THURSDAY, DECEMBER 10, 1896.

MODERN PSYCHOLOGY.

Analytic Psychology. By G. F. Stout. Two volumes. Pp. 289, 314. (London: Swan Sonnenschein and Co., Ltd., 1896.)

An Outline of Psychology. By Edward Bradford Titchener. Pp. vii + 352. (New York: The Macmillan Company, 1896.)

MR. STOUT'S "Analytic Psychology" is a very important and valuable contribution to the study of mental processes. With the exception of Dr. Ward and Prof. James, no other English writer in modern times has treated the subject with as much originality and freshness as the present editor of *Mind*. The two volumes before us are, however, only introductory to further work from the same hand, to which we shall look forward with special interest. Problems of genesis and development are not examined in the present work, which treats only of fundamental questions connected with analysis and definition. Yet the reader who peruses Mr. Stout's powerful criticism of current doctrines will at once realise the importance and difficulty of these preliminary questions. Unfortunately the science of mind is still at an inorganic stage. Its authorities are still in conflict on the most elementary questions of classification, terminology, method and scope. We are bound to say that the author's method of solving time-honoured puzzles, highly suggestive as it is, raises almost as many difficulties as it meets. This hardly detracts from the merit of the work, which we appreciate unreservedly. Students of psychology need not be reminded of the troublesome questions which are inevitably thrust into the foreground at the beginning of every text-book or treatise. The antithesis between knowing and feeling, the limits of consciousness, the conception of activity, the function of introspection—these are some of the well-known problems which our author handles in novel manner. Undoubtedly the most striking innovation in terminology and method is the author's introduction and use of the contrast between what he terms *noetic* and *anoetic* consciousness. Modifications or contents of consciousness are broadly contrasted, according as they do or do not refer to an *object*; the former are called *noetic*, the latter *anoetic*. This distinction, of course, roughly corresponds to distinctions variously formulated by previous writers. What amounts to nearly the same as the anoetic consciousness has been vaguely and variously styled pure sentience or feeling, or has been obscurely relegated to the regions of subconsciousness. But Mr. Stout throws light on many obscurities of exposition by his thoroughgoing application of this antithesis between anoetic and noetic. Thus previous writers have identified the *object* of thought and attention with the *presentations* entering into the current of conscious experience. Mr. Stout definitely opposes *presentation* and *object*. The *object* to which noetic consciousness refers cannot, from the nature of the case, be a present modification of individual consciousness. All thought and perception involve reference to something which, as it is meant or intended, is other than the thinker's own conscious content. This view connects itself with every detail of analysis propounded by the author, and can hardly be appreciated without reference to his treatment of other topics, such as the conception of mental disposition, the relation of apperception to noetic synthesis, the interconnections of thought and conation, the development of desire and volition. A remarkable unity and harmony characterise the treatment of all these questions, in consequence of the very careful definitions and distinctions given at the outset. The chapter on "Relative Suggestion" is, perhaps, the most interesting and original in the book. It supplies a much-needed corrective of older associationist views, and an exposition of the link between mere cohesion of ideas and the processes of constructive thought and imagination. In another most important chapter, the conception of mental activity is very ably defended against Mr. Bradley's attacks, and in opposition to some statements of Prof. James and others. Mr. Stout is a champion of the doctrine of apperception, as propounded by Herbart and his followers. But his own modifications of this doctrine are considerable and important. The chapter on "Noetic Synthesis" prepares the reader for the author's special views on this point. Noetic synthesis involves a distinct content of consciousness, viz. "the apprehension of a whole which determines the order and connection of the apprehension of the parts." But "when we consider a noetic synthesis not merely as involved in this or that conscious process, but as a mode of mental grouping which persists as a disposition when it has ceased to operate in actual consciousness, we have the idea of an apperceptive system." Under apperception we investigate the gradual growth and differentiation of new phases of noetic synthesis. Again, the view of the relations between apperception and attention is a special feature of Mr. Stout's doctrine: "Whereas attention is an attitude of consciousness towards a presented *object*, apperception is a process of interaction between *presentations* or *dispositions*." His position on these points is worked out in most instructive detail, which it is impossible for the reviewer to indicate. Finally, Mr. Stout gives a prominent place to *belief*, as a fundamental attitude of consciousness towards its object, and propounds an original doctrine of pleasure-pain, which is supported by subtle and suggestive reasoning.

The general treatment is rendered especially instructive by the large number of well-chosen illustrations of mental processes analysed at first hand. The psychological standpoint is perfectly preserved throughout, and we do not find a substitution of physiological or physical hypotheses for genuine psychological analysis. In spite of the marked originality of style and exposition, at no point is the tone unnecessarily antagonistic; and suggestions are accepted from writers of every school of thought, with only such modification as is necessary to adapt them to the author's general scheme.

Prof. Titchener's "Outline of Psychology" is written with admirable clearness. The results of experimental psychology are expounded in a style both attractive and simple. The author's own views are supported by careful reasoning, and at the same time the beginner is not overwhelmed with any superfluous controversial matter. Rules for experimental and introspective research and illustrations of their application are arranged and expounded in a thoroughly methodical manner. The author admits only two ultimate kinds of "conscious elements"—sensation and affection—definitely rejecting *activity* as a third conscious element. Space is devoted to what may be called "Numeral Psychology," *i.e.* the estimate of the total number of different conscious elements. The method, of course, is to ascertain the just discriminable difference. Underlying this whole procedure there appears to be a logical fallacy, or at least a difficulty which modern text-books entirely ignore. Thus, suppose that *a*, *b*, *c*, *d*, *e*, *f* . . . is a series of measurably different physical stimuli, and A, B, C, D, E, F . . . the sensation-processes supposed to correspond with the stimuli. Suppose, further, that *a*—*d* or A – D represents the just discernible difference. Then, by hypothesis, sensation A *is* just distinguishable from sensation D, while sensation B is *not* just distinguishable from sensation D. Hence sensations A and B have opposite predicates, and therefore they are different, although, by hypothesis, they are consciously undistinguishable. Now in "counting" the number of sensation-elements, it is always assumed that difference means the same as distinguishableness. But that this leads to logical contradiction is obvious from the above, while it is in flat opposition to Weber's logarithmic formula, which implies that a continuous variation of stimuli corresponds to a *continuous*—not discrete—variation of sensation. The author's mode of distinguishing (1) sensation, whether peripherally or centrally aroused, (2) perception or idea, and (3) the association of ideas, seems decidedly original and worthy of careful consideration. No doubt he is right in making the distinction between (1) and (2) depend on the absence or presence of objective significance; but it seems unsatisfactory to offer only a "biological reason" (p. 183) for the unity possessed by the perceptual or ideal complex of sensations. Again, in treating of conception, judgment and reasoning, no higher mode of intellection seems to be recognised than association. We feel ourselves carried back to the dark ages of psychology when we read (p. 301)—

"We speak of a comparison of two impressions when the ideas which they arouse in consciousness call up the verbal associate 'alike' or 'different.' . . . We have in this process of comparison or discrimination, then, a case of verbal association."

We are curious to know whether the words "alike" or "different" have any significance; and, if so, whether this significance is an object of conscious apprehension or not. Other passages point to similar defects, owing to the author's confidence in sensation and association as the sufficient materials for all intellectual processes. It is true that the author avoids many of the fallacies of the old mechanical view of association, and many parts of his exposition are unexceptionable in the light of modern criticism. But the characteristics of the book that are to be most highly commended are clearness, simplicity, wealth of illustration, and, in general, adaptation to the needs of the beginner who requires to be placed *en rapport* with the latest results of experimental psychology.

W. E. JOHNSON.

A MANUAL OF DAIRY WORK.

The Book of the Dairy. Translated from the German of W. Fleischmann by C. M. Aikman and R. P. Wright. Pp. xxiv + 344. (London: Blackie and Son, 1896.)

NO branch of practical agriculture has made greater progress during the last quarter of a century than that which may be broadly described as dairy farming. The evidences of this advance are to be sought, however, not so much in the operations antecedent to the production of milk as in the processes employed in its after treatment. In making this assertion, we do not overlook the improvements which dairy farmers have effected in the housing, feeding, and general management of milch kine. But these have resulted mainly from the intelligent modification of time-worn practices, whereas in the manipulation of milk, either for sale as such, or for manufacture into butter or cheese, there has been ample scope for modern ingenuity in the introduction of novel methods. The cow remains to-day what she has been for ages—a physiological implement for the production of milk, and we may recall the words of Charles Dickens, "If civilised people were ever to lapse into the worship of animals, the Cow would certainly be their chief goddess." Cows, especially of certain breeds, have, by judicious selection exercised by the breeder, been greatly improved in their milk-yielding capacity, in respect both of quantity and of quality. But there is no essential distinction between the cows of to-day and those which furnished milk to our Saxon ancestors—the difference is only one of degree. On the other hand, the change in the methods and appliances of the dairying industry, even if the comparison be made with so recent a period as only thirty years ago, is so profound that it may well be termed revolutionary. The displacement of the old system of cream-raising by the rapid work of the centrifugal separator, the rational use of micro-organisms in the ripening of cheese, the sterilisation of milk in the destruction of tuberculous and other germs, the direct and almost instantaneous manufacture of butter from fresh milk, are only a few illustrations of what has been accomplished in very recent years. With such changes constantly in progress an extensive literature has sprung up around the industry of dairying, and many notable works upon the subject have been published in the English, French, German, and Danish languages.

Of the dairying experts of Germany, no one occupies a higher position than Dr. Fleischmann, of Königsberg, and no doubt many readers will welcome an English translation of his well-known manual of the science and practice of dairy work, which Messrs. Blackie have issued in a style deserving of commendation. The first chapter deals with the secretion, properties, and composition of milk, and discusses the defects which give rise to bitter, coloured, ropy, lazy, or sandy milk. The extraction, immediate sale, and testing of milk form the subject of the next chapter, which is partly commercial in its scope. For the third chapter the translators have chosen the not very intelligible title of "Milk in its relation to micro-organisms, dairying, and bacteriology." Butter-making and cheese-making are the respective subjects of the two succeeding chapters, which are followed by one on the "Preparation of keeping milk, fermented milk, and the bye-products of milk." The economic aspects of dairying are next dealt with, and a concluding chapter is devoted to margarine and margarine cheese.

The definition of milk, with which the book opens, seems to lack those qualities of precision which should characterise a definition. What kind of notion would the following words convey to a reader who knew nothing about milk?—

"By milk, in the widest sense of the term, is understood the secretion of the special glands of the female mammal. It is a white, opaque liquid, of the character of an emulsion, with a faint odour and a slight flavour; and it is produced during a longer or shorter period after parturition. It consists chiefly of water, fat, casein, albumin, milk-sugar, and mineral salts, and is specially adapted for the sustenance of the young."

That milk "consists chiefly of water" we know; but had the translators been on the alert, they would have suppressed the word "chiefly" in the foregoing passage. The difficulties of translation, indeed, are exemplified in various unhappy phrases, as, for instance, when keeping milk is defined as milk which "possesses the property of being able to keep."

A point about which there has been much controversy—the existence or not of an enveloping membrane upon each of the fat globules in milk—is dealt with emphatically enough:—

"The fat globules are not surrounded with a membranous envelope. Owing to the action of molecular force, the little globules are surrounded by a thin watery covering of serum, and act very much as if they were actually surrounded by a membrane."

Dairy farmers, and many who are not dairy farmers, will be puzzled by a statement, which apparently has been casually dropped in on p. 21, concerning the impetus which a globule receives through its weight and centrifugal force; there is at least novelty in the idea of the "centrifugal force" of a fat globule of milk. On p. 46 is another statement which will certainly startle all experienced feeders of dairy cattle; it is to the effect that "milk cows must not be fed with beans, peas, lupines, pea-straw." Of feeding with lupines we do not know much in this country; but as to the other materials, a footnote shows that even the translators felt uneasy, and it is regretable that they did not suppress the passage. The author recommends, in the winter feeding of butter cows, the moderate use of beet, in conjunction with other foods. This, of course, is perfectly intelligible to a German farmer; but the translators should have added that for all practical purposes the English mangel is competent to take the same place in the food as the German beet. The feeding of cows, indeed, is a subject which might well have been treated more fully. This section contains a statement which we cannot forbear quoting, for it relates to a matter of as much practical interest to the dairy farmer as of scientific interest to the physiologist. On p. 42, the author says:—

"There can be no doubt that, in the case of cows yielding a large amount of milk, the fat derived from the food is utilised for the formation of milk-fat."

The nature of the few criticisms we have made should render it obvious that a free translation and adaptation of Fleischmann's work would have been more valuable than the very literal translation that has been provided. Many of the woodcuts—of which there are eighty-five, besides half-a-dozen full-page plates—are different from those in the German original, and it is matter for regret that the same latitude was not allowed in connection with the text. It cannot be doubted that the translators possess the knowledge and skill essential to the production of a serviceable adaptation, and their description of—for example—the manufacture of Cheddar cheese in this country would probably have differed considerably from that of which they have laboured hard to furnish a word-for-word rendering. Viewing the book as a whole, it is not one to put into the hands of a beginner. A discriminating reader, however, who already possessed some knowledge of the subject, would peruse its pages with profit.

OUR BOOK SHELF.

Elementary Geology. By G. S. Boulger, F.L.S., F.G.S. Pp. viii + 180. (London and Glasgow: William Collins, Sons, and Co., Ltd., 1896.)

DR. W. S. DAVIS' "First Book of Geology" has been rewritten and revised throughout, and transformed by Prof. Boulger into the text-book now under notice. The chief criticism we have to offer upon this metamorphosed volume—and the criticism applies to most elementary text-books—is that details are dealt with much too early. Four pages in the present volume are devoted to general remarks on the objects and methods of geology, geological evidence, and divisions of the subject; and about five pages to descriptions of the form and size of the earth, terrestrial movements, the nebular theory, the probable condition of the interior of the earth, and the cause of the Glacial period. The nature of the descriptions may be gathered from the statement of the limited space occupied by them. Of this brief treatment of large subjects we do not, however, enter a complaint, for the book is intended principally for pupils connected with the Department of Science and Art, and, regretfully though we say it, these pupils like concentrated essence of facts, which can be assimilated with the smallest possible mental exercise. Such readers may develop a mild kind of interest in the first nine pages of the book; but then comes the *pons asinorum* of text-book geology—the account of rock-forming minerals and their distinctive characters. Why should such a paragraph as the following be put before a beginner in geology?

"Sulphur unites with many metals to form *sulphides*, including the abundant iron-pyrites (FeS_2), and many important metallic ores, such as chalcopyrite, galena, and blende, ores of copper, lead, and zinc respectively. Chlorine with sodium forms the abundant *chloride*, common salt (NaCl). Iron forms two oxides, the *ferric oxide* (Fe_2O_3), which occurs as hæmatite and hydrated as limonite, both important ores, and the *ferrous oxide* (FeO), while both occur in the black oxide, magnetite (FeO, Fe_2O_3, or Fe_3O_4). The oxide of aluminium (Al_2O_3) is called *alumina*; that of calcium (CaO), *lime*; that of sodium (Na_2O), *soda*; that of potassium (K_2O), *potash*; and that of magnesium (MgO), *magnesia*; and these oxides and those of iron are, when in combination, known as *bases*. In combination with acids they form *salts*; with silicic acid (H_2SiO_3), silicates; with carbonic acid (H_2CO_3), carbonates; with sulphuric acid (H_2SO_4), sulphates. The majority of rock-forming minerals are silicates."

It seems to us to be a great mistake to assume that young students of geology possess sufficient knowledge of chemistry to comprehend such a list of names and formulæ as is contained in the foregoing quotation. A book constructed on educational lines should not so readily run into details, and should never do so without sufficient explanatory text.

Taking the book generally, it is better than many others of its class, but little more can be said for it. Every geologist will, however, endorse the prefatory remark that "no text-book, however large, can impart an adequate knowledge of geology unless supplemented and controlled by actual contact with the facts of nature."

Annual Report of the Geological Survey of Canada. New series. Vol. vii. 1894. (Ottawa: S. E. Dawson, 1896.)

THIS large volume of over 1200 pages contains, in addition to the Summary Reports of the operations of the Survey for 1894, seven detailed reports on certain portions of the Dominion, and is accompanied by eleven geological maps.

The Summary Report shows that geological work is being carried on by the large staff of the Survey in every part of the Dominion. Especial mention is made of the trial borings now being put down at Athabasca Landing in the North-west Territories, where there is good reason to believe large supplies of oil will be obtained from the Devonian rocks at a depth of about 1500 feet. An account is also given of the recent advances in the development of the mining industry of British Columbia, where of late years such extensive mineral deposits have been discovered, as well as of the explorations in the Labrador peninsula carried out by Mr. Low, who has discovered in this inhospitable region deposits of iron ore which are believed to surpass in size any that have hitherto been discovered in North America.

Of the special reports, two deal with British Columbia: one, by Dr. G. M. Dawson, containing a description of a portion of the interior plateau of that province in the Kamloops district; and the other, by Mr. R. G. McConnell, giving an account of the explorations of the Finlay and Omineca Rivers. These are followed by a report on the country about Red Lake, in Keewatin, by Mr. Dowling. The fourth report is by Dr. R. H. Ells and Dr. F. D. Adams, on a portion of the province of Quebec, comprising the island of Montreal and a part of the eastern townships to the south and east. Mr. Chalmers then describes the superficial geology of the provinces of New Brunswick, Nova Scotia, and Prince Edward Island; while, in the concluding reports, Dr. Hoffmann and Mr. Ingall treat of the chemical work of the Survey and the mineral statistics of the Dominion respectively. Dr. Dawson's report contains an excellent description of the interior plateau of British Columbia from a geological and geographical standpoint. The very extensive development of the Cambrian in this part of the Dominion is noted, as well as the continued volcanic activity from Cambrian to recent times, the volcanic materials, at a very modest computation, having a thickness of 20,000 feet.

Poems of George John Romanes. Pp. xvi + 108. (London: Longmans, Green, and Co., 1896.)

THIS small volume consists of a selection from the poems of the late Mr. George John Romanes. It contains two long poems entitled "A Memorial Poem to Charles Darwin," and "A Tale of the Sea." Both are fine and of a striking quality. Sonnets form the rest of the book, and in many of these the naturalist, as well as the poet, is revealed to us by the accurate descriptions of nature, and the many references to objects and phenomena connected with science. We may add that Mr. T. Herbert Warren, President of Magdalen College, Oxford, has written the introduction, in which he gives a short biographical sketch of the author.

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.*]

The Pound as a Force, and the Expression of Concrete Quantities generally.

WHAT is Prof. John Perry tilting at in his educational tirade on page 50 of your issue for November 19? To judge from a friendly post-card asking me to reply, he seems to imagine that he is attacking physicists; but apart from this private information I should have imagined that he had in his mind a nearly extinct type of Cambridge text-book, and some—I do not know how many—belated schoolmasters.

