rolandic fissure. He regards this area as being a cortical region presiding over complex later developed skilled movements, which clinico-anatomical observations had previously proved. Moreover, the area agrees closely with the intermediate area of Flechsig mapped out by developmental methods. He finds that the whole inferior frontal convolution is similar in structure, and he assumes, therefore, that it is similar in function, and therefore governs the motor element in speech. This argument is, however, not very convincing.

Chapter x. deals with the remainder of the frontal lobe, which he divides into frontal and pre-frontal. The results of this chapter are disappointing, for it might be expected that histological studies would have thrown more light on the possible functions of this lobe; for the author states on p. 248:—

"Without adding materially to our knowledge of the functions of the frontal lobes, histology throws light on some of the observations of previous observers." "No explanation can be given of the truth that stimulation of the frontal lobe produces eye movements."

He rather exaggerates the poverty of fibres in this region according to some authorities.

Chapter xi. is concerned with the island of Riel, which consists of two types of cortex, the anterior similar to the lobus pyriformis, the posterior to the adjacent first temporal convolution. The insula is old, and it plays a more important part in primitive mammals than in man.

At the end of each chapter is a summary and an index of references to the work of other observers on the subject. The book concludes with a valuable addendum, part i. containing a comprehensive survey of the cell and fibre architecture of the cortex of three types of mammals, the cat, dog, and pig.

Part ii. takes into consideration the function and homologues of the areas which can be defined by the difference in cell and fibre characters. There is a vast amount of information and patient, careful work in this book, and it is impossible in a review to do more than indicate some of the principal points; but all men of science who are interested in the subject of brain structure in man and animals will be well repaid by a careful study of the work, aided by the admirably executed twenty-nine plates illustrating the cell and fibre structure of the brain and the topography of the histologically defined areas. F. W. M.

PIONEERS OF GEOLOGY.

The Founders of Geology. Second edition. By Sir Archibald Geikie, F.R.S. Pp. xi+486. (London: Macmillan and Co., Ltd., 1905.) Price 10s. net.

A FOUNDATION should be laid on a sound bottom, and should be itself constructed so as to hold together in one solid mass. For this, each man engaged upon it must carry out thoroughly the work entrusted to him, one in an obscure corner mixing the mortar, another, more in evidence, laying the bricks.

So in the building up of systems of knowledge we must take care that our theories are based upon those ascertained facts which we call the laws of nature, and, further, that each stage in the superstructure is consistent It is difficult to appraise exactly the value of the work of each. Many a modest and retiring worker has suggested good things which have afterwards been followed up by others; many a thoughtful student has pointed out faulty reasoning upon which vast theories were being erected.

Sir Archibald Geikie, on a former occasion, came round and selected for commendation or for criticism some of those who have been most prominent in building up the science of geology, and pointed out what was good and what might have been better done. He now inspects more in detail the work of those who laid the very foundations or prepared the ground for their reception, and gives us, first of all, a sketch of what, as we gather from very scattered notices, were the views held by the Greeks and Romans on geological questions. Then he carries us through the dark ages, in which only a small spark of intelligent observation gleamed here and there.

In order to present the speculations of the earliest writers who have referred to the subject in some definite order, our author considers them under three heads. In the Mediterranean area underground processes forced themselves upon the attention of all thoughtful and observant men, and, when we remember the story of Graham Island, which was rapidly thrown up, had the British flag hoisted upon it by Admiral Smythe, and then disappeared, it is interesting to note that Strabo and Pliny confirm the sudden appearance of islands due to ejected material. These and other ancient writers, however, could not get very far in the exploration of earthquakes and volcanoes, but referred them to wind pent up in vast cavities in the bowels of the earth.

With regard to the processes at work upon the surface of the earth, we learn that the ancient philosophers inferred that the sea now covers areas that were once dry land, and that land will appear where we now find sea, but that these phenomena escape our notice because they take place successively during periods of time, which, in comparison with our brief existence, are immensely protracted.

Herodotus calls Egypt "the gift of the Nile," while Strabo points out that deltas are prevented from advancing seawards indefinitely by the wash of the waves.

Then followed the dark ages, so far as concerned investigations into the operations of nature, until the Arabs took up the work and the learned Avicenna translated Aristotle, and expressed, even more clearly than did his Greek master, opinions regarding the origin of mountains and valleys, which show a singular forecast of modern geology.