Let me assure him, speaking no doubt for others but of most knowledge for myself, that if any student of mine could only express force in poundals and energy in foot-poundals I should be as disgusted as he himself.

One of the first things a student of physics has to learn is that no numerical exercise is fully worked out until it is expressed in units to which he and others are accustomed, and of which they can "feel" the magnitude. As an intermediate step such an expression as 10^7 F.P.S. or C.G.S. units is legitimate enough, but the final answer should be expressed in hours, or days, or other appropriate unit, if time is the subject; in miles, or millimetres, or inches, if it be a length; in hundredweights, or tons, or grammes, or pounds weight, if it be a force; and in ergs, or foot-pounds, or kilogramme-metres, or Joules, or even in kilowatt-hours, if energy be the quantity under consideration.

An educated student speaking to a workman should use the colloquial unit of the shire in which the works are situated; in addressing a foreign correspondent (if orders ever reach this country now from Germany, for instance), he should employ a less insular and more international system; he should, in fact, have no difficulty in making a specification in any conventional system of units to which he has the key.

Prof. Perry asks us to limit ourselves to the C.G.S. system on the one hand, and to the British gravitational system on the other; with those he thinks we can jog along, but with any others we are liable to make mistakes. Does he call that education? If this is the type of "finished engineering student" he is accustomed to, no wonder they "cannot get into works without paying high premiums." (Parenthetically I wonder what premium the Hopkinsons paid in order to be taken into works.) Surely he would not say to a youth training as a banker, "despise all *thalers* and *marks* as trumpery, let us have nothing but good English pounds, and then we shall know where we are, and make no mistakes."

Ah, but, he will say, these units are appropriate to different countries, and you must be able to adapt yourself to the coinage in travelling. Even so! Yet he would seek to limit the physicist, whose range of travel is as wide as the universe. Has he forgotten the variety of subjects with which physical science is concerned? Sometimes there is astronomical energy to be expressed, sometimes thermal, sometimes chemical energy, and sometimes electrical. Would he be content that his educated engineer should be able to express these in nothing but a unit appropriate to the pumping of water out of a mine? When an engineer sees the expression $\frac{1}{2}mv^2$ (which, by the way, he seldom does see; it is generally $wv^2/2g$ in his books, as if gravity were concerned in every transaction of the universe), he is not to think of it straight as momentum multiplied by velocity, or even as inertia multiplied by the square of a velocity, or as energy in any of its protean forms; he is to think of it as a number of foot-pounds. He cannot receive the data in any units whatever and bring out the answer in any other units whatever, one set for the French motor car driver, and another set for the owner, and another for the electrician; no, but he is to say, I must first have the mass given me in pounds, or I may make a mistake; then I must divide the number of pounds by a mystic number, viz. 32·18, in order to bring them to the particular kind of practical unit of inertia which my revered instructor so highly prized; and then I must be told the number of feet per second contained in the velocity (I should be confused by a specification in telegraph posts per minute or kilometres an hour); after that I can do the arithmetic quite nicely, and I remember that the answer always comes out in foot-pounds, which gives no trouble to any one; thus shall my employer not suspect me of being college-taught, and I shall gain advancement in the profession to which I have reason to believe that I was "heaven-born."

Prof. Perry seems in a parlous state, between "friends" who "worship a German soul-destroying fetish," and foes, "academic enemies," who object to the use of the term centrifugal force! Now, I wonder who they are, and why they object to this term. There was once a type of text-book wherein kinetic problems were treated statically, and the centrifugal force exerted by the revolving body was depicted in the diagram and reasoned about as if exerted *upon* the body; does Prof. Perry count among his enemies those who fought against this misleading practice? Again, there appear to be other foes who will not let him use the pound-weight as a unit of force in peace; but is he not a victim of some delusion? A pound-weight or an ounce-weight or a ton-weight are extremely handy force units for actual application, or for calculations dealing with heavy bodies at rest; and an engineer is largely concerned with the statics of heavy bodies, as Prof. Perry truly says, why then should he not use the appropriate unit? Again, when he is pumping water or lifting weights he finds the foot-pound or the kilogram-metre a handy conventional abbreviation for an energy unit: it must be some churl who objects, not a physicist. Was the foot-pound repugnant to Joule? All that a physicist is anxious about in connection with units is that they shall be used accurately and intelligibly, he knows that they are mere agreed-upon conventions, of which some are more generally convenient than others, and he tries to define them conveniently for the practical man's use, and to retain visibly all essential factors; but he is careful not to identify the number of units, or any other mere measure of the thing, with the thing itself.

This last is a point on which some, I fear, are still not clear. Nobody makes this mistake with regard to matter. It can be filed and twisted and heated, &c., it never runs the risk of being thought of as a number of units. Energy is less tangible, and runs more risk of being so maltreated; while as to force, a few philosophers can now be found who teach that force is a mere measure of the time-rate of change of momentum. I wonder if they would say that to a man on the rack!

As to units, I have no objection on principle to hogsheads or kilderkins, but I should seriously object to a student who held that while a pound was a force, a kilogramme was a mass, and at the same time was willing to believe that a kilogramme equalled 2·2 pounds.

To identify weight and mass is barbarous, to denote their units by the same name is unwise, to lose sight of the dimensions of g, and treat it as merely equivalent to 32·18, is illiterate. The whole matter can be put in a nutshell by saying, w and g are both vectors, parallel vectors, and m is their (scalar) ratio.

There are, in fact, three distinct things, all capable of being denoted by such a word as "ton" in common parlance. There is the mass or quantity of material, which concerns us in dealing with markets; there is the inertia or reaction to force, which is important when we are dealing with acceleration; and there is the etherial stress, due to the neighbourhood of the earth, which drives the two pieces of matter together unless they are propped apart.

The last-mentioned curious and ill-understood deportment of two bodies is interesting in itself, and appeals directly to the engineer whenever he has to increase the distance between the earth and another body; it has, indeed, laid such hold of his imagination that he has begun to think it the most fundamental property of matter, and is willing to identify it with the actual substance of the smaller of the two bodies: he is even willing to identify it with its inertia-reaction, especially after division by some arbitrary number suited to himself, his parish, and his work.

May I tell Prof. Perry what is at the root of the perennial debate between engineers and teachers of mechanics?

It is the subject of *acceleration*. An engineer's bodies are nearly always either at rest or in uniform motion, their accelerative stages he is usually able to ignore. The portion of mechanics which serves his need is, therefore, simple enough, and he rebels against more. But the teacher perceives the treatment of acceleration to be the key to mechanics in its higher sense—viz. as an introduction to physics, and as the foundation science of the material universe. He emphasises the idea of inertia, therefore, and sets problems in the accelerative stages of motion, because he knows that there lurk the difficulties and there the soul of the science. He hopes that an engineering student, in these days of a wider application of physics than was common half a century ago, may be willing to learn something more than the mutilated fragment of science which serves for commercial purposes. Sometimes he hopes, but at present he hopes in vain, that the student's own more immediate superiors will refrain from encouraging him in half-knowledge and casual omissions, and the testing of everything by immediate pecuniary results. He hopes that the Engineer, although very busy in his proper domain, may have a sympathetic faith in a larger training, and not inadvertently snuff out any nascent clearness of ideas by ranging himself alongside our true and only natural foes, the powerful obstacles of ignorance, idleness, and prejudice.

Vast improvements in school teaching are possible, and should be strenuously urged. Prof. Perry is now, I suppose, head of the Government teaching of mechanics in this country, and his educational views are no individual concern; but let him discriminate. There is plenty of scope for his warning voice and vigorous sense of the need for contact with realities at every stage. Let him inveigh against wasting time over the fifth book of Euclid, for instance, (if any body now does) and other extravagantly refined conceptions too subtle for the majority of people who have so much to learn of which their teachers are ignorant, let him urge teachers to express common things easily and not only in a scholastic jargon misunderstanded of the people; but, *maxima debetur pueris reverentia*, let him urge clearness of idea and accuracy of speech on all who deal with the junior student. These should not call different things by the same name; these should not be satisfied with lazy and incomplete specifications with essential factors omitted; these should grasp the real and the essential and distinguish from the arbitrary and the conventional, emphasising the one and treating lightly the other, and not considering either themselves or their pupils heaven-born geniuses because unable to grasp fundamental principles.

Above all I ask Prof. Perry to believe that the physicist means something solid when he asserts that formulæ need not all be of the engineering pocket-book type, the type where the units must be stated before an equation is intelligible or useful. Such formulæ are in truth a mere mixture of arithmetic and convention, very useful in their place but not really applied mathematics at all.

Misapprehension on this point is at the bottom of the needless and hampering introduction of units by engineers into every equation; and at the risk of being tiresome, I must once more illustrate the difference between an arithmetical formula of the engineering pocket-book type, and a real mathematical equation, by some simple example. The following may or may not be a sailor's rule, but it is an approximately true and handy one:—

Your height above the sea-level expressed in feet, if square-rooted and multiplied by $\frac{5}{4}$, gives the distance of the visible horizon in miles.

A handy rule I call it, and no more. Your ship's captain who knows that alone is in the position of your engineering student who, whether taught at college at not, has been taught badly, and has not brains enough in himself to supply the deficiency.

The equation, of which the above rule is a convenient but specialised and mutilated version, is $2\,\mathrm{R}h = d^2$. My readers must pardon the triviality of the illustration, and the fact that it is not accurate to the second order of minutiæ, because none of these things matter to my present purpose. The principle I am urging is illustrated well enough by the two points, (1) that the size of the earth, which was omitted from the rule, makes its appearance in the equation, and it is obviously a vital element in the problem; (2) that the equation requires no specification of units, but is complete in itself, and is independent of every system of units that ever were devised; h is not the number of feet, or of metres, or anything else, it is the actual height; d is not the number of miles or of inches to the horizon, but it is the distance itself; and similarly $2\,\mathrm{R}$ is the diameter of the earth, and not any numerical specification of that diameter. The thing, so far as it is true at all, is true from the bottom upwards and entirely true, number and dimensions and everything, with no factor omitted, or slurred over, or suppressed; that, and not the C.G.S. or any other trivial convention, is what is meant by absolute measure. *Ex uno disce omnes.*

Using this trivial example as a type or fable, I say that the college-taught student who knew $2\,\mathrm{R}\,h = d^2$, or its equivalent Euc. III. 36, but could not apply his knowledge to estimate the distance of an iceberg or a hull, though he spent his days at sea, would be an ass, capable of bringing his college-training into well-merited contempt. Also, that the youth who could apply his pocket-book rule, without knowing or seeking the reason of it, would be a useful ignorant machine, creditable enough in the forecastle, passable amidships, but out of place on the bridge, and not to be desired as the product of any educational institution whatever. OLIVER J. LODGE.

University College, Liverpool.

FEW physicists will allow to pass without protest some of Prof. Perry's observations appearing in NATURE of November 19, however reluctant they may be to raise a fresh dispute on the evergreen subject to which they refer. So far as one can gather, the Professor has long since adopted one of the many ways in which the fundamental relation of dynamics may be regarded, and works himself up into a stage fury because the majority of modern physic'sts regard the question in a somewhat simpler and more correct way.

Prof. Perry has an admirable fondness for kindergarten methods. Let then a beginner be armed with a simple spring balance, made, say, with elastic cord, a small waggon on wheels, a number of masses, a rule, and a clock. By a few simple experiments on a level floor or table, such as one of Prof. Perry's heaven-born engineers should delight in, he can soon be made to convince himself, independently of the units in which he measures, that the rate of increase of velocity a of a body acted on by a force is roughly proportional to the force and inversely as the quantity of stuff in the body. He will thus readily grant, in a general way, that $a = k\frac{F}{m}$, where k is some constant, and will be in a position to understand the absolute truth of this relation later on. If he is an English student, he will have no objection to measure distances in feet, time in seconds, the stuff that he puts into his waggon in pounds, and perhaps the pulls that he applies to his waggon in pounds weight. He will surely admit the propriety of expressing a in (feet per second) added on per second—in the unit sometimes called, on the suggestion, I think, of Prof. Lodge, the "hurry." k then becomes the number g, and the experimenter will easily convince himself that with these units it is about 32. If he is a *bonâ-fide* beginner, I doubt if he will ever make a set of experiments in physics which will afford him more instruction, rough though his results may be.

But with these units k is not quite constant: not *absolutely* so even if the standard pound is kept in London, Prof. Perry notwithstanding. And, incidentally, is an engineer who loads the lever of his safety-valve with a bucketful of bricks in other latitudes in just the same position as if he did the same in London? Not that I intend to imply that variations in g matter much to the professional work of men who (very properly) compound for any little discrepancy between their calculations and the ways of nature by liberal use of factors of safety, of trifling magnitudes such as 10.

We pass then to the conception of absolute measurement, the interest and value of which are not reserved exclusively for those who use the C.G.S. system, but exist in all systems. We can make $k = 1$, and write the fundamental equation in the form $a = \frac{F}{m}$, most readily by adopting either of two conventions, (1) by expressing matter in pounds and forces in terms of a unit the gth part of a pound weight (the poundal); or (2) by expressing forces in the approximately constant unit the pound-weight, and matter in a new unit, also approximately constant, consisting of g pounds. Of these two alternatives Prof. Perry chooses the last. It is also the worst, for four reasons at least, viz.:

(1) That the system is needlessly complicated, through demanding the conception of two standard portions of matter; namely, the standard pound-mass whose weight is the unit of force, and the "engineer's unit" of mass or inertia (*teste* Perry) of 32·18 pounds.

(2) That the unit of force is variable or vague, unless careful reservations are made.

(3) That the unit of mass is ditto, ditto.

(4) That a majority of those who use any such system at all, already use, largely for the above reasons, the other convention, involving the idea of the poundal.

And no amount of abuse or sophistry from the non-orthodox will get over the fact that so long as we have as standards a foot, a second, and a lump of matter that we call a pound, and so long as we think of forces as we do at present, that force which, acting on that lump of matter, would give it an acceleration of one (foot per second) per second must always have a singular interest for us, entitling it to rank as a unit even with those who personally may be content to reckon the forces with which they have to deal in some other way.

But why should Prof. Perry be so dissatisfied? His students make no mistakes, and by the adoption of his shibboleth the very tender blossoms for whom he pleads will be enabled to produce luxuriant crops in the profession for which they seem so unfit. Can it be that in attempting, for instance, to become electrical as well as mechanical engineers, they find a horrible gulf between the artificial system they know and the C.G.S. units they will have to use?

And what right has the Professor to assume that all real engineers regard the question as he does? I wonder what percentage actually do so. On what platform, for instance, is Prof. Greenhill just now, to whom the idea of mass is as if it were not, absolute measurement an accursed thing, and, above all, that relic of the dark ages, Prof. Perry's 32·18 lb. unit, Anathema? If only these champions of rival heresies can be persuaded to demolish one another, there will be for the orthodox a great peace. M. J. JACKSON.

Oxford, November 24.

MAY I, as a teacher of physics, many of whose pupils enter the engineering profession, be allowed to say a word in my own defence in reply to Prof. J. Perry's scorn, expressed in an article, "The Force of One Pound," in NATURE of November 19, vol. lv. p. 49, for those who, like myself, teach my pupils the use of the poundal in dynamical calculation.

I am sure that Prof. Perry agrees with me in looking at an absolute system of measurement, whether British or metrical, as the only logical one, and where for practical purposes change of unit has to be made, there seem to me to be two courses open: (1) to make such a change in one, or all, of the fundamental units and work *ab initio* with these changed units; or (2) to work in absolute units, converting the absolute into the practical unit, by means of multiplication by a suitable factor, or, in other words, to introduce a constant of variation, different from unity, into our equations. I prefer to adopt the latter alternative where units of force have to be expressed in practical pound-weight.

Prof. Perry seems to suggest a third course, and asks us to begin with an absolute system in which the unit of force is to be one of our absolute units, the other two presumably being the ordinary foot and second. Of course, a system of theoretical dynamics could be built upon this basis, but to teach it, as we are invited to do, side by side with the C.G.S. system, would confuse the mind of any pupil unless he were an engineering student.

But there is another branch of engineering science in which exactly the same thing has to be done, namely, electrical science. Here, too, we have a system of equations which are invariably expressed in absolute C.G.S. measure, that is, in terms of units not practically in use. Here we may again either work out anew the formulæ, choosing as unit of length the quadrantal arc of the earth (10^9 cm.), and as unit of mass the 10^{-11} gm., or, as I prefer, employ the ordinary formulæ and multiply the result obtained from it by the appropriate factor when wishing to reduce the result to practical volts or amperes; or is there still a third method in which volts and amperes become the fundamental units in terms of which lengths and forces have to be measured? L. CUMMING.

Rugby, November 23.

Recent Work on the Madreporarian Skeleton.

I SHOULD like to draw attention here to a paper just published on the skeleton of Madreporaria, by Dr. von Koch, Professor of Zoology in Darmstadt, in the Gegenbaur *Festschrift*. Some time ago, in November 1895, an "abstract" was published by me in the *Proceedings* of the Royal Society, vol. lix., embodying the results of a full paper entitled, "Microscopic and Systematic Study of Madreporarian Corals." The full paper, with very numerous illustrations, will be published this month in the *Philosophical Transactions*. Prof. v. Koch does not mention this abstract in his reference-list of literature. It will be all the more interesting to those who may happen to be familiar with both papers to have set before them the more important points wherein Prof. v. Koch's new paper was anticipated by mine of last year, and serves to confirm my published statements.

One of the advances made in my "abstract" was the recognition of lamellar structure throughout all the various parts of the Madreporarian skeleton. And this is the main kernel of the skeletal structure as now elucidated by Prof. v. Koch. For example, he writes of the epithecal "foot-plate" in the young coral:—"This first thin little plate is afterwards more and more thickened by more or less plainly laminated deposits (*Geschichtete auflagen*) of new skeletal substance from the ectoderm" ("Das Skelett der Steinkorallen," in *Festschrift*, für Carl Gegenbaur ii., p. 253). I give the translations from Prof. v. Koch's paper as literally as possible.

In the treatment of *septal* structure the results obtained by Prof. v. Koch coincide in a very great degree with statements previously published in my "abstract," as will appear from the parallel columns below.

"ABSTRACT," OGILVIE. (*Proceedings* Roy. Soc., 1895.)	"DAS SKELETT DER STEINKORALLEN," v. KOCH. (*Festschrift*, für C. Gegenbaur, 1896.)
The opacity of the "primary streak" is explained as due to "a larger amount of organic cell-material" originally present near the median plane—*i.e.* at the growing edge—of the septum. Then the passage continues: "Sections show that the fibro-crystalline structure of the septum is the same throughout its whole thickness, essentially that of a double system of thin calcareous lamellæ, either smooth or fluted, and corresponding to a deposit from opposite flaps of an invagination (*l.c.* pp. 11–12).	Regarding the structure of the septa, . . . the first-formed parts, "primary streaks" (Primärstreifen) show a more irregular structure and distinguish themselves usually by greater opacity from the "stereoplasm" or secondary part lying on either side, whose crystalline elements are more or less perpendicular to the "primary streaks." One can often plainly recognise lamination (Schichtung) in these secondary deposits (Auflagen) (*l.c.* p. 255).
Regular *curves* or *lines of growth* are evident on the septal surfaces marking the intervals between successive growth-periods. The space between two growth-curves or lines on the septal surface represents the part of the septum built up in one growth-period, and it has been called by the author a septal *growth-segment* (*l.c.* p. 12)	The fairly simple and easily recognisable structure thus described is, as a rule, rendered somewhat more complicated by the presence of *growth-streaks* (*Anwachsstreifen*) alternately darker and lighter lines, which appear in sections parallel to the surface of the septal edge, and are caused by differences in the crystallisation of the layers of thickening laid down one after the other (*l.c.* p. 256).
In certain cases "the fibro-crystalline deposit is radially symmetrical around ideal trabecular axes in the median septal plane." As examples, the markings perpendicular to the spiniform-toothed edge of the Mussa septum are quoted, and reference is made to the striæ of Galaxea septa, the ridges on the septa of Fungia, &c. (*l.c.* p. 11).	"Frequently also streaks are found at right angles to the former (they correspond to the teeth of the septal edge), and in many genera, Mussa, the Fungias, Siderastræa, and others, they can be so clearly distinct from each other that one can distinguish individual centres of crystallisation in them, and lines of separations" (*l.c.* p. 256).

Prof. v. Koch then goes on to derive the "porous" and "comb-like" varieties of septa from the simple "plate-shaped" septa, and this practically completes his contribution to the subject of septal structure. Septal varieties and their systematic importance form a large part of my paper presented to the Royal Society in July 1895, and are features shortly indicated in the published "abstract."

With regard to the question of "true" and "false" synapticulæ, Prof. v. Koch does not go beyond the distinction originally drawn by Herr Pratz. But the important fact is that his research *upholds* this distinction even while he declares it to be of small value; whereas several authors have in recent years declared it quite *untenable*. In this Prof. v. Koch's actual observations again agree with, and were anticipated by, mine; this is also the case in his statement that both kinds of synapticulæ occur alongside one another in the genus Fungia. A few farther quotations may be compared concerning other parts of the skeleton.

"ABSTRACT," OGILVIE, 1895.	"DAS SKELETT DER STEINKORALLEN," v. KOCH, 1896.
"The microscopic structure of dissepiments and tabulæ is demonstrated by the author to be the same. Both are composed of a series of calcareous growth-lamellæ laid down from one surface only of the aboral body-wall of the polyp. The fibro-crystalline deposit is therefore perpendicular to the plane of contact between polyp and skeleton" (*l.c.* p. 13).	"The fine lines ("Schraffen" denoting the arrangement of the crystals) are always placed nearly perpendicular to the surface of the dissepiment; there is often in addition a very fine set of lines parallel with the surface, and in this, therefore, the dissepiments closely resemble the stereoplasm of the septum." . . . "A tabula is just the same as the sum of all dissepiments lying in one plane" (*l.c.* p. 260).
"Cases occur in both those families where the only peripheral support is afforded by the epitheca. The author is inclined to think this was the primitive form of the Madreporarian calyx, and to look upon both theca and pseudotheca as later modifications associated with retrogression of the epitheca, greater prominence and rapid growth of the septa, and very often with the processes of vegetative budding (*l.c.* p. 14).	"We may accept as a great probability that the primitive skeleton of the Madreporarian corals consisted of a lamellar shedding (Abscheidung) of lime by the ectoderm basis and epitheca, which formed a protective covering round the individual polyps" (*l.c.* p. 272).
A series of evolutionary changes are enumerated, which appeared within the group of Madreporaria during the course of geologic ages. Among others, the following occur as shortly expressed in the abstract:—"Septa became more prominent and exsert in growth; their structure became more elaborate, their surfaces fluted and richly granulated, their edges knobbed, toothed, serrated, spined" (*l.c.* p. 16).	"Provided the septa are once present in their due position, it can easily be understood how the varieties of septal structure, briefly described above, may come to originate. In a very low grade they would simply be present as small eminences of the basis and epitheca, and would then eventually grow outwards as longer processes" (*l.c.* p. 273).
"The 'Rugose' epitheca became tardy in growth, and was replaced functionally by a theca or pseudotheca" (*l.c.* p. 16).	"As soon as the wall is once present . . . the epitheca loses its significance as a supporting skeleton, and it continues to exist only as a protective covering outside, which in consequence tends to become less thick." . . . "Especially in colonies the epitheca is completely retrograde round the individual calyxes" (*l.c.* p. 274).

Naturally, Prof. v. Koch's paper of some twenty-five pages treats only a few of the questions examined and discussed in my complete paper of some 275 pages, as it will appear in the *Philosophical Transactions* of the Royal Society. Nevertheless, it is satisfactory that these few points included in Prof. v. Koch's paper should afford strong and independent evidence in favour of results arrived at by me and already published a year ago.

MARIA M. OGILVIE.

British Association.—Toronto Meeting, 1897.

IT is possible a number of the members present at Liverpool were unable to obtain all the information they desired regarding the programme of the Toronto meeting, and others may be glad to avail themselves of an opportunity to obtain information on various subjects connected with the meeting. Kindly grant me the use of your columns to say I shall not return to Canada till probably in February, and that I shall be only too pleased to answer inquiries and give information. My address is "Canaan Lodge, Canaan Lane, Edinburgh."

ALAN MACDOUGALL.

Secretary, Local Executive Committee, Toronto Meeting, 1897.

Edinburgh, December 1.

A Case of Abnormal Magnetic Attraction.

LETTER, copy of which is appended, came to me this morning. May be it is of sufficient interest for your readers.

A. G. FROUD.

60, Fenchurch Street E.C., December 4.

S.S. *Coronilla*, Oxelosund, November 30, 1896.

To A. G. Froud, Lieutenant R.N.R., Secretary Shipmasters' Society.

DEAR SIR,—Compasses and their deviations and errors being a matter of importance, you may perhaps be interested in a case of local attraction which came under my notice here.

Whilst approaching here, Hafringe Lighthouse, bearing N.N.W. (c.m.), about six miles distance, our standard compass suddenly started swinging over an arc of sixteen points. On mentioning this to our pilot afterwards, he told me of a nineteen-fathom patch on that bearing and distance which has been found to affect compasses so, and on the latest Swedish charts the bank and its effect are noted. Going out I shall try and pass over it again. Sea was smooth and compass steady at the time.

THOS. ROGERS.

THE NATIVES OF SARAWAK AND BRITISH NORTH BORNEO.[1]

ANTHROPOLOGISTS are again indebted to Mr. Ling Roth for presenting to them, in a convenient form, the results of wide reading and diligent compilation. It is by such well-directed enthusiasm that the labours of the student are materially lightened; for not only has the author, in this instance, marshalled a portentous array of accurately acknowledged quotations, but he has sedulously collected illustrations of objects preserved in numerous museums and private collections, in order to fully illustrate the descriptions that he quotes. It is perfectly evident that this has necessitated an immense amount of painstaking labour, which of itself is sufficient to raise the book from the rank of a mere compilation to that of a work containing original research. It is true that Mr. Ling Roth has borrowed illustrations from other authors; but he has supplied a large number of well-chosen figures, most of which are clever pen-and-ink sketches by Mr. C. Prætorius.

Owing to Mr. Ling Roth's conscientious method of giving verbatim quotations from numerous authors, the book has rather a patchwork appearance which is slightly distracting, and may even be somewhat repellent to certain readers; but this plan is to the advantage of the student, who can thus read the original traveller's observations in his own words. The accounts are at times at variance; but this may be due to the tribes not being always clearly discriminated, and it is well known that local differences are of common occurrence, and there is always the idiosyncrasy of the recorder to be taken into account: when there are many observers, there are likely to be some discrepancies.

FIG. 1.—Sea-Dyak Women (Sakarang Tribe). The corsets are composed of cane hoops covered with innumerable diminutive brass links.

Some of the most satisfactory portions of the book are the various essays or detailed descriptions which have in some instances been published before, such, for example, as Archdeacon Perham's memoir on the "Sea Dyak Gods," and the papers by S. B. J. Skertchly, "On Fire-making in North Borneo" and "On some Borneo Traps," or the translation of Dr. Schwaner's ethnographical notes. The author has also contributed others, among which may be mentioned "Alleged Native Writing in Borneo" and "Negritoes in Borneo." The first "Appendix" consists of 160 pages of vocabularies, but, considering the amount of space devoted to lists of words, the chapter dealing with language is meagre; the construction of a language is of more importance than the actual words employed, interesting and suggestive as these often are.

The Land Dyaks, who occupy the south-west corner of the Raj of Sarawak, are a small, slightly built, untattooed people, with skin and hair similar to that of the Malays; some tribes burn their dead. Their language is quite distinct from that of other groups, and they substitute the letter *r* for *l*. The Sea Dyaks live further to the east; they are more stoutly built, well-proportioned, and tattoo slightly on the arms. They live in long houses along the river-banks, and bury their dead. Both peoples consult birds as omens. The term "Dyak" should be restricted to these two peoples; even now there is some obscurity as to its exact significance. It is probably derived from *dayah*, the generic name for "man"; the Malays, and later the Europeans, learned to call certain peoples Dyaks on account of their general term for men, but the latter never used it as a collective name for themselves. Rajah Sir James Brooke was the first to divide the Dyaks into Land and Sea Dyaks. Some have suggested that the term is derived from a word meaning "inland," that is, the people of the interior.

The Milanaus are a very fair, quiet, sago-cultivating people who inhabit the greater part of the coast of Sarawak east of the land of the Sea Dyaks. Interior to these is the large territory of the allied Kayans. The Kayans are very hospitable, and, like the Hill Dyaks, of the most scrupulous integrity; but the Dyaks are braver, more truthful, less treacherous, and a finer-looking and superior people. Also quite different from, and bigger than the Dyaks, are the Muruts, an inland tribe of very low social scale. The Ukits pass a wandering life among the hills, and do not build houses; they live by hunting, and use the *sumpitan* or blow-pipe. The Muruts extend into the west of British North Borneo; in the centre are the Dusuns, an ill-favoured folk who, according to some travellers, have probably resulted from an infusion of Chinese blood with the aboriginal race of North Borneo.

[1] "The Natives of Sarawak and British North Borneo." By H. Ling Roth; with a preface by Andrew Lang. 2 vols. 8vo, with over 550 illustrations. Pp. xxxii + 464; ccxl + 302. (London: Truslove and Hanson, 1896.)

The eastern part of the territory is inhabited by Sulus. The northern coast contains mongrel populations, the most interesting of whom are the Bajaus, or Sea Gypsies, a curious, wandering, irresponsible sort of race of low culture, who dwell almost entirely in boats. They are supposed to have come from the Straits of Malacca, and they profess Islamism.

The Sea Dyak girls receive their male visitors at night, as privacy in the day is out of the question. About nine or ten at night, the lover quietly opens the door and goes to the mosquito curtains of his beloved, gently awakens her, and they sit conversing together. Of course, if this nocturnal visit is frequently repeated, the parents do not fail to discover it, although it is a point of honour to take no notice of him; if they approve, matters take their course, but if not, they use their influence with their daughter to say to him, "Be good enough to blow up the fire," the usual form of dismissal. These nocturnal visits but seldom result in immorality. The natives of Borneo appear to be a very moral people, on the whole, both before and after marriage. A good deal of freedom is permitted among some tribes to the lover, as a precaution against a sterile marriage, but marriage almost invariably follows pregnancy. Often a girl will commit suicide rather than face the disgrace of an unacknowledged child. Usually the bridegroom lives with or near his father-in-law (whom he often treats with more respect than his own father), and works for his benefit. Polygamy is rare. Divorce is very frequent, and may be obtained for a large number of causes or pretexts—bad temper, gossiping, laziness, unfaithfulness, any of which are deemed sufficient reasons for divorce without incurring a fine, as are also troublesome dreams and various omens; but, on the whole, the marital relations are satisfactory. The couvade is in force among both the Land and Sea Dyaks. At a birth the husband is confined to his house for eight days, and may eat only rice and salt, and for one month he ought not to go out at night.

The Kanowits follow the Milanau custom of sending much of a dead man's property adrift in a frail canoe on the river; they talk of all his property, but this is exaggeration. Mr. St. John, after describing the display of a dead chief's worldly possessions, goes on to say: "As I expected these valuables were not sent adrift, but merely a few old things, that even sacrilegious strangers would scarcely think worth plundering." Burning of the dead is confined to the Land Dyaks; the Sea Dyaks either bury theirs, or place the coffin in a miniature house built on piles eight or ten feet high; the latter is also a Kayan custom. A very wide-spread custom of the natives of Borneo is that of depositing the relics of their dead in a jar. In many places slaves or others are sacrificed at the funeral of an important man, in order to attend him in the future life. Some tribes have the cheerful practice of dancing round a tied-up slave, and as each man slightly wounds him they send messages to their deceased relatives, but the wounds are sufficiently numerous to cause his death. One tribe now substitutes a pig for a man.

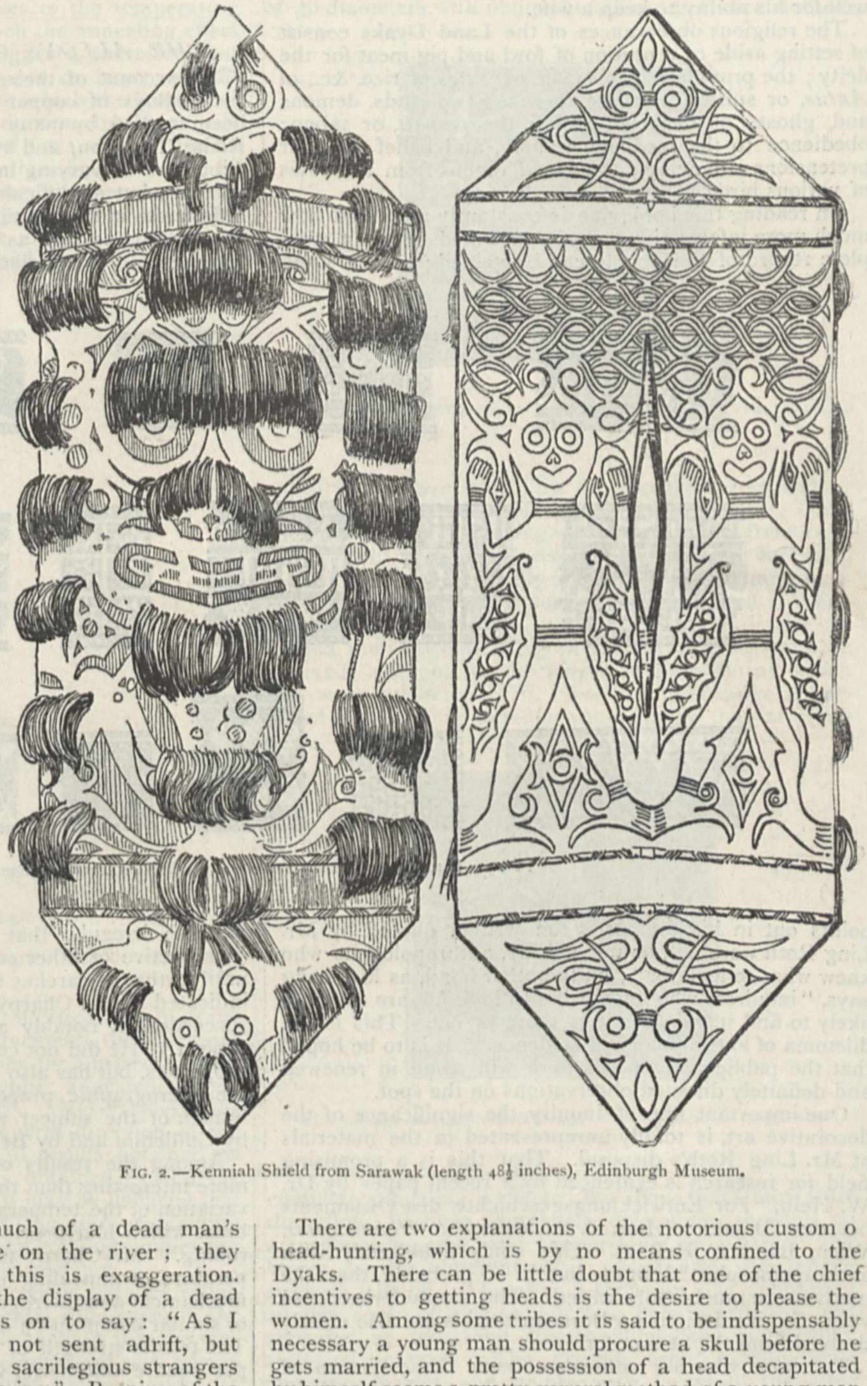

FIG. 2.—Kenniah Shield from Sarawak (length 48½ inches), Edinburgh Museum.

There are two explanations of the notorious custom o head-hunting, which is by no means confined to the Dyaks. There can be little doubt that one of the chief incentives to getting heads is the desire to please the women. Among some tribes it is said to be indispensably necessary a young man should procure a skull before he gets married, and the possession of a head decapitated by himself seems a pretty general method of a young man ingratiating himself with the maiden of his choice. Some tribes believe that the persons whose heads they take will become their slaves in the next world; and Sir Hugh Low states that among the Kayans, before a person can be buried, a head must be obtained. Several travellers are of opinion that the passion for head-hunting, which now characterises these people, was not formerly so deeply rooted in their characters as it is at present, although to a limited extent it is probably an ancient custom. The second reason is a fairly satisfactory explanation of the origin of the custom, and the first for its extension, as the fact of a young man being sufficiently brave and energetic to go head-hunting would promise well for his ability to keep a wife.

The religious observances of the Land Dyaks consist of setting aside of a portion of fowl and pig-meat for the deity; the propitiation by small offerings of rice, &c., of *Antus*, or spirits (of these there are two kinds, demons and ghosts of departed men); the *pamali*, or taboo; obedience to the medicine women, and belief in their pretensions; dancing; the use of omens from the notes of various birds.

On reading this book, one is constantly reminded how much more information must be collected before a complete record of the people can be gained; as Mr. Lang points out in his preface, "the writers quoted by Mr. Ling Roth were not, or not usually, anthropologists who knew what to look for"; on the other hand, as Mr. Lang says, "inquirers who know what to look for, are only too likely to find it, whether it is there or not. This is the dilemma of anthropological evidence." It is to be hoped that the publication of this work will result in renewed and definitely directed observations on the spot.

One important line of inquiry, the significance of the decorative art, is totally unrepresented in the materials at Mr. Ling Roth's disposal. That this is a promising field for research is evidenced by a recent paper by Dr. W. Hein, "Zur Entwicklungsgeschichte des Ornaments bei den Dajaks" (*Ann. k. k. Naturhist. Hofmuseums*, Wien, Band x. Heft 2). This study deals only with anthropomorphic designs, but it is probable that the motives are much more varied. The characteristic and very effective designs on Bornean shields are also mostly derived from the human form.