Sir Archibald Geikie leads us on in his happy style through the later middle ages, pointing out the prejudices that hindered free inquiry, and bringing in great names, like that of Leonardo da Vinci, which we would hardly expect to find among the pioneers of geology.

Many were the shifts to which men were driven in those days in order to avoid collision with ecclesiastical authority. Some said that what looked like bones, shells, and plants in the rocks were introduced during Noah's flood; some refused to admit that they were anything but earthy concretions; and one writer went so far as to suggest that even the potsherds of Monte Testaccio at Rome were only natural productions of the earth. Some clear-headed writers tried from time to time to place scientific inquiry upon a better and more independent footing. Steno, for instance, in the seventeenth century, broke away from all preconceived ideas and prejudices, and his treatise "De Solido intra solidum naturaliter contento" marks an epoch in the history of geological investigation.

The next phase was characterised by the appearance of a number of cosmogonies, or historical sketches of the manner in which it was supposed that the crust of the earth had been built up and reached its present condition. Men's judgment was often wrested, and facts and logic strained, in the attempt to make these "theories of the earth," as they were called, consistent with orthodox ideas and with themselves, but, though they did little to advance scientific truth, they at any rate forced people to think about such things.

Buffon recognised that the earth was only part of a great planetary system, and suggested that many of the changes produced upon its surface were such as would be evolved in a mass gradually cooling down. He worked long and carefully, appealing to observation and experiment, and often getting very near a good theory, but never quite achieving it.

Sir Archibald Geikie could not, of course, in the case of the ancient writers, tell us much of their personality, their bringing up, and early associations. The description of these gives a human interest to

his account of the later writers, and enables us to realise many circumstances which coloured their scientific work.

It is interesting to learn that the majority of the more notable of those who have created the science of geology have been men engaged in other pursuits who have devoted their leisure to scientific research. Until lately there was no training in natural science such as can now be obtained at our universities and elsewhere. The nearest approach to it was the instruction given in the medical schools, and many of the best geologists have been medical men. None could, then, have been called professional geologists in the sense of having been trained specially for geological study, and but few in the sense of having made it their life's work and received pay for it, such as Sedgwick, who, having been a resident fellow of great distinction in both classics and mathematics, was appointed professor of geology, or Murchison, who, having been a soldier, was made director of the Geological Survey.

The author has recast and added to the biographical sketches of the great leaders of geology as drawn in his first edition, and has made a good book yet better. It is a work which should be in the hands of all students of geology, while the general reader cannot fail to be interested in this chapter in the history of discovery told in such charming, simple language.

ELECTROCHEMISTRY.

Experimental Electrochemistry. By N. Munroe Hopkins, Ph.D. Pp. xiv+284. (London: Archibald Constable and Co., Ltd., 1905.) Price 12*s.* net.

THE author's desire is, as he states in the preface, to produce a book which will prove useful both in the laboratory and in the lecture theatre, or, as he probably means, for home study. The book commences with a brief historical review of the subject, and the student is intended to carry out some of the classical experiments upon which the foundations of this essentially experimental branch of chemistry and physics have been built up. For example, he is instructed how to repeat Sir Humphry Davy's work on the isolation of the alkali metals. A portion of this chapter is also devoted to instructions how to manipulate the electrical supply by cutting down the current from the lighting mains with a lamp resistance, or to alter the voltage by means of a small motor generator. The author then comes to the subject of electrolytic dissociation. Dr. Hopkins is no half-hearted supporter of the ionic theory; it is evidently his sheet anchor, by which all other theories must be tested, and if they do not conform then there is evidently something lacking in these theories. It must be admitted that the author makes out a very strong case for the theory of electrolytic dissociation, and he gives experiment after experiment to prove his case. Chapter ii. deals with osmotic pressure and how to carry out the determinations; a complicated apparatus is described for experimentally proving the principle of Soret. In chapter iii. boiling- and freezing-point methods are dealt with, and experiments are described to show that chemical action will not take place except in the presence of moisture.