To those who are conversant with the evolution of savage decorative art, it is evident that such patterns as those on Kanowit baskets have a significance which is at present unsuspected. As an example of the difficulty a student at home finds in endeavouring to interpret the significance of a native pattern, we have only to look at the design to the left in the illustration on p. 38 of Mr. Ling Roth's book, which, without a clue, could never have been imagined to indicate a cloudy sunset.

Sufficient has been said to show that this book is a valuable storehouse of information, and it also reflects great credit on the publishers for the artistic manner in which it has been produced. An idea of the character of the illustrations may be gained from the three which accompany this notice. ALFRED C. HADDON.

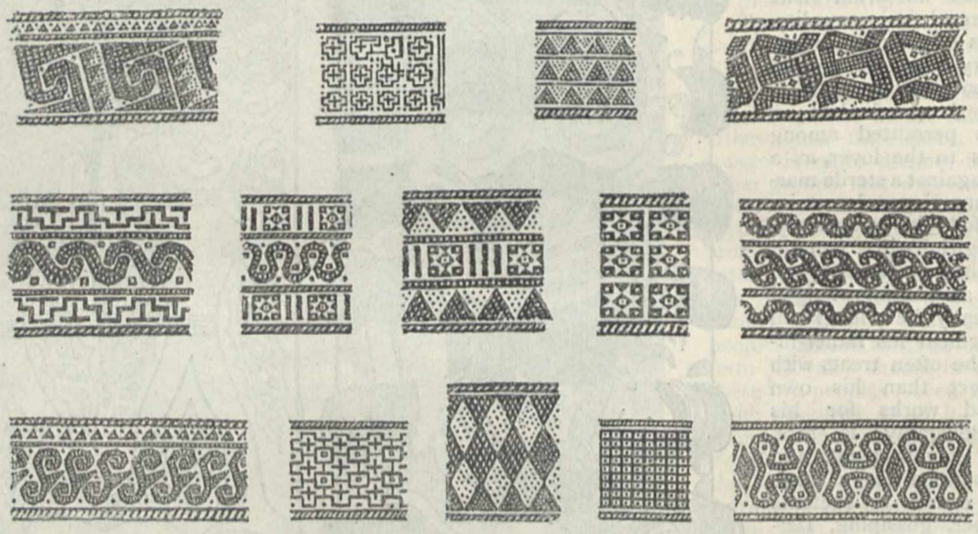

FIG. 3.—Patterns on Kanowit Baskets in the Brooke-Low Collection.

THE ALLOYS OF COPPER AND ZINC.

ON account of their great industrial importance, the alloys of copper and zinc have at various times been studied by many observers. Mallet, Matthiessen, Riche, Thurston, and a host of others have made contributions of varying importance to the literature of the subject; but so difficult is it to eliminate the accidental differences in the physical conditions that Prof. Thurston announced, as late as the year 1893, that the curves representing the variations in the properties of brasses were so irregular that the effects of composition only (irrespective of other conditions) must remain unknown until further researches should be made. To the task thus indicated M. G. Charpy has addressed himself, and has succeeded in notably advancing the knowledge on the subject.[1] He did not confine himself to the mechanical properties, but has also made a careful investigation of the micrographic properties of a number of alloys, a branch of the subject which had already been attacked by Guillemin and by Behrens in 1894.

Among the results of the mechanical tests, none are more interesting than the determination of the effects of variation of the temperature used in annealing pieces of brass which had previously been hardened by repeated rolling. M. Charpy finds that, if the maximum temperature of annealing is maintained for some time, the mechanical and micrographical properties of test pieces of similar composition depend only on that temperature. The tensile strength of metallic copper, in kilogrammes per square millimetre, when annealed at different temperatures, is shown in Fig. 1, the shape of the curve

[1] "Recherches sur les Alliages de Cuivre et de Zinc," by M. G. Charpy (*Bull. de Soc. d'Encouragement*, 5th series, vol. i. p. 180, February 1896).

A B C D being similar in the case of all the brasses. It may be seen that reheating has no effect on the tensile strength of copper unless the temperature exceeds 280°, when there is a progressive lowering of the tensile strength until the temperature reaches 420°. Above that point a further increase of temperature has no effect on the metal, the annealing being complete. Finally, when the temperature is so high that the copper is "burnt," the tensile strength again falls off rapidly.

It is remarkable, however, that the more thoroughly the test piece is hardened, and consequently the higher its initial tensile strength, the lower is the temperature (in the above instance, 280°) at which the annealing effect becomes sensible. M. Charpy suggests, therefore, that in pure, completely hardened copper or brass, any increase in temperature, above that at which the hardening was effected, would cause a reduction in the tensile strength, and that the broken curve C B A would then be a straight line, C B E. It would thus be predicted, as may be seen by a glance at the diagram, that the tensile strength of completely hardened pure copper would be about 52 kilogrammes per square millimetre, and, as a matter of fact, A. Le Chatelier raised the tensile strength

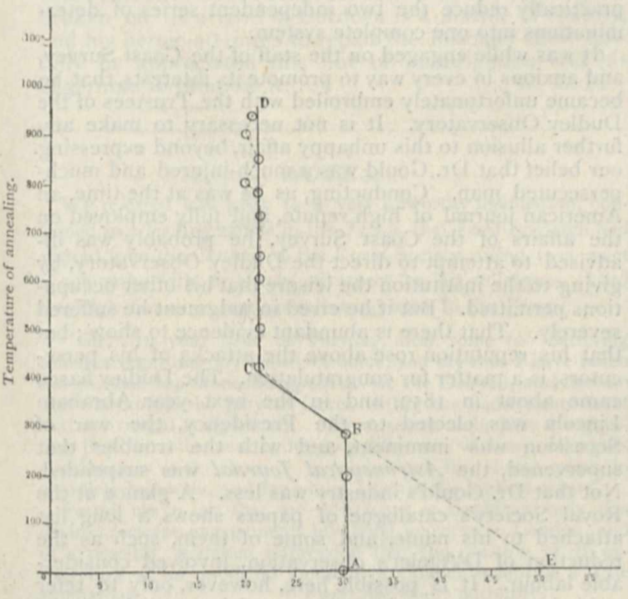

FIG. 1.—Variations in the tensile strength of metallic copper.

of copper to 51 kilogrammes by successive wire-drawings. In spite of this close agreement, the inference must be accepted with some caution, for apparently there were no experiments made on copper annealed at temperatures between 280° and 420°. Nevertheless the approximate correctness of the general direction of the line B C is attested by a number of results obtained on the analogous parts of the curves obtained by studying the brasses, whence, for example, it may be deduced that the maximum tensile strength of the alloy containing 30·2 per cent. of zinc should be about 70 kilogrammes per square millimetre, or 44 tons per square inch.

In tests made on completely annealed bars, in which M. Charpy believes that all accidental differences in the physical conditions are eliminated, he finds that the tensile strength increases with the percentage of zinc, passes through a maximum when the alloy contains about 45 per cent. of zinc, and then decreases rapidly. The elongation increases similarly with the percentage of zinc, but passes through a maximum when the alloy contains 30 per cent. of zinc, and then decreases rapidly. It follows that there is no advantage in using for industrial purposes alloys containing less than 30 per cent. of zinc, as they are more costly, and possess both less resistance and less malleability than those richer in zinc. On the other hand, if there is more than 43 per cent. of zinc present, the alloys are brittle, and should not be employed, so that only those with from 30 to 43 per cent. of zinc can be recommended for use.

In the micrographical researches, in which enlargements of 30 diameters with obliquely falling light were studied,

FIG. 2.—Alloy containing copper 80 per cent., zinc 20 per cent., annealed at 700°.

appearances were noted by M. Charpy corresponding to many of the results of the mechanical tests. Thus, for example, on hardening alloys containing from 0 to 35 per cent. of zinc by passing them through the rolls, the crystals are gradually deformed and disappear, a homogeneous granulated surface being obtained. When the hardened alloys are annealed, the crystals are reformed, their size depending on the maximum temperature attained, and not on the length of time during which they were subjected to it. No striking change is produced by reheating to temperatures below that at which

FIG. 3.—The same annealed at 900°, showing increase in the size of the crystals.

complete annealing is effected, but above that temperature the alloys become completely crystalline, showing no amorphous magma, and the crystals grow larger and larger as the temperature is raised and the tensile strength falls off. Thus Fig. 2 shows an alloy containing 20 per cent. of zinc which has been hardened and annealed at 700°, and Fig. 3 shows the same alloy annealed at 900°. The crystals are octahedra with numerous macles, and are obviously larger in the latter case than in Fig. 2.

When the reheating is carried to a very high temperature, near the melting point of the alloy, so that it is "burnt," a number of blowholes, looking like bubbles of gas, make their appearance (see Fig. 4, which represents commercial brass, containing 30 per cent. of zinc, after it has been annealed at 820°). As the temperature rises, these blowholes increase in number, and at the same time fissures develop round the crystals and eventually form a complete network. It appears that an alloy, not easily fusible, forms round the crystals, and, becoming liquefied, rounds off and corrodes them, thus giving the appearance of fissures. These effects are more readily produced if traces of lead and tin are present, as is usually the case in commercial brass, and the network round the crystals doubtless contains these metals. Under these circumstances the test pieces are of little tensile strength, and are not malleable.

M. Charpy prepares the alloys for examination with the microscope by etching the polished surface by electrolytic attack He points out that the fracture is useless as a guide to the mechanical properties of any metal or alloy. It has usually been supposed, owing to the appearance of the fracture, that a highly crystalline metal is necessarily fragile ; but this is far from being the case. Brass may be mainly composed of crystals as much as one millimetre in diameter without any interstitial matter, and yet may have an elongation of 60

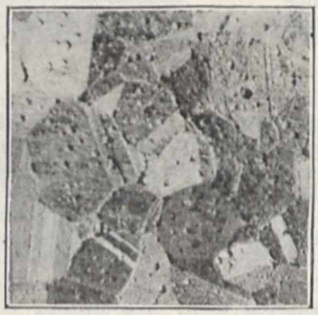

FIG. 4.—Commercial brass, containing traces of lead and tin, "burnt" by being annealed at 820°.

per cent. The only deduction that can be drawn from the appearance of the fracture is that if the crystalline structure is revealed in this way, the metal is brittle and of little tensile strength.

The microscopic structure revealed by etching polished surfaces enables the alloys of copper and zinc to be divided into three classes—those containing less than 35 per cent. of zinc, those containing from 35 to 45 per cent. of zinc, and those containing more than 45 per cent. of zinc. It enables the observer to determine whether the metal has been cast, and, according to the size of the grain, whether the casting has been made at a high or a low temperature, and what is the nature of the mould. It shows the effects of hardening, of annealing at various temperatures, and, lastly, shows whether or not the metal has been burnt.

M. Charpy infers, from the identical appearance of the alloys containing less than 35 per cent. of zinc, that these all consist of isomorphous mixtures of copper with the compound Cu_2Zn, which contains about 66 per cent. of copper. He also confirms the existence of the compound $CuZn_2$ containing 67·2 per cent. of zinc, which forms a perfectly homogeneous alloy under all conditions, and finds that if more zinc than this is present, it remains in the free state soluble in potash. On the other hand, M. Charpy expresses no opinion as to the form in which the metals are present in the alloys containing more than 34 and less than 67 per cent. of zinc. T. K. ROSE.

DR. BENJAMIN APTHORP GOULD.

ANOTHER busy life, devoted to the advancement of astronomy, is ended by the death of Dr. B. A. Gould. Practically, half a century has passed since his name came prominently before the public, in connection with the establishment of an astronomical journal in America, and throughout this period he has maintained a foremost place in the ranks of American astronomers by the unwearying energy he has exhibited, and the mass of work he has accomplished. For many years he was attached to the United States Coast Survey, where, under Superintendents Bache and Peirce, he did good service in the determination of longitudes at stations along the Atlantic seaboard, from New Orleans to the extreme north-eastern boundary of the United States. In those early days the employment of the method of telegraphic signals had not long been in use in America, and was scarcely known in Europe, and its subsequent development for longitude investigations owes much to the energy that Dr. Gould brought to bear upon problems of this character. When the Atlantic cable was successfully laid, he perceived the advantages it offered to connect the American with the European longitudes, and thus to practically reduce the two independent series of determinations into one complete system.

It was while engaged on the staff of the Coast Survey, and anxious in every way to promote its interests, that he became unfortunately embroiled with the Trustees of the Dudley Observatory. It is not necessary to make any further allusion to this unhappy affair, beyond expressing our belief that Dr. Gould was a much-injured and much-persecuted man. Conducting, as he was at the time, an American journal of high repute, and fully employed on the affairs of the Coast Survey, he probably was ill-advised to attempt to direct the Dudley Observatory, by giving to the institution the leisure that his other occupations permitted. But if he erred in judgment he suffered severely. That there is abundant evidence to show ; but that his reputation rose above the attacks of his persecutors, is a matter for congratulation. The Dudley fiasco came about in 1859, and in the next year Abraham Lincoln was elected to the Presidency, the war of Secession was imminent, and with the troubles that supervened, the *Astronomical Journal* was suspended. Not that Dr. Gould's industry was less. A glance at the Royal Society's catalogue of papers shows a long list attached to his name, and some of them, such as the reduction of D'Agelet's observation, involved considerable labour. It is possible here, however, only to refer to his best-known work, the successful establishment of an observatory at Cordova, and the great amount of work therein accomplished. The observatory itself is the outcome of a private expedition that Dr. Gould planned to the Argentine Republic, in order to extend to the southern hemisphere the system of zone observations that Bessel and Argelander had applied to the north. This private expedition was welcomed and adopted by the Argentine nation, and led to the foundation of that national observatory under whose auspices those valuable and extensive catalogues have been published, and whose preparation kept Dr. Gould at Cordova some fourteen years. While waiting for the full instrumental equipment of the observatory, Dr. Gould and his assistants occupied themselves with the preparation of charts of the southern hemisphere, giving the position of those stars that could be seen with the naked eye, and assigning to them magnitudes, which practically extended Argelander's scale to the whole heavens. For this work he was awarded the Gold Medal of the Royal Astronomical Society ; he had been elected a foreign associate in 1855.

Dr. Gould on leaving South America returned to Boston. Here, in 1886, after an interruption of twenty-five years, the *Astronomical Journal* again made its appearance under his editorship, and seems likely to have a long and prosperous career.

Although Dr. Gould's reputation as an astronomer will probably rest on the manner in which he carried to a successful issue long, and even wearisome, undertakings, involving continual repetitions of the same processes (witness the Cordova Zone Catalogue and the long series of longitude determinations), it must be admitted that he was keen to recognise the merits of new developments. He must be regarded as one of the first, if not *the* first, to foresee the practical advantages of the application of photography to the accurate determination of star places. So far back as 1866, he had co-operated with Mr. Rutherfurd in photographing the Pleiades, and had deduced the positions of some fifty stars in this group, clearly demonstrating the smallness of the average error of measurement, and the possibility of using those measurements in cosmical inquiries. Later he measured the relative coordinates of the stars in the Præsepe cluster, and the plan of operations proposed for the conduct of the Cordova observatory orginally contemplated the employment of photographic apparatus. The disappointment that Dr. Gould suffered on finding the object-glass broken on its arrival at Cordova is a matter of history, and his heroic attempts to repair the mischief show how fully he appreciated this line of investigation and his eagerness to promote it. W. E. P.

NOTES.

WE referred last week to a very unworthy insinuation, contained in a leading article in the *Times*, that Lord Rayleigh had retired from the Council of the Royal Society owing to a want of sympathy with, or a want of respect for, his colleagues. Lord Rayleigh has since sent the following letter to the *Times*.

"Sir,—In your issue of Tuesday, after some too flattering remarks regarding my tenure of office, you say that I have taken the unusual step of declining to sit on the Council, and that no one who knows the play of forces within the Society can doubt that my refusal is significant. There seems to be here a suggestion that my retirement is due to a difference with my colleagues —colleagues with whom I have worked for eleven years in complete harmony, and for whom I retain the highest regard.

Permit me to say that my retirement is significant only of a desire to escape engagements involving journeys to London, and of a possibly mistaken impression that the position of an ex-Secretary as an unofficial member of Council would be a little anomalous. "I am, Sir, yours faithfully,

"Dublin, December 2." "RAYLEIGH.

THE Davy-Faraday Research Laboratory of the Royal Institution, founded by Dr. Ludwig Mond, F.R.S., will be opened by the Prince of Wales on Tuesday afternoon, December 22.

THE first instalment of the Austin Corbin herd of buffalo, twenty-five in number, has just been removed from the Corbin Estate, in New Hampshire, to Van Cortlandt Park in New York City.

THE eleventh German Geographical Congress will be held at Jena on April 21, 22, and 23. The papers and discussions will principally refer to polar investigations, physical geography, biological geography, the topography and natural history of Thuringia, and the teaching of geography in schools.

THE death is announced of Dr. Karl Sebastian Cornelius, the author of many works on physics and physical geography, and privat-docent, with the title of Professor, in the University of Halle. We also notice the death of the zoologist, Dr. Fritz Westhoff, of the Königl. Akademie at Münster.

MR. P. F. COOK sailed for Hamburg a few days ago in the interests of the American Colonisation Society and of the Smithsonian Institution. He will remain a month at the Hague, studying myriapods and insects, and will then proceed to Siberia for a residence of several months, to conduct investigations of scientific and economic matters.

THE Liverpool Chamber of Commerce has unanimously adopted a resolution in favour of the adoption of the metric system of weights and measures, and urging that at the earliest possible moment consistent with the public convenience a Bill should be brought in to make the system compulsory.

DR. BERNARD DYER has been elected President of the Society of Public Analysts for the year 1897. The newly-nominated Hon. Secretaries are Mr. E. J. Bevan and Mr. Charles E. Cassal.

WITH reference to our note of November 19 (p. 58), on the "Welby Prize," we are requested to announce that, in consequence of unforeseen delays, it is found desirable to extend the time allowed to competitors till January 1, 1898, and that Prof. Émile Boirac, Paris, becomes the French member of the Committee of Award.

AFTER an absence of three years, the expedition under Lieut. Hourst has safely returned to Europe from the Niger. The party ascended the Senegal River, and then carried the section of an aluminium boat overland to the upper part of the Niger. On reaching this river the pieces of the boat were put together, and two native boats purchased. In these the expedition sailed down the Niger to Timbuctoo, where a stay of ten months was made. The voyage from Timbuctoo to Lokoja, at the confluence of the Niger and Benue, seems to have been arduous, but from that point the expedition was towed by a launch belonging to the Royal Niger Company to the coast at Wari. How much fresh topographical information Lieut. Hourst's party has obtained is not yet stated; this will depend on the highest point reached on the Niger. Reuter's message states that the expedition "first met the river Niger at Kayes"; but that town is on the Senegal River. There can be no doubt, however, that much valuable scientific information was obtained, for the expedition travelled slowly, and was admirably equipped. One novelty was the use of a phonograph for reporting the native war songs. The expedition kept peace with the natives throughout the journey, in which it differs greatly from some of those previously conducted by French explorers in that region.