The next chapter treats of experiments in electrolytic induction. Some of these experiments are of an extremely interesting character, although whether opponents of the ionic theory would be prepared to admit that they are valid proofs of the theory is open to doubt. Starting with the well known fact that a negatively charged conductor will induce an opposite charge in the end of a rod brought into its neighbourhood, he describes experiments to show that the same holds good in the case of an electrolyte, and then argues that, as electricity can only pass through a liquid by means of ions, therefore the induced charge is caused by ionic movement. In the experiment of Ostwald and Nernst, where the actual liberation of hydrogen by an induced charge is made visible to the naked eye, the proof seems complete. The author, however, gives other very interesting cases where the induced charge is shown by means of a delicate mirror galvanometer, and in which no chemical change is obvious, any more than it is obvious in the case of a solid conductor. Some of the most novel experiments in this direction described by the author are those in which he shows that a magnet induces a current of electricity in an electrolyte, the magnet being placed in the centre of a glass coil containing the electrolyte.

The chapter on the velocity of electrolytic conduction is interesting, and the question of the absolute velocity of the ions is very fully dealt with. Here again the author shows his ingenuity by the number of novel experiments which he describes, and by his modification of the experiments of other workers. A large number of experiments are described to illustrate Faraday's laws, both in connection with dissolved and fused electrolytes. Dr. Hopkins also describes an experiment to illustrate the mechanical transfer of matter through solid glass. A piece of glass rod is taken with platinum wires fused into either end, the wires being about 1 cm. apart in the centre. The two wires are connected in series with a milliammeter and with the electric lighting circuit. No current, of course, passes, but on heating with a Bunsen burner until the glass commences to soften a deflection is noticed on the ammeter. With the softening of the glass, therefore, the ions are free to travel, at any rate; the glass is no longer an insulator.

The portion of the book dealing with electrolytic analysis is very short, and will be useful more as a suggestion as to what can be done than as a guide for analytical purposes. To a certain extent the same remarks apply to the electrolytic preparations which are given. The part devoted to furnace work, that is, laboratory furnace work, is pretty full. A good deal of space is given to the isolation of aluminium and also of sodium. The section devoted to calcium should be brought up to date.

An interesting account is given of the production of nitric acid from the atmosphere, with historical notes, and this chapter fails in one thing only—no

mention is made of the Birkeland successful manufacturing process. This is hardly the author's fault, because it is so recent that the author could only have added it to the book as a supplement, bearing in mind the time a book takes to pass through the press. A few organic preparations are given, such, for example, as the preparation of chloroform; not having tried it as illustrated by the author we wonder whether it is a success. It looks very similar to the description of processes which we know are not successful.

The last portion of the book is devoted to primary and secondary cells, and to the generation of electricity from carbon. Nothing is impossible in science, and perhaps some day the glowing hope of many young and some old investigators may be realised, and the carbon cell become our source of electrical energy.

The book is well printed and splendidly illustrated. The author is an American, and it makes our mouths water to think of the magnificent equipment which his laboratory must possess. It is not difficult to understand why electrochemistry flourishes abroad; the foundations were laid here, part of the superstructure was raised, but where is the finished building? We advise those interested in electrochemistry, and also those who do not believe in it—and there are a goodly few—to read this book.

F. M. P.

THE VANISHING EAST.

A People at School. By H. Fielding Hall. Pp. viii+286. (London: Macmillan and Co., Ltd., 1906.) Price 10*s.* net.

THERE are several different ways in which to write of foreign countries, and Mr. Fielding Hall, who knows his Burma as thoroughly as it can be known by a European, has chosen the psychological point of view and the philosophical method. He had already broken ground in this direction in his "Soul of a Nation," and one hoped that the fascinating study afforded by that book was to be continued in the present one, which deals with the Burmese in their transition stage. The hope is not altogether fulfilled. An author must not complain if his work is always measured by his own highest achievement, and, although "People at School" is an interesting and suggestive book, it is disappointing after the "Soul of a Nation." It is, as the author confesses, made up of chapters written at odd times, and the result of this method is a certain amount of repetition and some contradiction, while the style is so jerky and broken as to become fatiguing; but, when these criticisms as to manner have been made, one is still aware that the matter of the book is unusually good and interesting. So much has been written of eastern countries that it is no small achievement to give an unhackneyed rendering of so familiar a theme—and Mr. Hall is never conventional and at the same time is always faithful to life.

The first half of the book gives a picture of Burma before and at the time of the British "occupation" of Upper Burma. In writing of times that are past and gone, while still within our recollection, we have all to be on our guard against a popular illusion as to the "good old days." My sympathies are naturally with Mr. Hall in his half-stifled regrets for the picturesque period of Burmese history. I too knew old Burma; I too sat under a banyan tree and represented the majesty of England to a district, dispensing paternal justice with the sureness (and successfulness) of youth and profound faith in the mission of the Anglo-Saxon. I shared the dacoit hunts the wearisome monotony of which, varied by the writing of picturesque reports, Mr. Hall describes with such humour and veracity. Moreover, I assisted (as he was not able to do) in the settling-down period, and am able to endorse his remarks as to the only policy possible towards a conquered people and the folly of burning villages as reprisals; and we were both younger in those days than we are now and life was much more of a vast adventure. We must not cast too much personal glamour over the good old times when we comment on the dull sobriety of Burma to-day—the well administered Indian province.

Nevertheless, a feeling of depression creeps over me as I read of the Burman of to-day. He is prosperous, says Mr. Hall, but is losing his sense of the joyousness of life. One's memories of Burma are inextricably interwoven with the picture of a childishly happy people—the most attractively merry, gentle, light-hearted people of the East. Have we put them into a dull, conventional mill? Are we crushing them with the weight of our materialistic civilisation? Despite his half-hearted disclaimers Mr. Hall is evidently afraid that this is so, and, although he stoutly hopes that this is only a transition period—a people at school—and that manhood will bring the Burman a newer and brighter horizon, yet one cannot but regret that political destiny made it necessary for us to destroy the Burmese ideals when we could give them nothing better. Our system of government, as Mr. Hall shows clearly, while respecting native laws and custom, is inevitably a superstructure, unlike the system which grows up from the soil. Even our method of employing the headmen of villages as Government officials has its weak side, and it is interesting to note that a similar system regarding the chiefs of tribes is having the same effect in South Africa. Both headman and chief are no longer regarded by villagers or tribe as representatives of the people, but as those of the Government. It is a strong distinction.

There are several points on which I must join issue with Mr. Hall. He would have us believe that the Indian money-lender and coolie and the Chinese trader are really helpful to the Burmese and advance their progress. So long as the Burman is able to retain his hold of the soil that may be, but how long can he do this in the teeth of foreign invasion? Mr. Hall also rests too much of his psychology on the presumed "youth" of the Burmans as a race, disregarding their many points of resemblance with other Indo-Chinese peoples. One would have liked a comparison also with the Japanese, who have many of

the "youthful" characteristics of the Burmese. While the former "adapt" Occidental civilisation, however, the Burmese can only "adopt" it, with the result that it seems to denationalise them.

The interesting chapter on women, who play so large a part in Burma, being the equals of men legally and socially, suggests another interesting comparison (which Mr. Hall seems to miss) with the French nation. The Burmese law of inheritance (that is the Buddhist law that a man may make no disposal of his goods after death) resembles the French system of dividing the property between the children. The result in both countries is to limit individual ambitions and to raise the legal status of women, who become co-partners with their husbands in all business affairs and are often much the better horse.

That this book is rather suggestive than conclusive is one of its charms, and no one who cares for the mysterious and vanishing East should fail to read this study of a people at school.

ARCHIBALD R. COLQUHOUN.

ELEMENTARY MATHEMATICS.

(1) *Easy Mathematics of All Kinds.* Vol. i. *Chiefly Arithmetic.* By Sir Oliver Lodge, F.R.S. Pp. xv+436. (London: Macmillan and Co., Ltd., 1905.) Price 4*s.* 6*d.*

(2) *Arithmetic for Schools and Colleges.* By John Alison and John B. Clark. Pp. viii+471+xlvii. (Edinburgh and London: Oliver and Boyd, 1905.) Price 4*s.*

(3) *Elementary Trigonometry.* By H. S. Hall and S. R. Knight. Fourth edition, revised and enlarged. Pp. xv+415. (London: Macmillan and Co., Ltd., 1905.) Price 4*s.* 6*d.*

(4) *Engineering Mathematics, Simply Explained.* By H. H. Harrison. Pp. 165. (London: Percival Marshall and Co.) Price 1*s.* 6*d.* net.

(1) ONE of the reasons which induced a busy scientific man like Sir Oliver Lodge to write a book on easy mathematics is thus given by the author in the preface:—

"The mathematical ignorance of the average educated person has always been complete and shameless, and recently I have become so impressed with the unedifying character of much of the arithmetical teaching to which ordinary children are liable to be exposed that I have ceased to wonder at the widespread ignorance, and have felt compelled to try and take some step towards supplying a remedy."