THE success which has attended the installation of a meteorological observatory on the summit of Mont Blanc has (says the *Daily Chronicle*) stimulated Italian men of science to crown Monte Rosa with a similar edifice. Queen Margherita, herself an expert mountaineer, supports the project by a donation of 160*l*., the Duke of the Abruzzi gives 200*l*., and the Italian Alpine Club, the Ministers in their private capacity, and the physical faculty of the University of Turin figure among its chief contributors. It is intended to utilise the hut on the Gniffetti peak, built three years ago as a shelter for climbers. Situated at a height of about 14,000 feet above sea-level, the observatory will, as regards elevation, rank fourth among the twenty-seven mountain observatories of the world, being surpassed in altitude on by those of Arequipa, Mont Blanc, and Pike's Peak.

IN 1897, for the first time since the British Medical Association came into existence, the annual meeting will be held outside the British Isles. In order to induce as many members of the Association as possible to decide to go to Canada next year, the *British Medical Journal* prints an illustrated article in the curren number, showing the extensive preparations already commenced at Montreal, and giving valuable details as to ways of reaching the Dominion, and the cost of the journey. It may be remembered that the Association will meet on Tuesday, August 31, and three following days. This date has been decided upon for several reasons, the most important being that the British Association meets in Toronto from August 18 to 27. It will thus be possible for those who can spare the time to attend both meetings.

IT is proposed to hold an international electrical exhibition at Turin in 1898. The Executive Committee and the Special Commission invite exhibits from all parts of the world, and the exhibition will comprise the following classes: (1) Apparatus for teaching electro-technics; (2) materials for the conduction of electricity; (3) instruments for electric and magnetic measurements; (4) telegraphs and telephones; (5) signalling apparatus and safety appliances on railways, lighting and heating of carriages; (6) dynamos and motors; (7) mechanical appliances and electric traction; (8) electric lighting; (9) electro-chemistry and electro-metallurgy; (10) miscellaneous; (11) apparatus of historic interest. Signor Galileo Ferraris has been appointed President of the Commission.

DURING the past week this country has been visited with very severe gales, the greatest violence of which seems to have been felt on the South Coast. The reports issued by the Meteorological Office show that on the morning of the 4th instant the centre of a very deep depression suddenly appeared near the mouth of the English Channel, and advanced eastwards to the Channel Islands, where the barometer fell as low as 28·32 inches. During the night the storm changed its direction and moved northwards over England, while the wind increased to a whole gale from the southward, accompanied with heavy rain, and very high seas. In the neighbourhood of London the maximum wind force was registered at about 1 a.m. on the 5th, or between two and three hours after the time of the destruction of the Chain Pier at Brighton. The pressure recorded by the anemometer at the Royal Observatory was 18 lbs. on the square foot, which is equivalent to a velocity of about seventy-eight miles in the hour.

THE death of Prof. Emil von Wolff, in his seventy-eighth year, has just taken place at Stuttgart. The *Times* gives the following particulars of his career: "Born at Flensburg in 1818, he took his doctor's degree in the University of Berlin in 1843, and in the same year he was appointed assistant in the chemical laboratory in the University of Halle. Four years later he became instructor in chemistry at the agricultural institute at Brösa, near Bautzen. After passing some years at Möckern, near Leipzig, at the first agricultural experiment station ever founded in Germany, he was in 1854 called to the chair of Agricultural Chemistry at the Royal Agricultural College, Hohenheim, Wurtemberg. This post he retained for the rest of his life, so that he occupied the chair for a period of forty-two years. In 1868 he published a work dealing with practical systems of manuring, and six years later appeared the work which has made his name known throughout the world; this was his 'Landwirtschaftliche Fütterungslehre,' in which he dealt with farm foods and the rational feeding of farm animals. Since then the work has run through half-a-dozen editions, and has been translated into various languages, though long before any complete translation was attempted his tables of analyses of foods had been adapted to and incorporated with many volumes published in England, France, and the United States. As an authority on animal nutrition and the composition of foods Wolff stood pre-eminent, and all of the methods of the so-called rational feeding of live stock trace their origin to him and to the enthusiasm of the many students whom he trained during the last half-century."

A COMPETITION between heavy vehicles propelled by automatic traction is being organised by the Automobile Club of Paris; and in order that the makers of all kinds of cars, waggons, and similar vehicles should have plenty of time to prepare for the contest, which is open to all the world, the official programme has already been issued. The contest is to be for vehicles transporting passengers and goods on the high roads not in direct communication with railways, and it is to be held over roads in the vicinity of Paris on July 1, and five following days. A committee will be appointed to see how the competing vehicles work, whether they stop readily on the inclines, what speed they attain up and down hill, and, in a word, to judge how far they are likely to be of practical use. The prizes will be awarded with special reference to these qualifications. In order further to encourage makers of motors to compete, the Automobile Club will prepare an official report of the trials, and send it to all the civil engineers, industrial companies, and mayors in France. Entries may be made, and full particulars obtained from the Secretary of the Automobile Club, Place de l'Opéra, Paris.

AT the Royal Institution, on Monday, the special thanks of the members were returned to the Duke of Northumberland, K.G., President of the Institution, for a donation of 200*l.* to the fund for the promotion of experimental research at low temperatures; to Colonel Coleridge Grove for a bust of his father, the late Sir William Grove; and also to Prof. Dewar, for a marble pedestal for the bust. The following are among the lecture arrangements at the Institution before Easter:—Prof. S. P. Thompson, six lectures (adapted to a juvenile auditory) on light, visible and invisible; Prof. Augustus D. Waller, twelve lectures on animal electricity; Prof. Henry A. Miers, three lectures on some secrets of crystals; Dr. J. W. Gregory, three lectures on the problems of Arctic geology; Prof. Percy Gardner, three lectures on Greek history and extant monuments; Prof. W. Boyd Dawkins, three lectures on the relation of geology to history; Mr. Walter Frewen Lord, three lectures on the growth of the Mediterranean route to the East; and the Right Hon. Lord Rayleigh, six lectures on electricity and electrical vibrations. The Friday evening meetings will begin on January 22, when a discourse will be given by Prof. Dewar; succeeding discourses will probably be given by the Right Rev. the Lord Bishop of London, Prof. Jagadis Chunder Bose, Prof. John Milne, Dr. G. Johnstone Stoney, Lieut.-Colonel C. R. Conder, R.E., Mr. Shelford Bidwell, Prof. Arthur Smithells, Sir Edward Maunde Thompson, Sir William Turner, Mr. Charles T. Heycock, and the Right Hon. Lord Rayleigh.

SOME interesting information regarding the effects of inoculation for cholera is to be found, according to the *Pioneer Mail*, in the report on the railway reconnaissance from Assam to Burmah *viâ* the Hukong valley. Mr. Way, the engineer-in-chief, had to engage coolie transport, and 357 Khasias were collected at Margherita. Cholera was raging in the neighbourhood at the time, and, in spite of all precautions, the coolies were attacked. Fortunately, Surgeon-Captain Hare was at Dibrugarh, engaged in the special duty of inoculating labourers on the tea gardens, a work which had been begun by Dr. Haffkine some time before. He willingly agreed to deal with the Khasias, and the majority of them submitted to inoculation. The effect was very marked; the deaths among the inoculated were only 2·55 per cent., while among the uninoculated they came to nearly 19 per cent. The disease made such ravages among the latter that the coolies themselves became thoroughly convinced of the efficacy of inoculation, and finally all agreed to undergo the treatment. From that time onward no fresh cases of cholera occurred. Dr. Hare states that the 52 men first dealt with formed a separate group messing together in the same sheds. Of these, 30 were inoculated and 16 left; of the 16 uninoculated, 11 developed cholera and died; among the 36 there was only one case, but this terminated fatally. There seems to be no room for doubt that if all the coolies had been inoculated at the outset the disease would have ceased in a few days.

THE Maryland Geological Survey, in an endeavour to make its work fundamental, and at the same time of the greatest value to the material interests of the State, has taken up, in its preliminary investigations, a thorough study of the magnetic conditions affecting that portion of the earth's crust within the borders of Maryland. In addition to the importance of this work upon the future observations and determinations of the great rock-masses contained within the State, these investigations will be of immediate practical benefit to all land surveyors, and from that standpoint alone justify the undertaking. We learn from an advance sheet from *Terrestrial Magnetism* that the investigations are being conducted by Dr. L. A. Bauer, under the direction of the State Geologist, Prof. W. Bullock Clark. The Survey will ultimately average one station to about 140 square miles, thus equalling in detail that of Rücker and Thorpe in the British Isles. There is probably no State in America that presents, within so small an area, such a variety of geological formations as Maryland. It is then peculiarly fortunate that a detailed magnetic survey has been undertaken in this State, and simultaneously and in connection with the Geological Survey. It is hoped that other States will soon follow the example set by Maryland.

AT a recent meeting of the Otago Institute, Mr. G. M. Thomson exhibited some interesting fossil remains obtained from a mining claim at St. Bathans. The fossils occurred in a bed of hard clay which was overlaid by 30 feet or 40 feet of lacustrine (marine?) clays. They consist of leaves and fruit capsules of a species of Hakea. The genus Hakea belongs to the order Proteaceæ, and is at present confined to Australia, where about 100 species are known. Of these sixty-five have only been found hitherto in West Australia. The occurrence of the genus in New Zealand in Tertiary times is of great interest in its bearing on questions of geographical distribution.

AMONGST the things recently exhibited at the opening meeting of the Geologists' Association and at the "at home" of the Geological Society, one that deserves attention was shown by the Geological Photographs Committee of the British Association. Several portfolios were exhibited which contained the prints recently acquired by that body, among them being a fine set of views of the Yorkshire Coast taken by Mr. Bingley, a large series of small photographs taken during the recent re-examination of Charnwood Forest by the Geological Survey, and some most useful prints showing the chalk of Beer and the landslips of that neighbourhood, taken several years ago by Sir Henry T. Wood. The whole collection, now numbering about 1400 photographs, is lodged in the library of the Jermyn Street Museum, where it is borne company by the Survey collection of prints taken and acquired by the officers of the Geological Survey, the two collections supplementing one another. Although so much has been done, the labours of the Committee are by no means over, and many parts of Britain still need to be surveyed by the camera. Many local bodies have given ready aid to the work, and they must still be looked to to watch for phenomena which ought to be registered, and to help in keeping the collection up to date. It is hoped that this may come to be a recognised part of the work of local societies, and no pains are being spared to enlist the services of new societies, and to encourage those which have begun, to continue in their good work. Among the districts scarcely, if at all, represented at present in the collection are the following:—Bedford, Bucks, Berks, Cambridge, Cumberland, Essex, Gloucester, Hants, Hereford, Herts, Huntingdon, Lincoln, Middlesex, Monmouth, Norfolk, Northants, Nottingham, Oxford, Rutland, Stafford, Suffolk, Surrey, Sussex, Warwick, Westmoreland, Wiltshire, Worcester, South and Central Wales, Scotland, except parts of the Highlands and of the Central Valley, S.E., S.W., W., and Central Ireland. It is true that some of these districts do not lend themselves so well as others to this method of illustration, but what work there is should be done without delay. There will thus be got together a set of illustrations which will be a most valuable addition to published maps, sections, papers, and memoirs, and one which will in many respects remedy the deficiencies and supply the omissions of the methods of illustration usually employed.

PROF. E. VILLARI describes (*Atti dei Lincei*, v. 8) some fresh experiments relating to the property possessed by Röntgen rays of inducing in gases the power of discharging electrified bodies. This power is found to persist for a certain time after the rays have ceased, and it is not altogether destroyed, although considerably reduced, by causing the gases to flow through a tube several metres long. Sparks from an induction coil, whether reinforced by a condenser or not, are found to impart the same discharging power to gases, and their efficacy in either case increases at first with the length of the spark; but after a certain length of spark has been exceeded, the efficacy without the condenser decreases to zero. Another series of experiments on the electrostatic dispersion of Röntgen rays is described by Dr. Uno Panichi (*Rivista Scientifico-Industriale*), who examines the question of whether Röntgen rays are emitted from a Crookes' tube after the discharge within the tube has ceased. Dr. Panichi finds that within 1/50 of a second from the termination of the discharge, the Crookes' tube has no effect whatever on an electroscope, so that any after-effects which may be observed in other experiments must be due to the aforementioned modifications in the air which has been traversed by the rays.

THE January number of *Science Progress*, which now appears quarterly and in an enlarged form, will contain important and interesting articles on "Liquid Crystals," by Prof. H. A. Miers, F.R.S., Professor of Mineralogy in the University of Oxford; on "Selection in Man," by Dr. John Beddoe, F.R.S.; on "The Glossopteris Flora," by A. C. Seward, Lecturer on Botany in the University of Cambridge; on "Condensation and Critical Phenomena," by Dr. E. T. Kuenen.

A COMPLETE list of the scientific writings of the late Prof. Adolfo Bartoli has been compiled by Dr. Carlo del Lungo, and is published in the *Rivista Scientifico-Industriale* for August–October 1896.

FROM Profs. Elster and Geitel, we have received a copy of their important paper, published in the current volume of *Wiedemann's Annalen* (pp. 487–496), on the photo-electric after-effects of kathodic rays.

THE snakes found within fifty miles of New York City are enumerated by Mr. R. L. Ditmars, with brief descriptions of the species, and notes on their local distribution and habits, in an "Abstract" (No. 8) of the *Proceedings* of the Linnean Society of New York.

THE Deutsche Seewarte has issued the seventh volume of *Ueberseeische meteorologische Beobachtungen*, containing actual readings and monthly results of various stations in distant parts of the globe. The observations in Labrador are especially interesting to students of weather sequences which may affect this country, as many areas of low barometric pressure between Canada and the North Atlantic Ocean take their course over that peninsula. In addition to four stations in Labrador, the present part contains observations from Walfish Bay, Samoa, and German East Africa—altogether twelve stations. The observations are made with trustworthy instruments, and by competent observers, and form a valuable contribution to meteorological knowledge.

PROF. A. KLOSSOVSKY, Director of the Meteorological Service of the South-east of Russia, has sent us a *résumé* of work done during the last ten years. The headquarters of the Service is established at the magnetical and meteorological observatory of Odessa; this institution was founded by the Minister of Public Instruction, and has an annual allowance from the local municipal authorities. The main credit for the establishment of the system is due to Prof. Klossovsky, who for some years maintained it by his own exertions, being of the opinion that in so large a country as Russia, investigations of this nature, intended chiefly for the benefit of agriculture, cannot be managed and controlled by the central office at St. Petersburg. At the present time Prof. Klossovsky has enlisted the services of nearly 1000 observers, who deal more especially with rainfall, hail and thunderstorms. In addition to the yearly volumes of results, several investigations of considerable importance have been published.

PHYSICAL chemists have been anxiously awaiting the publication of the sections on chemical affinity required to complete the second enlarged edition of Dr. Ostwald's indispensable "Lehrbuch der allgemeinen Chemie" (Wilhelm Engelmann, Leipzig). This branch of the subject has been left for the second part of the second volume; and the first instalment of that part, dealing almost entirely with the history of chemical affinity, has just been published. It is expected that the treatment of the subject will occupy four or five instalments of about the same size as the present one, which runs into 208 pages, and all of them will be published in the course of next year. We propose to await the completion of the work before reviewing it, and at present content ourselves with announcing the appearance of one instalment.

THE December number of the *Geographical Journal* is full of interesting papers and notes. Mr. Montefiore Brice's account of the work of the Jackson-Harmsworth polar expedition, read before the Royal Geographical Society on November 10, is printed in full with illustrations, and appended to it is a report by Mr. Harry Fisher, the botanist to the expedition, on the flora of the Franz Josef Archipelago. Prince Henri d'Orleans describes his journey from Tonkin by Tali-fu to Assam. The eruption of Ambrym Island, New Hebrides, South-west Pacific, in 1894, is described, and illustrated from photographs, by Commander H. E. Purey-Cust, R.N. Mr. John L. Myres' paper, in which he gives an account of an attempt to reconstruct from the text the maps used by Herodotus, is very suggestive. Among the notes we observe the announcement that the Council of the Society not only intends to present Dr. Nansen with a special gold medal for his recent Arctic expedition, but also to award silver replicas of the medal to Captain Sverdrup, Lieut. Scott Hansen, Lieut. Johannesen, and Dr. Blessing, and replicas in bronze to the other members of the expedition.

THE effect of pressure on the velocity with which acids bring about the inversion of cane-sugar has recently been the subject of several investigations. It is well known that, at atmospheric pressure, the velocity of inversion is very nearly proportional to the degree of electrolytic dissociation of the acid used. Further, the degree of dissociation of acids increases, in general, with increasing pressure; it might thus be supposed that the rate of inversion of sugar under the influence of acids would do so also. Röntgen found that with strong, *i.e.* almost completely dissociated acids, the contrary was the case. Rothmund confirmed this result, but showed that if ethyl acetate be substituted for sugar, the velocity of change is increased by pressure, possibly owing to the sugar being changed into a less, and the ethyl acetate into a more easily hydrolysed modification. A further addition to our knowledge of the matter is made by O. Stern, in the current number of *Wiedemann's Annalen*. He finds that the rate of inversion of sugar by weak acids (acetic and phosphoric) is increased by pressure, while with strong acids (hydrochloric, sulphuric, and oxalic) it is decreased. The author gives his results without comment; it is, however, striking that an increase of velocity is found only with the weak acids, *i.e.* those which are dissociated into their ions, under ordinary pressure, to a small extent only; with these acids a considerable increase in the number of dissociated molecules is possible; with the strong acids, however, this is not the case, because they are almost completely dissociated at ordinary pressure. Taking into account the influence which the pressure has on the body undergoing hydrolysis, some sort of interpretation of the results may be given.

WITHIN the past few days, a number of new editions of scientific books have been received. Messrs. C. C. Hawkins and F. Wallis's simple and accurate volume on the theory, design and manufacture of "The Dynamo" (Whittaker and Co.) has passed into a second edition. The book well combines the theoretical and practical sides of electricity.—"Select Methods in Inorganic Quantitative Analysis," by Prof. Byron W. Cheever, has been revised and enlarged by Prof. Frank C. Smith, and the third edition is now published by Mr. William F. Clay, Edinburgh. In this volume the methods to be followed in the chemical analysis of a set of substances are described, and also the methods of calculating and preparing volumetric standard solutions. The contents thus provide a beginner's course of gravimetric and volumetric analysis.—Another, but much larger, manual to assist beginners in the practice of quantitative analytical chemistry, is "A Manual of Quantitative Chemical Analysis" (Henry Holt and Co., New York), by the late F. A. Cairns, the third edition (revised and enlarged) being by Prof. Elwyn Walker. The book was first published in 1880, and the important changes and advances which have been made since then have necessitated a very thorough revision. The chief feature of the work is mineral analysis, and in the treatment of this branch of analytical practice, as well as of others, students will find very helpful instructions, whilst from it professional chemists will derive useful suggestions.—Messrs. Longmans, Green, and Co. have just published a new and enlarged edition of Mr. G. S. Newth's excellent volume on "Chemical Lecture Experiments." The work contains full directions for the preparation and performance of experiments for illustrating, in lectures, the properties of the non-metallic elements and their more important compounds. Most teachers of chemistry know Mr. Newth's very serviceable volume; those who do not, should hasten to make themselves acquainted with it.

ALL the physical geography required by pupil-teachers and masters in elementary schools is set forth in an orderly manner in "Graphic Lessons in Physical and Astronomical Geography," by Mr. Joseph H. Cowham. The book, which is published by the Westminster School Book Depôt, and by Messrs. Simpkin, Marshall, and Co., is now in its sixth edition. The lessons in it are admirably arranged, the important points in each of them being given prominence. The illustrations are very instructive, and most of them are suitable for sketching upon the blackboard. In fact, the book furnishes strong evidence of the attention paid by the author to the methods of teaching his subject, as well as to the subject itself.—The tenth edition of "The Pocket Atlas of the World," by Mr. J. G. Bartholomew, comes to us from Messrs. John Walker and Co. The "Atlas" has been greatly amplified and extended. Without increasing its bulk, seventy-two new plates have been added; the text has been rewritten, and the maps revised to the date of issue.—"A Text-book of Shades and Shadows and Perspective," prepared for the use of students in technical schools, by Prof. John E. Hill, has reached a second edition. The book, which is published by Messrs. John Wiley and Sons, has been thoroughly revised and, in the main, re-written.—Messrs. Cassell and Co. have commenced the issue of a cheap edition of their "Technical Educator." The parts will appear weekly, and each will contain ninety-six pages of text and illustrations.

THE additions to the Zoological Society's Gardens during the past week include two White-thighed Colobus (*Colobus vellerosus*, ♂ ♀), a Campbell's Monkey (*Cercopithecus campbelli*, ♂), a Green Monkey (*Cercopithecus callitrichus*, ♂) from West Africa, presented by Dr. S. H. Armitage; a Lesser White-nosed Monkey (*Cercopithecus petaurista*) from West Africa, a Black-headed Lemur (*Lemur brunneus*) from Madagascar, presented by Miss Baird; an Arabian Gazelle (*Gazella arabica*, ♂) from Arabia, presented by Mr. R. G. Buchanan; two Raccoons (*Procyon lotor*) from North America, a Golden Eagle (*Aquila chrysaetus*), a Buzzard (*Buteo vulgaris*), European, presented by Lord Arthur Cecil; two Laughing Kingfishers (*Dacelo gigantea*) from Australia, presented by Mr. F. Beaumont; five Eyed Lizards (*Lacerta ocellata*), European, presented by Mr. P. Goupille; a Thick-necked Tree Boa (*Epicrates cenchris*) from Tropical America, deposited.

OUR ASTRONOMICAL COLUMN.

LEONID METEORS IN AMERICA.—The display of meteors on November 13 and 14 is said to have been great at some places in America. Published accounts include the statement that as many as twelve at a time were seen; and a press dispatch from Indianopolis states that meteors were visible there in broad daylight, in fact about the middle of the day.

A NEW SPECTROSCOPIC BINARY IN PUPPIS.—A new addition has recently been made to that class of stars of which ζ Ursæ Majoris, β Aurigæ, and μ' Scorpii are the present members. The star in question is Lacaille 3105, A.G.C.10534, and the Draper Memorial photographs show that it is a binary, its photometric magnitude being 4·50 (*Harvard College Obs. Circular*, No. 14). Prof. E. C. Pickering first noticed its binary character in February of last year, and this has been corroborated by several photographs secured by Prof. Bailey. A discussion of all the photographs taken, gives the length of the period as 3d. 2h. 46m., the formula representing the times of inferior conjunction being given as J.D. 2412777.16 + 3·115 E.

At these times the lines in the spectrum are said to be single; for the next thirty-seven hours they are double, the fainter component of each having a greater wave-length than the brighter component. The lines then again become single, and finally double for the remainder of the period, the fainter components having shorter wave-lengths, and being therefore towards the violet end of the spectrum.

RELATIVE MOTION IN THE LINE OF SIGHT.—In a *Harvard College Observatory Circular* (No. 13), Prof. E. C. Pickering describes a new method by which the relative motion of stars in the line of sight may be determined by means of the objective prism. As yet only preliminary trials of this method have been made, but it promises, as we are told, to be fairly satisfactory. In a discussion with Mr. E. S. King, of the experiments made by comparing the corresponding lines in the spectra of different stars with their images taken on another plate without the prism, and with the film reversed, the following process was evolved. It may be briefly summed up as follows. Two stars which are close enough to be photographed on a single plate are first selected. Let one of these be supposed at rest, and the other moving, say, towards the observer with a velocity represented by a deviation of amount *d* in its spectrum. If a photograph be taken such that the end of the shorter wave-length of the moving star be turned towards that of the star at rest, the distance between the images of a given line in the two spectra will be lessened by the amount *d*. By turning now the prism through 180°, the spectra will also be rotated through the same amount, and the end of greater wave-length of the spectrum of the moving star will now be turned towards that of the star at rest. If a photograph be taken in this position, the distance will in this case be increased by *d*. By superposing the two photographs thus obtained, making the images of the given line in the spectra of the star at rest coincide, the difference in the readings of the same line in the other spectra gives double the displacement of this line.

In actual practice the photographs can be obtained one on each side of the meridian, the act of reversing the telescope turning the prisms, and with them the spectra, through 180°.

For the examination of the plates, the film sides of the negatives must be placed together to ensure an accurate comparison, thereby necessitating that one of the photographs has to be obtained with the film side *away* from the objective prism. The question of change of focus can here then arise, of which, however, Prof. Pickering makes no mention.

The advantages of this method, as stated by him, may be condensed as follows:—Directness of the determination of the motion. Double the deviation is measured. Accidental errors of measurements are much less than when each in turn is bisected by a spider line, as the ends of two similar lines are made to coincide. Since each line in the spectrum may be used, a large number of independent determinations may be obtained from one pair of plates. Further, a visual telescope may be employed, as it is only *necessary* that one line should be in focus. Corrections for the motion of the sun in space, or of the earth in its orbit, may be disregarded, as they affect both stars equally.

FORMULÆ FOR COMPUTING WAVE-LENGTHS.—By the investigations of several workers the positions of the lines in the spectra of numerous substances are being mathematically determined. It was Lecoq de Boisbaudran who first pointed out the regularity in position in which lines of some substances appeared. Stoney, and others after him, found out that some of the lines of hydrogen were harmonically situated in the spectrum. It was left, however, for Balmer to bring forward a formula by which the wave-lengths of the lines in the hydrogen spectrum could be computed with wonderful accuracy. The formula was as follows:—

$$\lambda = A\frac{n^2}{n^2 - 4},$$

where n represented the numbers 3 to 15, and A the number 3645·42 in Ångström's units. Cornu at the same time, and Deslandres a year later, worked on this question, the latter producing a formula from which the bands of several elements could be computed.

In 1887 Kaiser and Runge set to work, and between them they advanced the new idea very considerably by describing a general formula which represented a great number of series of different elements, and which also included that of hydrogen, Balmer's formula being found to be only a special case. The new formula became then

$$\tau_n = A - Bn^{-2} - Cn^{-4},$$

the reciprocal of the wave-lengths (τ_n), instead of the wave-length themselves being here employed. The first three members of such a series sufficed to represent the series of lines with considerable approximation from values obtained from observation with the exception, perhaps, of the longest and shortest waves For the determination of these constants, which appear in this formula, three distinct measurements of the number of oscillations are necessary.

The drawback of this formula is that for the longest, or, at any rate, the two longest waves, it is not sufficiently accurate; and, even if more terms were added, the determination of the values of the additional constants would be uncertain owing to the limited accuracy of the wave-length measurements.

In determining the accuracy of this expression, Messrs. Kaiser and Runge were thus led to undertake the investigation of more accurate determinations of the spectra of the elements.

More recently, however, Herr Balmer has succeeded in finding an expression which represents the series with greater accuracy than formerly. This differs slightly from those given above, in that the third term is dispensed with, and an additional constant is placed in the denominator of the second term. The expression is

$$\tau_n = A - B/(n + c)^2.$$

That this is capable of giving results of very considerable accuracy is shown by its application in the case of the spectrum of helium, these results being given in the *Verhandlungen der Naturforschenden Gesellschaft in Basel*, Band xi. Heft 3, a "Separatabdruck" of which paper we have before us. All six series of lines in the spectrum have been computed, and in every case the differences, observed minus calculated, are small. Herr Balmer describes also a method by which the line series can be graphically constructed.

THE "LINCEI" AND EXPERIMENTAL SCIENCE.[1]

IN accepting the invitation to deliver an address on the twenty-first anniversary of the revival of this Academy, when it added social and philological science to mathematics and physical and natural science, I have from the outset not ignored the difficulty of my task, which I have since found even greater than I expected. Nevertheless, a consideration of the work done by the first Lincei, who founded this most ancient of all existing scientific Academies, and a notice of their contribution to the progress of all experimental sciences, particularly biology, appeared to me a subject worthy of your attention.

Federico Cesi, founder of the Lincei, leaving Rome in 1618, handed over to D. Virginio Cesarini, and Giovanni Fabri, Fellows, the mission of giving the ring of the Lincei to Carlo Muti. Cesarini subsequently wrote to Cesi that he had instructed the newly-elected Fellow in the usages and rules of the Academy, and "particularly in the liberty of conscience, love of truth, confession of ignorance, and also, so far as my poor intelligence can, I have not failed to open to him the true founts of human science, not dialectic but real, praising mathematics and natural science as the sole and only principles by which to gain knowledge in this world." The extract, which I have taken word for word, shows clearly the method by which alone the Lincei believed scientific truths could be sought out; and we should have known it more exactly but for the loss of a manuscript, by Cesi, on the "Universalis rationis speculum in quo universalis ars continetur." Still, we do know that at the first meeting, held October 15, 1603, Giovanni Eckio described the operation of the mind, by which it proceeds from facts to conceptions; that is to say, he spoke of induction.

The Lincei were not content with philosophising, but made experiments on subjects pertaining to natural and medical science; and set themselves to observe and calculate the motions of the stars. To this end they provided apparatus and instruments, including the telescope and the microscope, which latter they were the first to use, making known its advantages in the study of botany and zoology. The first print of a microscopic object is that by Francesco Stelluti, representing the honey bee, and placed as frontispiece to the *Apiarium* by Cesi, published in 1625.

The Lincei were also the first who instituted experiments to solve the question of the generation of living objects from putrefaction, an opinion then universally held. We find that Cesi was the first to recognise the animal nature of sponges, corals, and fresh-water polypi; that he maintained there was a gradual transition between the three natural kingdoms, and that he discovered fossil wood. For their method of pursuing science, the Lincei were persecuted from their very first meeting in 1603, and so bitterly, that they were obliged to separate and keep apart for several years. The Lincei had been preceded by Leonardo da Vinci, who held induction to be the only legitimate method in natural science; by Andrea Vesalio, who had overthrown Galen, insisting on the direct study of human anatomy; and by Niccolo Copernico, who subverted the Ptolemaic system, and established the sun as the centre of our planetary system around which the earth and other planets revolve.

On another side, the ground for scientific research had been prepared by the Florentine Platonic Academy, who had substituted Plato for Aristotle, and had grafted platonic idealism on the growing sentiment of Christian art. It was necessary, however, to free science from the spirits of the alchemists, from the idealism of the neoplatonists, from the teleological argument of the scholiasts; in a word, from every trace of transcendency and of finality, so that the human mind, being freed from prejudices and preconceptions, might be enabled, through the study of nature, and by the aid of mathematics, observation, and experience, to seek the real causes of phenomena. This was the work initiated by the Lincei, this was the innovation, deemed bold and dangerous, which gave rise to the new philosophy—Natural Philosophy—which in its turn originated the great scientific movement culminating in a Galileo, a Bacon, and a Descartes.

Galileo lived in the scientific atmosphere of the Lincei (to which Society he was elected in 1615), and he is held to be the founder of the experimental school, proceeding with steady steps in their ways, inventing valuable instruments, and making discoveries of the greatest scientific value. Bacon made no experiments, but gave instead the laws of induction; yet living among such surroundings as those of Elizabeth's court, then swarming with alchemists, notwithstanding his having combated their philosophy and that of the scholiasts with much minuteness, he still believed in spirits, and could not unfetter himself from final causes. Bacon has been accused of not appreciating with exactness the relation between cause and effect, not caring for mathematics, and supposing effects the results of one sole cause, which rarely occurs in nature. Purely inductive methods do not suffice for natural science, for when by them we arrive at one acquired truth, we can from this one deduce others by reasoning, and even rise by mental theories to more general principles. In this sense great credit is due to Descartes, who employed deductive methods, and exhibited the advantages in the study of nature arising from mathematics, as had been already recognised by the Lincei, and used by Copernicus, by Kepler, and, in conjunction with experimental methods, by Galileo.

To demonstrate the importance of the true causes which act on living organisms not solely from their exact value, we might adduce numerous examples taken from the progress made in our own time by medicine, the most practical and beneficent to humanity of all sciences; for if physics and chemistry have by their appliances increased the enjoyments of social life, medicine has succeeded in lightening many of the burdens of suffering humanity. The terror produced by the announcement of a great epidemic, when it was believed to be a chastisement sent from heaven to punish men on earth, ceased from the day when it was found to be the deleterious action of minute living objects, the so-called pathogenic microbes, and when aseptic and antiseptic cure, and the inoculation of attenuated virus and of curative serums were discovered to subdue and destroy the infinite armies of these imperceptible but deadly enemies to mankind, animals, and useful plants. I will not dwell longer on these and other victories of contemporary medicine, my only intention being to treat of science, which does not take account of utility, but is intent on discovering the causes of phenomena. If in practical life we must look to the good of humanity in science, there can be no special ulterior object of any kind. In medicine, however, as in every other science, we distinguish practice, or the application of scientific truths to the benefit of humanity, from science itself. Medicine reaps the benefit of the whole science of life, biology, of which morphology is an essential part, as well as that which seeks the true causes of organic forms in their origin, growth, and involution. Morphology, then, is called upon to solve the problems of organisation; for example, we desire to know why animals and plants leave their present form, in what way species differ or resemble one another, and in what relation they stand to their ancestors. The answer to such queries was at one time easy, but not scientific; when, that is to say, it was believed there was one pre-established type in which individuals were formed and species fixed, the answer was: that the form was what had been created, that consequently species were independent, that their ancestors had for their mission only to bear in their loins germs of such as they had been themselves, created contemporaneously with other matter in determined numbers, and with their form predetermined even to its minutest parts. With this doctrine research flagged, nothing was explained, and from the time of Gassendi (1592-1655), who was the first to formulate it, up to our present century, that is to say, till it was overthrown by the doctrine of evolution, our knowledge of living beings remained stationary. The science of the organisation of living beings, therefore, commenced when the theory of evolution became prevalent.

[1] Abridged translation of an address delivered before the Reale Accademia dei Lincei, by Signor Todaro.

Evolution admits that, as a result of real causes, characteristics may vary and be transmitted to descendants; hence, species are established by transformation from a common origin. Hereditary variation and transmission are the two essentials in the conception of species as now understood by zoologists and botanists, who regard them rather as to what they may become than what they are. This new conception of species has brought about an entire revolution in the study of biology, it being now recognised that individual, or, as it is called, ontogenetic development depends on genealogical or philogenetic development, in which the causes of existence must be sought, and the explanation found of the form presented by animals and plants in the actual state. Various theories, which I will briefly note, have been formulated to explain the action of the causes which produce the astonishing phenomena of variability of character and their hereditary transmission. The first of these theories, natural selection, which tried to explain everything, has had its day, and now is only invoked to account for certain secondary characteristics, or those attributed to the adaptations of individual forms. In fact to admit, with Darwin, the selection of properties subservient to their purpose, such as would arise in the struggle for existence, in which the strongest would survive, is the same as introducing a teleological cause into the explanations of nature, where no struggles nor purpose exist, but only phenomena which are in the relation of cause to effect, as had been established by natural philosophy. The principle of improvement from internal causes, propounded by Nägeli, is but the affirmation of a result of which the causes, not only internal but also external, acting and reacting on each other, still remain to be found. Julius Sachs accepts improvement from internal causes, but adds mechanomorphosis produced in plants by mechanical means, such as the action of light and of gravity.

To study the effects of physico-chemical, or mechanical causes in living bodies, Roux has lately formulated his biomechanical theory, which is far more scientific than the old mechanical theory of Descartes. Nevertheless the author does not take into account development, which is the fundamental principle of evolution, and in consequence of which forms and structures cannot all be explained solely by actual causes; since we must not lose sight of the idea that actually existing forms are essentially the product of causes which have operated slowly and successively in time. Roux, wishing to give the explanation of the trabecular structure of the liver, and the multipolar form of the hepatic cells of adult mammals, refers the cause of the orientation of the above-named cells to the action of material exchange, and which, from the bipolar form they take in all glands, have become transformed into multipolar cells in the liver of adult mammals. Hence, he refers also to this cause the transformation into fine network of the nutritive circulation which from tubular has become trabecular. But the case given by Roux leads us to one conclusion only, namely, that the elements, tissues, and organs are so closely correlated, that no alteration can take place in one without necessarily occasioning alteration in the others. But to know how the liver of adult mammals has become trabecular, and its hepatic cells multipolar, it is necessary to investigate the history of its genealogical development, such a transformation being effected by causes which have worked in time.

Can this investigation be made? Surely, by not limiting ourselves to the bare testimony of our senses, but by taking advantage also of induction. Comparing the liver of the adult with the liver of the embryo of the same mammals and with the liver of the other vertebrates, observation shows that in the embryo of mammals the liver is tubular, exactly as it is found in inferior vertebrates, even in the adult stage; hence we have been able to conclude that there was a period when, in the ancestor of the mammals, the liver was tubular through its whole life, and that the trabecular form is a later development. Thus far it is true we have not pointed out precisely what is the cause, or rather what are the causes which have transformed the gland from tubular to trabecular; but can we fill up this hiatus by the study of present causes? In the example under consideration, when we know that the nutritive current runs in one case only in one direction, and in the other in various directions, we cannot yet say that we therefore know the cause or causes of such variations, since we do not know precisely what were the causes, external and internal, which produced the alteration in the material exchange. Only by comparative research of organic forms we find that the trabecular form of the mammals is derived from the tubular form, and we thus come to an important result, thanks to which we can establish the parentage of animals—namely, that in the embryo are registered the genealogical documents of the race of his ancestors; and if we can but read them we shall find them, although more or less modified. Usually the more recent are the more clearly imprinted, while it is difficult to decipher the very old ones; indeed, sometimes these are entirely lost. We have an example in the development of the Molgulidæ and of the Salpæ, which, together with the Ascidians and other forms, constitute the class Tunicata.