No teacher of arithmetic or elementary mathematics can afford to be without this most suggestive book, in which the results of much thought and a wide experience are presented in a deeply fascinating style, and untrammelled by conventional or artificial restrictions. The first four chapters give suggestions for teaching very young children the operations of counting and the simple rules of arithmetic. The appeal is made through their games and any concrete things in which they are likely to have an interest, and vulgar and decimal fractions and negative quantities seem to present no difficulties. The writer is emphatic in his declaration that the whole subject of mathematics is essentially experimental and should be developed on an experimental basis. Concrete quantities are quite early dealt with like abstract numbers, and multiplied and divided freely, *e.g.* 60 miles/1 hour is the *speed* of an express train. The author advises that units should, where suitable, be inserted in the numerator and denominator of a fraction, and cancelled like ordinary numbers, in order to emphasise the *dimensions* of the quantities under consideration.

But it is impossible in a short article to give any adequate account of the book, treating as it does, to mention only a few things, of the decimalisation of money, indices, logarithms, incommensurables and discontinuity, approximations, progressions, means and averages, differentiation, &c., with interesting historical references and digressions, the whole being continuously illustrated and illuminated by applications drawn from the wide domain of natural science, of which the author has so extensive a knowledge.

(2) The arithmetic by Messrs. Alison and Clark is a very complete treatise, written mainly on conventional lines, and devoting a large portion of its space to commercial aspects of the subject. But the authors do not forget that the physical laboratory has also claims on their attention, and they give many good exercises in physics and mechanics, using four-figure tables of logarithms, and approximate methods of computation in appropriate cases. The authors are very partial to abstract reasoning, and general propositions seem to us to be introduced and deductions established somewhat prematurely, before the boy can have the concrete and experimental knowledge requisite to understand the matter. Thus in chapter vi., immediately after the completion of the four simple rules, the laws of the operations for the symbols are fully discussed; but it is wisely hinted that this chapter may be skipped on a first reading.

The text-book is intended for use in both schools and colleges. It is profusely supplied with examples of varying grades of difficulty. The answers collected at the end of the volume themselves occupy forty-seven pages of closely printed matter. The book is very suitable for advanced pupils and for prospective teachers, but beginners would require guidance as to what parts to omit.

(3) The new edition of Messrs. Hall and Knight's "Elementary Trigonometry" has been revised and enlarged by the introduction and use of four-figure tables of logarithms and antilogarithms of numbers, and of natural and logarithmic functions of angles, also by examples of the graphing of trigonometrical functions, and the insertion of additional examples of a practical nature. A first course is specially outlined which, by omitting some of the more advanced formulæ, allows numerical computations by four-figure tables to be reached at a comparatively early stage, and most teachers will no doubt follow this plan.

The revision has brought the fourth edition up to modern requirements, and little more need be said about a book the great merits of which are so generally recognised. In defining the ratios and establishing the fundamental formulæ for angles of any magni-

tude, we should like to have seen the essentially vector nature of the subject made more manifest, and at intervals enforced by examples drawn from physics and mechanics. There seems no good reason why in elementary text-books of trigonometry practical applications should in the main be confined to the ship-tower-flagstaff type of examples.

(4) The text-book on engineering mathematics by Mr. H. H. Harrison comprises chapters on arithmetic, algebra, trigonometry, mensuration, logarithms, squared paper, and the calculus. The presentation of the subject by the author is crude and uninteresting, no examples are provided for practice, and the book cannot be recommended for any class of student.

TROPICAL MEDICINE.

Lectures on Tropical Diseases, being the Lane Lectures for 1905 delivered at the Cooper Medical College, San Francisco. By Sir Patrick Manson. Pp. viii+230. (London: Constable and Co., Ltd., 1905.) Price 7*s.* 6*d.* net.

TROPICAL pathology no doubt owes much of its fascination to the fact that new diseases, or the causes of old diseases, have only within the last decade been completely elucidated, and that every year, if not every month, fresh facts appear and fresh subjects of inquiry suggest themselves. Thus almost before the ætiology of sleeping sickness was fully elucidated, students of tropical pathology were given a fresh subject of inquiry from the discovery of the cause of the dreaded "tick fever" of Tete on the Zambesi, and of other parts of tropical Africa. When the interest in the Anophelinæ and *Stegomyia fasciata* had somewhat waned, the tropical pathologist had his attention diverted to tsetse-flies, and then again the hue and cry was in the direction of ticks, especially in Africa towards *Ornithodorus moubata*, the transmitter of the spirochæte of "tick fever."

In India the malariologist must have recently received a severe shock to find that many of his most familiar cases, which he designated "malaria cachexia with enlarged spleen," are in all probability due to an entirely new parasite, or at least the parasite can be found in the organs of such cases. In tropical pathology Africa has provided many of these novelties, but, in the opinion of medical men who have travelled widely in tropical Africa, there is not now much probability left of the production of a completely "new" disease. We do not, of course, imply that many minor discoveries do not remain to be made, and, indeed, even great ones, such as the causes of yellow fever and beri-beri; and to the investigator who is content with elucidating minor problems these fascinating lectures will afford numerous examples of the kind of work that still remains to be done.

But a word of caution is perhaps necessary; for the reader is presented with a host of interesting suggestions and speculations, and unless he advances cautiously and weighs these carefully in the light of experience, he may well take the phantom hypothesis for fact, for it would be possible in this particular branch of pathology to adduce examples where hypothesis simply has actually retarded the acquisition of knowledge. We would prefer rather to see the investigator laboriously accumulate facts and to base on these his own hypothesis rather than, starting with a ready-made hypothesis, to try and adapt his facts to it. With this caution we think these lectures should serve as a stimulant to the jaded investigator depressed by the slowness of his own advance, as he perhaps remembers that it took Ross some two years or so to work out the mosquito cycle of the malaria parasite, and that the first hypothesis as to the path followed by the parasite in the mosquito was a wrong one.

While, then, a perusal of these lectures has raised some doubts in our minds as to the general validity of presenting those, presumably novices, with a number of interesting suggestions, yet for even the veteran there is abundance of sound common sense to be found here which he will do well to treasure up. If, further, we venture to criticise various statements in detail, we do not do so in a spirit of opposition, but simply as an expression of a difference of opinion. The author (p. 2) refers to helminthology as "until recently an insignificant if not a despised branch of pathology"; but surely this is somewhat forgetful of the claims on our gratitude and respect of such helminthologists as Leukart, Dujardin, Rudolphi, Cobbold, Küchenmeister, &c. We can only in part agree with the opinion that, regarded "as a cultivating medium, there is no difference between the juices and tissues of an Esquimaux and those of a Caucasian or those of a negro." For what else but a difference of medium is the explanation of the fact that the healthy countryman will survive wounds and infections that prove fatal to the less resistant townsman? It is partly a difference of medium in the host, we believe, that causes malaria to be a mild disease in temperate regions, and a deadly one in tropical climates, where in both cases we may be dealing with a single infection of a particular person. In what else does the good of change of air, a sea voyage, &c., consist, but in producing a change of medium in the host in which, *e.g.*, the dysentery amœba is living?

In treating of filariasis (p. 80) we do not think the author sufficiently emphasises the fact that the final link in the chain of evidence connecting the mosquito with the transmission of filaria is wanting. Grassi and Noe's experiments on the transmission of filariæ to dogs by means of mosquitoes are by no means convincing, and to experiment on man is hardly possible. In the case of the malaria parasite the experiment has been done several times, but it was Schaudinn who actually first saw the malarial sporozoit penetrate the red cell. We had made the same experiment as Schaudinn on many occasions without success, except that we saw the sporozoit transformed into a body indistinguishable from a so-called "ring form," and if the investigator follows out the method given on p. 98 he will not see what Schaudinn describes. For Schaudinn expressly says that on using sporozoits taken from the salivary gland he got no results; it was only on using sporo-

zoits taken from large oocysts in the stomach that he got (two) successful results.

In discussing the ætiology of sleeping sickness we think the author scarcely puts Colonel Bruce's discovery in its proper light. We would say that without Castellani's observation possibly Bruce would not have thought of or discovered the trypanosome, just as Dutton might never have discovered the *Trypanosoma gambiense* had it not been for Forde. But to claim Castellani as the discoverer of the ætiology of sleeping sickness is, we consider, hardly right. Further, the author appears to have some doubts as to whether this trypanosome is really the cause of the disease, and cites, by way of caution, the fact that similar evidence could have been adduced in favour of the embryo *F. perstans*. But to us it seems that the "evidence" in favour of *F. perstans* was never at any time on the same footing as that of *Trypanosoma gambiense*, and, as a matter of fact, collapsed immediately the hypothesis was tested by facts.