The larvæ of the Ascidians pass through two phases of development; in the first, they present the cordate type, which subsequently disappears, being transformed in the second phase into the definite and exact type of the Tunicata. Now, in the Molgulidæ and in the Salpæ the first phase is suppressed; the cordate type is not repeated, and development commences directly from the Tunicata type. Without the Ascidians we should be unable to establish the relationship of the Tunicata with *Amphioxus* and the Vertebrates; and the class Tunicata would have remained where at one time it was placed, between worms and molluscs. Now, thanks to historical and philogenetic research, we know that a high place awaits the Tunicata beside the Cordata and the Vertebrates; and we are led to admit that these three great classes have a common origin, the Protocordatus, which has disappeared, but which we can reconstruct from the characteristics we meet with in these three classes.

The reconstruction of extinct organisms, which we are able to effect by the study of morphology, demonstrates the highest function of this science; the veracity of such reconstructions has been sometimes confirmed by successive zoological and palæontological discoveries. From the fundamental characteristics we meet with in the embryos of Ascidians, *Amphioxus* and the Vertebrata, we can affirm with certainty that the common progenitor of the Tunicata, the Cordata and the Vertebrata, had the form of a fish; possessed an intestine divided into an anterior part chiefly respiratory, and a posterior part digestive; had a body divided into segments, a spinal cord, and a nervous dorsal tube decurrent from its anterior to its posterior extremity, an arterial longitudinal dorsal vessel and a venous ventral one. Here, then, is one of the important results achieved by science through the study of organic forms.

Nor have results of lesser importance been obtained by researches on heredity. Progressing by experiment; aided by optical appliances, which in our day have made astounding progress, and by which the microscope has been raised to a high pitch of perfection; furnished with the most precise and delicate methods of modern histological technique, by which every living element can be detected in the various phases of its activity; we have succeeded in discovering an important part of the secrets with which nature has surrounded the generation of living beings, secrets which naturalists of time not long past had declared impenetrable.

Guided by experimental methods, we may hope that science will be able ere long to solve complex and important questions relating to the organisation of living bodies; we seek not the nature of things, which is impossible for us to learn, but the true reason of phenomena, remembering what the Lincei had affirmed from their very first institution—liberty of conscience, love of truth, confession of ignorance.

THE NATURAL IMMUNITY OF VENOMOUS SNAKES

In a previous article (NATURE, October 24, 1895, p. 621) the "Serum Treatment of Snake-bite" was briefly discussed by the writer of this note; and Calmette's and Fraser's researches are now so well known, that it is not necessary to give a summary of them. One or two points, however, must again be alluded to, because recently Dr. D. Cunningham, of Calcutta,[1] has carried on some important experiments which throw fresh light on the matter, and which also supply answers to some of the questions raised by the writer in the above-mentioned article.

The most surprising conclusion of Calmette and Fraser was that the serum of an animal immunised against cobra poison will protect not only against this poison, but also against the poisons of other snakes. It might be thought that this is an argument against Behring's law that the action of immunising serum is

[1] "Scientific Memoirs by Medical Officers of the Army of India," 1895, ix. p. 1-30.

specific, *i.e.* that such serum can only counteract that virus against which the animal supplying the serum has been immunised. Most snake poisons, however, are so similar in their chemical nature and physiological action, that it is hardly surprising that chemically similar poisons which, according to their action on the animal body, belong to one physiological group, should have the same antidote. In the former article the writer pointed out that there is one poison, daboia poison, which, as shown by Cunningham and Wall,[1] differs from cobra venom in its physiological action; and that therefore one could hardly expect that (*a*) animals immunised against cobra poison would become resistant against daboia venom, and *vice versâ*, and that (*b*) a serum capable of acting as an antidote to cobra poison would also be capable of neutralising daboia venom.

By a series of experiments performed at the Calcutta Zoological Gardens, in 1895 and 1896, Cunningham[2] has supplied these *à priori* considerations with a sound basis of fact. He shows that a fowl immunised against daboia venom by means of an habitual cumulative treatment with that poison does not acquire a corresponding immunity from cobra venom; and conversely, that the serum derived from the blood of animals which have been artificially immunised against cobra venom has no effect whatever as an antidote to daboia venom. The results are precisely what had been anticipated by the writer from the perfectly distinct properties of the two poisons. It is therefore not possible, so far as our present knowledge goes, to establish a vicarious immunity against absolutely dissimilar poisons, and Calmette's statement that a serum prepared from animals protected against cobra venom is an antidote against the action of the venom of *all* poisonous snakes requires some correction. These experiments then strongly support Behring's law, and we must perforce adhere to the principle of the specificity of immunising serum: distinct toxins require distinct antitoxins.

Fraser[3] has asserted that the serum or blood of poisonous snakes possesses antitoxic powers, and has explained the snake's natural immunity from its own poison by assuming that it immunises itself by swallowing its own venom, and thus renders its blood antitoxic. In 1892, already the writer,[4] working in India with freshly-caught cobras, was unable to obtain any real antitoxic effects with the serum of a normal cobra. Cunningham has since devoted full attention to this matter, and shows conclusively that the serum of a normal cobra, whether it be administered together with, before, or after the poison, has no antitoxic action whatever, and one must agree with him "that the natural immunity of cobras is perfectly distinct in its nature from the artificial immunity which is established in other animals as the result of continued treatment with cobra venom, and that it is unconnected with any material of the nature of an antitoxin in the blood." Normal cobra serum has also no antidotal effect on daboia venom, although the cobra enjoys an extraordinary immunity against this venom. In the previous note it had already been maintained by the writer, that since a large number of innocent snakes are highly resistant against cobra poison, although they never ingest poison, it is almost impossible to regard the natural immunity of venomous snakes as being due to habitual ingestion of their own poisons. All we can say is that a number of reptiles and amphibia possess a high degree of resistance as a natural property or character, independent of any process of self-protection, whether by swallowing or inoculation. In a few interesting experiments Cunningham, moreover, clearly shows that the inoculation of a poisonous snake with its own venom does not lead to the production of antitoxic substances in its blood. This is important, because it might have been assumed that, whilst normal cobra serum possesses no antidotal properties, serum derived from cobras in which self-inoculation had taken place, might have become antidotal. One of Cunningham's cobras readily resisted inoculation with an amount of cobra venom sufficient to kill 1000 fowls, and yet its serum had no preventive action whatever on even the minutest dose of the poison. But what is stranger still: a fowl was inoculated with 3 cc. of serum from a cobra which had received ·75 gramme of cobra venom. Considerable drowsiness followed, and sixty hours later the bird died of typical cobra poisoning. The blood of the snake, therefore, which had been killed a week after it had been inoculated with a large dose of cobra poison, contained enough unaltered venom to give rise, on injection into a fowl, to fatal intoxication, although the snake itself had shown no symptoms. In other experiments Cunningham obtained the same result, viz. "that the serum of cobras treated with excessive doses of cobra venom has no protective action whatever, but may for some time contain enough unaltered venom to give rise to fatal intoxication in susceptible animals." Is it possible, then, that the natural immunity of poisonous snakes is due to the presence of the same antitoxic bodies which are called into existence in susceptible animals by a process of slow and gradual immunisation? Are not the conditions exactly parallel to those which we find in natural immunity from bacterial diseases? It is there quite exceptional to find that the serum of naturally immune animals possesses any bactericidal, immunising or antitoxic properties towards the bacteria or their toxins, from which the animals enjoy a natural immunity. We must come to the conclusion, at which both Cunningham and the writer have previously arrived, viz. "that snakes as a group appear to be relatively insusceptible to the action of cobra venom, whether they be poisonous or harmless."

Cunningham further believes that there is good ground for assuming that the degree of susceptibility, to some extent, runs parallel with that of respiratory requirement. Thus a *Zamenis* (*Ptyas*) *mucosus*, or "common rat-snake," may be submerged in water, without being the worse for such treatment, for about half an hour, and it may be exposed to an atmosphere containing a large amount of CO for at least two hours, without being in the slightest affected thereby. This parallelism between susceptibility to cobra poison and respiratory requirement, to some degree at least, holds good also for other cold-blooded animals. Thus the *Varanus salvator* is extremely resistant against the effects of cobra poison, and it is still more indifferent to submersion. That immunity from intoxication with cobra poison does not, however, depend entirely upon a low degree of respiratory requirement becomes clear, as Cunningham distinctly states, when we compare the Zamenis with the Varanus; for the former, which is much more rapidly drowned than the Varanus, possesses a far higher immunity than the latter. Certain *Lacertilia*, again, are as susceptible to cobra poison as fowls; but Calmette is wrong in stating that a high susceptibility is a general Lacertilian peculiarity. The *Calotes versicolor* is quickly killed by cobra poison, but it is also rapidly affected by submersion. Batrachia, however, which have a low respiratory requirement, are relatively insusceptible to cobra venom. Hence, although the natural immunity of these animals does not entirely depend on their low respiratory requirement, this property is a factor of great importance; but however this may be, the natural immunity of poisonous snakes certainly does not depend on a process of self-immunisation. It would be interesting in this connection to study the natural immunity of freshly-hatched cobras, which, it is said, are venomous from their birth.

A. A. K.

1 "Indian Snake Poisons, their Nature and Effect,' 1883.

2 "Report on the Results of Experiments on the Action of various reputed Antidotes to Snake-Venom." (Calcutta, 1895-1896.)

3 "Immunisation against Serpents' Venom." (Address, Roy. Inst., March 20, 1896.)

4 *Journal of Physiology*, vol. xiii., 1892.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—On December 1, Convocation decided to affix the University seal to a memorial to the Duke of Devonshire, Lord President of the Council, desiring that a central educational authority for secondary schools be created.

Dr. J. S. Haldane has been reappointed Lecturer in Physiology for three years from January 1, 1897.

Messrs. E. E. Blackburn, E. E. Marsh, and F. A. Storr have satisfied the examiners in the second part of the examination for the Diploma in Public Health.

The Hebdomadal Council has accepted an offer from Prof. Poulton to present a statue of Charles Darwin for the court of the University Museum.

A bust of Sir Henry Acland is about to be placed in the court of the Museum as a memorial of his services to the Oxford Medical School.

Mr. H. B. Hartley, of Dulwich College, has been elected to a Brackenbury Natural Science Scholarship, and Mr. L. K. Hindmarsh, of King Edward's School, Birmingham, to a Natural Science Exhibition at Balliol College.

Mr. R. E. Thwaites, of Batley Grammar School, has been elected to a Millard Scholarship in Natural Science at Trinity College.

Messrs. G. W. Williams, of Pocklington School, and H. H. Crosthwaite Thomas, of Kendal School, were honourably mentioned as a result of the examinations for Hasting's Exhibitions at Queen's College.

The following elections to Mathematical Scholarships and Exhibitions have taken place:—Balliol College: H. C. Beaven, of Rugby School; W. H. Beveridge, of Dulwich College. Queen's College: R. B. Threlfall, of Heversham School. Brasenose College: F. F. Beach, of Monmouth Grammar School. Worcester College: O. Meade-King, of Exeter Grammar School; W. C. Burnet, of Boston Grammar School.

Cambridge.—The Arnold Gerstenberg Studentship for promoting the study of moral philosophy and metaphysics among students of natural science, both men and women, has been divided between Mr. C. S. Myers, of Caius College, and Mr. A. G. Tansley, of Trinity College, who have already taken honours in the Natural Sciences Tripos.

A vote of the Senate will be taken to-day (December 10) on the question whether or not the Sedgwick Memorial Museum of Geology shall be erected in the ground recently acquired from Downing College.

The General Board of Studies, while adhering to their opinion as to the importance of maintaining and endowing the Professorship of Surgery, now propose that it shall be suspended for one year. The proposal is made on the ground that it is desirable to give time for bringing about an official connection between the office and "a Hospital." Of course Addenbrooke's Hospital is intended, and it remains to be seen whether the Governors will be willing to reopen a question which was thought to have been satisfactorily arranged a few months ago.

The State Medicine Syndicate states that in the past year sixty-seven candidates have presented themselves for the examination in Public Health. Thirty-five were successful in obtaining the University Diploma.

Mr. E. W. Brown, of Christ's College, Professor of Applied Mathematics at Haverford College, Pennsylvania, has been approved for the degree of Doctor of Science. Prof. Brown's researches in the lunar theory are numerous and important.

Dr. L. E. Shore, Fellow of St. John's College, has been appointed University Lecturer in Physiology, in the place of Dr. A. S. Lea; and Mr. A. Eichholz, Fellow of Emmanuel College, has been appointed an additional Demonstrator in Physiology.

Mr. F. B. Stead, of King's College, has been nominated to occupy the University's table at the Naples Zoological Station, in the place of the late Mr. Gray.

The Walsingham Gold Medal has been awarded to Mr. W. McDougall, of St. John's College, for a monograph embodying original research in physiology.

The Gossage Chemical Laboratory of the University College, Liverpool, will be opened on December 12, by the Earl of Derby. Prof. Ramsay will deliver an address upon that occasion. This addition to the chemical department will, says the *British Medical Journal*, afford increased accommodation to medical students and candidates for the D.P.H., and will provide the means of carrying on special advanced chemistry. In connection with this department it is proposed to undertake the preparation of some of the rarer chemical compounds for the use of investigators who now have frequently to send abroad for them.

The regulations applicable to secondary schools receiving grants from the Technical Education Board of the London County Council for the year 1896–97, which are published in the last number of the *Gazette*, are of a very satisfactory and thorough kind. Amongst several important additions and alterations, we are glad to notice that scholars entitled to free education are not to be required to pay for entrance fees, books, examination fees, or other extras. The arrangements which continue to be made towards perfecting the practical teaching of science in the metropolitan secondary schools leave little to be desired. In the issue of the *Gazette* before us we find an account of additions to six more of these schools, viz:—Cooper's School, Bow; Philological School for Boys, Marylebone Road; Roan School for Boys, Greenwich; James Allen's School for Girls; Brompton School for Girls; and Rame's School for Boys, St. George's-in-the-East. In nearly every case laboratories for the teaching of practical physics and chemistry have been provided, and in some of them manual instruction has also been added to the curriculum.

The Catalogue (*Anglice*, Calendar) of the Michigan Mining School for 1896–1898 has lately been issued. Beside the usual school statistics, cuts of buildings, outlines of courses, &c., the volume contains a number of tables giving the classification of rocks and minerals, which students taking the course in geology, mineralogy, and petrography will find very valuable in their class and laboratory work, as well as helpful in their future researches. The scope of the work done and the methods employed in this department of the school are well outlined by these classifications. The catalogue contains also various statistics concerning the mineral production of the United States, and of Michigan in particular. Mention is made of the equipment and work of many of the most important copper and iron mines in the Upper Peninsula. The data thus collected brings out the fact that the school has all that could be desired in its situation, in the very midst of the most productive mines, in which are found the finest mining machinery in the world. The weekly excursions to the neighbouring mines and mills, laid out as a regular part of the student's work, together with the annual trip to the more remote iron mines, enable him to study and compare the plans of work employed.

Mr. Balfour's remarks, reported in Nature (p. 85), upon the difference between technical instruction as understood by most of the committees which dispense it, and the higher technical instruction in which Germany takes the lead, ought to be known to every local educational authority in the country. The matter was referred to in a recent address, (p. 69), in which Prof. Meldola deplored the action of Technical Education Committees in frittering away the fund at their disposal upon numerous small classes, instead of concentrating their attention upon a few, and making these thorough. The folly of this has been pointed out on many occasions in these columns, and every thoughtful educationist regrets that so much money is being wasted upon trade subjects while the scientific principles underlying them are generally neglected, and often ignored altogether. With the idea of finding the nature of the instruction given in technical classes, we have looked through the invaluable *Record* published by the National Association for the Promotion of Technical and Secondary Education, and have derived therefrom the following instances:—

In addition to classes in other subjects, Bedfordshire provides instruction in nursing, carpentry, and farriery; Buckinghamshire supplies dressmaking, lace-making, straw-plaiting, horticulture; Cambridgeshire: basket-making, brick-work, vocal music; Isle of Ely, poultry-rearing, bee-keeping, ploughing, draining and dyking, vocal music; Cheshire, pattern-cutting and clicking, type-writing, music; Cornwall has classes in cabinet-making and plumbing; Devonshire, sheep-shearing and thatching; Dorsetshire, brick-making; Essex, smiths' work, sail-making, photography; Herefordshire, ploughing and hedging, précis-writing, horse-shoeing, and political economy; Hertfordshire really distinguishes itself by providing for instruction in nineteen "technical" subjects, including embroidery, wicker-work, china-painting, allotment gardening, hedging and ditching, sheep-shearing, ploughing, and farriery. Lancashire encourages the teaching of subjects which differ as widely as "hat-manufacture" and "financial science." The difficulty experienced in reading the report of the work in Lancashire was to find some subject which was *not* taught. Leicestershire adds "hosiery" to its repertoire, and Lincolnshire (Holland) stacking. Norfolk provides on its "bill of fare" every subject from needlework to seamanship. Shropshire adds leather-work, a subject favoured by many other counties. Staffordshire offers metal-work, repoussé-work, and gesso, while Surrey is distinguished by "economics." East Sussex fosters music, and teaches life-saving. Wiltshire sanctions classes in brewing, and Worcestershire in cider-making. The borough educationists are disposed in many cases to be inventive. At Bath "technical arithmetic" has been invented, at Bolton "machine" calculations are taught as a separate subject, while the youth of Burnley are taught "commercial" English. The authorities at Blackburn assist the teaching of Greek and Latin, in addition to French, German, Spanish, Italian, and Portuguese, and add thereto the usual subjects, with vocal music, shorthand, and book-keeping. These instances are but a few of many which can be found in the *Records* for the last two years. No further argument is necessary to show the necessity for some sort of unanimity as to what ought to be attempted and what left alone. The worst of it is that all this dabbling dissipates energy which, with a little guidance, could be made capable of accomplishing really useful work.

SCIENTIFIC SERIALS.

Symons's Monthly Meteorological Magazine, November.—The climate of the British Empire in 1895. The values for that year present one unusual feature: the highest shade temperature (107·2°) was recorded at Calcutta, being apparently the highest reading there in the past fifteen years; the maximum is generally recorded at Adelaide. For extreme cold, Winnipeg (−45·5°) is unapproachable; this station has also the greatest annual range (133·8°), and the greatest mean daily range (23·0°). The driest station is Adelaide, mean humidity 59 per cent.; and the dampest, Esquimalt, 89 per cent. The highest temperature in the sun was 178·0°, at Trinidad, and the lowest temperature on the grass, −27·0°, at Toronto (the minimum temperature on the grass is not recorded at Winnipeg). Colombo, Ceylon, had the greatest rainfall, 92·23 inches, and Malta, the least, 11·38 inches. The greatest amount of sunshine occurred at Bombay and Jamaica.—The scientific use of kites. An account is given of the recent experiments at the Blue Hill Observatory; these have already been referred to in our columns. The Washington Weather Bureau is also giving great attention to the subject, and has requested Prof. Marvin and others to make a special study of this branch of meteorological research.—This number also contains notes on the first use of the word "isobars," and on meteorological observations in schools; the latter subject has already been noticed in our columns.