We cannot here discuss the evidence in favour of regarding *T. gambiense* as the cause of sleeping sickness, but it is supplied by a body of epidemiological, pathological, and experimental evidence surely conclusive.

Finally, the author suggests (p. 124) that, in the case of *T. gambiense*, the negro of the endemic areas of this parasite has acquired an immunity similar to that of antelopes in regard to *T. brucei*. But, so far as we are aware, there is not the slightest evidence of this, and, in fact, the evidence is to the contrary, viz. that where a negro has *T. gambiense* in his blood he will surely die sooner or later (of sleeping sickness).

We consider that for the medical man the most valuable portions of the book are those dealing with the diagnosis and treatment of tropical fevers, and these should be taken to heart, for it is not uncommon, for example, for a patient to die of liver abscess who has been treated throughout for "fever"; but fever is not always malarial, as is too often supposed.

The book has numerous illustrations in the text, but, with some exceptions, these are not entirely successful. We would heartily recommend those who wish for a series of stimulating, unconventional lectures to peruse this book. J. W. W. Stephens.

PROGRESSIVE TEACHING IN PHYSIOLOGY. Recent Advances in Physiology and Biochemistry. Edited by Leonard Hill, M.B., F.R.S. Pp. xix+740. (London: E. Arnold, 1906.) Price 18*s*. net.

THE rapid advances that physiology is making are reflected not only in the journals that deal with research, but also in the vigour with which the teachers of the subject are applying themselves to their duties in relation to their students. At several centres in London there are every year now given courses of advanced lectures, open free to all the students of the London medical schools, in which they may hear from the lips of the investigators themselves the result of their research, and witness the most important of their experiments.

The book now before us is a corresponding expression of this teaching energy, and one can only hope that authors and publishers alike may find their venture a success. Students have not the time for hunting up original papers, but they ought readily to imbibe a summary of recent research when it is presented to them in an attractive way.

The collaborators deal with subjects on which each is competent to speak, because they have themselves worked at those they write about. Thus the editor, Mr. Leonard Hill, treats of the subjects of respiration and fat-metabolism. Dr. J. J. R. Macleod gives a summary of recent work in connection with carbohydrate metabolism, uric acid formation, and the immunity question. Another aspect of the respiratory process is dealt with by Dr. Pembrey, who also writes on internal secretions; and some interesting chapters on lymph production, absorption, and excretion by Dr. Beddard follow next.

All the subjects are treated in a lucid manner, and will give to advanced students a clear idea of the present position reached by physiologists on many of the thorny problems that beset the path of the original worker.

The opening articles of the volume, which are from the pen of Prof. B. Moore, come into a somewhat different category. He deals with the applications of physical chemistry to physiological phenomena, especially in connection with secretion, and the action of enzymes. He gives the latest views and results on this most important subject, and teachers and students alike owe him a debt of gratitude for his able treatment of these somewhat obscure questions. Those parts which relate to the rules and formulæ which regulate the processes of reaction-velocity and the like will be found rather difficult to many, for physiologists and medical students are, as a rule, rather rusty in their mathematics. But Prof. Moore's articles are not mere abstracts of the work of himself and others, for he has chosen them as the vehicle for the promulgation of a new doctrine, of which the keynote is struck in the opening chapter. The main object of his succeeding chapters is to convince the reader that this new conception is right, and will explain much that has hitherto been puzzling. The cell is treated as a transformer of energy, but the new energy produced, which is characteristic of living structures, cannot be brought into line with the known forms of energy in the inorganic world. It differs from heat and electricity, for instance, as much as, or more than, heat and electricity differ from each other, and he dubs it "biotic energy." Biotic energy is not, however, the old vitalistic principle revived under a new name, for it obeys the law of conservation of energy, and its investigation is capable of numerical and exact treatment just as that of heat and electricity is. A review is not the place to enter into any detailed criticism of such a view. The idea will serve to stimulate others to renewed research, and one foresees it will meet with considerable opposition in the future. Any doctrine which involves controversy is to be welcomed, and finality in the discovery of truth is brought nearer as the workers are provided with new theories as a basis of work. W. D. H.