IN the *Nuovo Giornale Botanico Italiano* for October, Sig. A. Preda concludes a very elaborate paper on the Italian species of *Narcissus*. In addition to an enumeration of the species, a detailed account is given of the structure of the flower and other organs of the plant, especially of the nature of the corona, and of the mode of pollination.—Sig. E. Migliorato discusses the nature of the spines in the *Aurantiaceæ*, which he decides to be of cauline, and not foliar origin.

IN the *Journal of Botany* for November, a very interesting addition to the British flora is recorded by Mr. F. Townsend, in *Euphrasia salisburgensis*, gathered by the Rev. E. S. Marshall in Co. Mayo. The species is an eminently Alpine one, being found at elevations between 3400 and 7800 feet in Switzerland. It appears to find its lowland limit in Ireland, where it occurs almost on the sea-level.

SOCIETIES AND ACADEMIES.

LONDON.

Chemical Society, November 19.—Mr. A. G. Vernon Harcourt, President, in the chair.—The following papers were read:—Sulphocamphoric acid and derivatives of camphorsulphonic acid, by A. Lapworth and F. S. Kipping. Sulphocamphoric acid $SO_3H.C_8H_{13}(COOH)_2$ is obtained by oxidising α-bromocamphorsulphonic acid; its sulphonic chloride is converted into π-chlorocamphoric acid by heat.—A compound of camphoric acid and acetone, by W. J. Pope. Camphoric acid crystallises from acetone in crystals having the composition $C_{10}H_{16}O_4, \frac{1}{2}Me_2CO$; they are crystallographically closely related to camphoric anhydride.—Mercury hyponitrites, by P. C. Rây. A solution containing both mercurous and mercuric nitrites is obtained by the dissociation of mercurous nitrite; on adding sodium hyponitrite, mercurous and mercuric hyponitrite are formed.—The nitrites of mercury and the conditions under which they are formed, by P. C. Rây.—The interaction of mercurous nitrite and the alkyl iodides, by P. C. Rây. Apparently ethyl nitrite and nitroethane are formed in the interaction of ethyl iodide and mercurous nitrite.—Crystallography of the monohydrated mercurous nitrite, by T. H. Holland.—On the identity of dextrose from different sources; with special reference to the cupric oxide reducing power, by C. O'Sullivan and A. L. Stern. The optical activity, cupric oxide reducing power, and the specific gravities of aqueous solutions of dextrose prepared from cane and beet sugar, starch and lactose have been determined; the factors thus obtained are the same for the various samples of dextrose, so that it is concluded that the latter are identical.—Note on Mr. W. J. Humphreys' paper on the solution and diffusion of certain metals in mercury, by Prof. Roberts-Austen.—Solution and diffusion of certain metals and alloys in mercury: Part II., by W. J. Humphreys. The author has investigated the rate of diffusion of aluminium, antimony, cadmium, magnesium, thallium, and a few alloys in mercury; he considers that solution and diffusion in mercury may serve to distinguish between mixtures and compounds in the case of alloys.—Note on the heat of formation of the silver amalgam Ag_2Hg_8, by Miss F. T. Littleton. The heat of formation of the amalgam Ag_2Hg_8 is about +3432, and its specific heat is 0·029; the specific heat calculated from those of the constituent metals is 0·0359.—Preliminary note on the action of alkyl iodides on silver malate, by T. Purdie and G. D. Landor. A mixture of isopropylic isopropoxysuccinate and isopropylic malate is obtained by the action of isopropylic iodide on silver malate; the formation of the first compound suggested the idea that the alkylic malates produced from the silver salt may be contaminated with alkyloxysuccinates. This idea seems to be fully confirmed by examination of the alkylic malates so obtained.—On certain thiocarbimides derived from complex fatty acids, by A. E. Dixon.

Entomological Society, November 18.—Prof. Raphael Meldola, F.R.S., President, in the chair.—Mr. Tutt exhibited a series of the ochreous form of *Tephrosia bistortata*, Goetze, known as ab. *abietaria*, Haw., captured by Mr. Mason in March 1895 and 1896, near Clevedon, Somerset; also a series of the second brood of the same species (ab. *consonari*, St.), bred from ova laid by the Clevedon specimens. He also exhibited a series of *Tephrosia crepuscularia*, Hb. (*biundularia*, Esp.), taken by Dr. H. Corbett at Doncaster; a peculiar variety of *Hipparchia semele*, captured by Mr. H. S. Clarke near Ramsey, Isle of Man; also a series of *Plusia bractea* bred from ova laid in July last. The eggs and larvæ had been subjected to forcing treatment, with the result that the moths emerged in October.—Dr. Sharp called attention to Mr. Ernest Green's plates of the *Coccidæ* of Ceylon, which were exhibited on a screen in the room, and said that he had been inclined to consider the *Coccidæ* as a distinct order of insects, but at present the evidence was hardly sufficient to warrant this. He asked Mr. Green if he could give him any information with regard to the development of the wings in the male. Mr. Green said that in the males of the *Coccidæ* the wings first appeared in the penultimate stage as small projections on the sides of the thorax. These wing-pads grew to a certain extent without any further ecdysis. Though the insect was then quite inactive, and took no food during this stage, the rudimentary wings and legs were free from the body, and were capable of some slight movement. After the final ecdysis the wings of the imago were fully expanded, and assumed their natural position before the insect left the sac, or puparium, in which the resting stage had been passed.—Mr. Bethune-Baker exhibited a yellow spider from Orotava, which was of the exact colour of the flowers that it usually rested upon, and which had been observed to catch *Vanessæ* which settled on these flowers. Mr. Barrett said he had noticed a spider with the same habit on the ox-eye daisy in Surrey. Mr. Bethune-Baker also exhibited a very curious dark variety of *Arctia caja*, bred by Mr. Moore.—Prof. Meldola stated that it had been of late found difficult to store bristles in the city owing to the ravages of a moth, living specimens of the larvæ and pupæ of which he exhibited. Mr. Barrett said that the moth was *Tinea biselliella*. Mr. Bland oid stated that the bisulphide of carbon treatment might be found to be of advantage if it were practicable, but more would have to be ascertained with regard to the extent and character of the ravages before anything could be determined upon. Mr. Merrifield, Mr. Green, and others took part in the discussion which followed.—Mr. Blandford called attention to the use of formalin as a preventive of mould, and said that it would probably be found of use in insect collections; an object once sprayed with this substance never became mouldy afterwards. Prof. Meldola said that formalin was another name for a solution of formic aldehyde; it is now much used in the colour industry, and is, therefore, produced on a large scale.—Mr. Newstead communicated a paper entitled "New *Coccidæ* collected by the Rev. A. E. Eaton in Algeria."

Zoological Society, November 17.—Dr. St. George Mivart, F.R.S., Vice-President, in the chair.—Mr. Sclater gave an account of some of the more interesting animals observed by him during a visit to the Gardens of Antwerp, Cologne, Dusseldorf, Hanover, Amsterdam, the Hague, and Rotterdam in June last.—Mr. P. Chalmers Mitchell made remarks on a supposed case of telegony exhibited by a fox-terrier in showing peculiarities due to a previous fertilisation of its mother by a Dachshund. A discussion followed, in which Sir Everett Millais, Mr. Tegetmeier, and others took part, and expressed opinions generally unfavourable to the theory of telegony.—Dr. Leonard Hill made some remarks on supposed cases of the inheritance of acquired characters as shown by breeding guinea-pigs.—Mr. Sclater exhibited, on behalf of the Hon. H. S. Littleton, a coloured life-sized model of the Australian lung-fish (*Ceratodus forsteri*).—Mr. Blanford, F.R.S., exhibited, on behalf of Major C. S. Cumberland, some heads of *Ovis ammon* shot by him on the Altai Mountains in Central Asia.—Mr. Oldfield Thomas read a paper "On Further Collections from Nyasaland," being a continuation of three previous papers on the mammals of that country. The specimens now referred to had been collected and sent home by Sir Harry Johnston, Consul Alfred Sharpe, Dr. Percy Rendall, and Mr. Alexander Whyte. Two species were described as new: a peculiar hoary-coloured baboon from Fort Johnston, proposed to be called *Papio pruinosus*, and a steinbok with the white streaks in its fur characteristic of the grysbok. The latter had been obtained by Mr. Sharpe in Southern Angoniland, and was proposed to be called *Raphiceros sharpei*.—Mr. W. E. de Winton read a paper on some rodents from Mashonaland and Matabeleland, British South Africa, collected by Mr. J. Ffolliott Darling and Mr. F. C. Selous. This memoir contained descriptions of six species and two subspecies of rodents new to science. Amongst these were a dormouse very much smaller than *Graphiurus murinus*, to which the name *G. nanus* was given; a pouched rat, which was called *Saccostomus mashonæ*; and a mole-rat, proposed to be called *Georychus nimrodi*.—A communication was read from Mr. Alfred E. Pease containing notes on the antelopes of the Aures and Eastern Algerian Sahara.—Communications were read from Dr. A. G. Butler, on two collections of Lepidoptera made by Mr. R. Crawshay in Nyasaland; and on a collection of Lepidoptera from Nyasaland, presented to the Museum by Sir H. H. Johnston, K.C.B., and collected by J. B. Yule.—A communication was read from Mr. Joseph I. S. Whitaker, containing field-notes on the gazelles of Tunisia.

Anthropological Institute, November 24.—Mr. E. W. Brabrook, President, in the chair.—Lieut. Boyle T. Somerville, R.N., read a paper entitled "Ethnographical Notes on New Georgia, Solomon Islands." Lieut. Somerville recently passed some time in the islands while on surveying duty with H.M.S. *Penguin*, and both he and Lieut. Weigall acquired sufficient knowledge of the native dialects to be enabled to converse with the people in their own language. To this circumstance, and to the fact that the hints given in "Anthropological Notes and Queries" were systematically followed, a paper of quite exceptional interest was due, which forms a valuable addition to previously existing material on the ethnology of the South Seas. A point of exceptional importance is the occurrence of a rarely seen hairy animal in the jungles in the interior of the island. From the descriptions given by a number of natives, of which Lieut. Somerville quoted five of independent origin, this animal would appear to resemble an anthropoid ape, though a native who had seen one declared that it was not very like a monkey shown to him on board a European ship. The peculiar prognathous character of the well-known carved figures made in the Solomon Islands is possibly copied from a similar characteristic noticed in an animal prototype. Whatever this animal may be, the natives here canonised it as an evil spirit, and attribute to it the power of visiting either with sickness or death those who are unfortunate enough to see it. In spite of these fanciful beliefs, the positive existence of some such animal is confirmed by Lieut. Weigall, who himself saw a curious hairy animal on the edge of the jungle, but was unable to approach within sufficient distance to obtain a perfectly clear view. It must be remembered that the vegetation in this part of the Pacific is unusually dense, owing to the very frequent and regular rainfall. Nearly all the natives live close to the sea, and in order to penetrate into the interior it is necessary literally to cut one's way. Under these circumstances it is at least possible that some rare species may have hitherto evaded the notice of travellers. Lieut. Somerville believes this to be the case, and he is a competent observer, quite able to estimate the value of the evidence presented in the different native accounts. A number of admirable lantern-slides accompanied the paper, and specimens of native art in the form of pencil-sketches of the frigate-bird, canoes, &c., made by natives under the author's eye, were exhibited. A carefully copied specimen of native music was also shown.

MANCHESTER.

Literary and Philosophical Society, December 1.—Dr. Edward Schunck, F.R.S., President, in the chair.—The President exhibited some specimens of the cochineal insect, and of the Cactus *Opuntia*, the only member of the Cactaceæ on which the insect lives.—Dr. C. H. Lees called attention to the experiments of E. Wiedemann on the specific heats of vapours and their variation with temperature, and remarked that, since the specific heats of all the vapours experimented on increase with the temperature, it is probable that they do so for all vapours, including steam. Hence, the value of the specific heat of steam between given temperatures, required in Rankine's formula for the total heat necessary to raise water from any temperature to steam gas at another temperature, is still unknown.—Descriptions of new species of mollusca from the millstone grit, and lower coal measures, of Lancashire, by H. Bolton. The author described five species of mollusca and one brachiopod from the millstone grit and lower coal measures which have recently come into the possession of the Manchester Museum, Owens College, by the acquirement of the collections of Sir U. Kay-Shuttleworth, Geo. Wild, and R. W. Cairns. Of the mollusca, three belong to the Pelecypoda, and two to the Gastropoda. Two of these are altogether new to the coal measures, and one proves to be of considerable importance to miners, as it occurs, in all cases yet known, immediately over the valuable Cannel Mine of the middle coal measures. The brachiopod is interesting in that it occurs in the lower coal measures and, also, in a remarkable marine band of the middle coal measures at Ashton-under-Lyne, the two horizons being separated by nearly 2000 feet of rock matter.—On some errors in science, by C. L. Barnes.

PARIS.

Academy of Sciences, November 30.—M. A. Cornu in the chair.—On periodic solutions and the principle of least action, by M. H. Poincaré.—Scientific exploration by balloon, by M. Mascart. Simultaneous experiments were carried out with captive balloons at Berlin, Munich, Varsovie and St. Petersburg, and with free balloons at Paris, Berlin, Strasburg and St. Petersburg, for the purpose of carrying out meteorological observations. The highest altitude was reached by the Paris balloon, 15,000 metres, the temperature indicated being $-60°$ C. Each ascent will be described later in full detail.—Estimation of nitric acid in the waters of the Seine, Yonne, and Marne, during the late rise, by M. Th. Schlœsing. The results obtained show that great rises in autumn contain much more nitrates than those at the end of the winter.—The lymphatics of the intestinal villosity in the rat and rabbit, by M. L. Ranvier.—On the periodic Giacobini comet, by M. Perrotin. A new system of elements for the Giacobini comet, from observations made at Nice between September 4 and November 3, 1896.—Actinometric observations made on Mount Blanc, by MM. Crova and Houdaille. From observations at Grands-Mulets (3020 metres), a value of 2·9 calories is deduced for the solar constant.—Remarks by M. Appell on the presentation of the second volume of his work on elliptic functions.—Reclamation of priority, by M. Stuart-Menteath, concerning his work on the geological constitution of the Pyrenees.—On the singularities of linear partial differential equations of the first order, by M. F. Marotte.—On a remarkable displacement, by M. Raoul Bricard.—On molecular entropy, by M. Georges Darzens. The product of the usual expression for the entropy of unit mass by the molecular weight of the substance, is called the molecular entropy. It is shown that for all bodies possessing similar molecular constitutions, compared in corresponding states, the difference of molecular entropy between two given states is the same.—On the absorption of nitric oxide by ferrous bromide, by M. V. Thomas. In aqueous solution at 10°, the absorption corresponded to the formation of the compound $3Fe_2Br_4.4NO$, at temperatures higher than this (15°–16°), the results indicated the formation of $Fe_2Br_4.NO$.—On the tempering of steel in phenol, by M. Levat. Comparative trials on the same steels tempered in water and phenol respectively, showed the hardness and elasticity in the latter case was much greater than in the former.—Action of potassium permanganate upon polyhydric alcohols and their derivatives, by M. L. Perdrix. Carbon dioxide, formic acid, and water are the only products.—Action of ammonium nitrate upon *Aspergillus niger*, by M. C. Tanret. An excess of ammonium nitrate in a solution in which *Aspergillus* is growing, tends to retard or even to prevent the formation of spores, the mycelium remaining white. At the same time that the *Aspergillus* is forced to grow by mycelium, free nitric acid appears in the cultivating liquid, and starch is formed in the tissue of the fungus.—Application of the Röntgen rays to the study of the skeletons of animals not extinct, by M. V. Lemoine.—The bacteria of coal, by M. B. Renault. A study of the fossil bacteria in coal. Two varieties of a species, named *Micrococcus carbo*, are described, together with a bacillus to which the name *Bacillus carbo* is given.—Minerals formed from lead scoriæ from Laurium, by M. A. Lacroix. The lead mines at Laurium (Greece), worked by the Athenians for lead and silver, gave rise to scoriæ rich in lead and unreduced galena. The sea-water, acting upon these scoriæ for more than two thousand years, has given rise to numerous crystallised minerals, among which were recognised laurionite, penfieldite, fiedlerite, phosgenite, cerussite, anglesite, matlockite, and hydrocerussite.—On the lower Cretaceous beds in valley of Oued Cherf, by M. J. Blazac.—On the ascent of the captive balloon at Paris on November 14, 1896, by MM. G. Hermite and G. Besançon.—Additional note to a preceding communication, on the relations existing between the lunar movements and barometric changes, by M. A. Poincaré.—On a new practical method of preparing acetylene, by M. L. Lechappe.—The microphone and the discovery of springs, by M. L. Holtz.—Nervopsychosis, by M. Boukteïeff.

DIARY OF SOCIETIES.

THURSDAY, December 10.

Royal Society, at 4.30.—On Prof. Hermann's Theory of the Capillary Electrometer: G. J. Burch.—An Attempt to determine the Adiabatic Relations of Ethyl Oxide: E. P. Perman, Prof. Ramsay, F.R.S., and J. Rose-Innes.—The Chemical and Physiological Reactions of certain Synthesised Proteid-like Substances: J. W. Pickering.—An Experimental Examination into the Growth of the Blastoderm of the Chick: R. Assheton.

Mathematical Society, at 8.—A Discovery in the Theory of Compound Denumeration: Prof. Sylvester, F.R.S.—On the Stationary Motion of a System of Equal Elastic Spheres of Finite Diameter: S. H. Burbury, F.R.S.—Concerning the Abstract Groups of Order K! and ½ K! Holoedrically Isomorphic with the Symmetric and the Alternating Substitution Groups on K Letters: Prof. E. H. Moore.—On the Influence of Viscosity on Waves and Currents: S. S. Hough.—On a Series of Co-trinodal Quartics: H. M. Taylor and W. H. Blythe.—The Connection of Quadratic Forms: Lieut.-Colonel Cunningham, R.E.—Description of Mr. Macfarlane Gray's Multiplying Apparatus: T. I. Dewar and Prof. Greenhill, F.R.S.

Institution of Electrical Engineers, at 8.—Annual General Meeting.

South London Entomological and Natural History Society, at 8.—Notes on the North American Agrotis subgothica: W. Mansbridge.

FRIDAY, December 11.

Physical Society, at 5.—The Application of Physics and Mathematics to Seismology: Dr. C. Chree.—On Musical Tubes: R J. Rudd.

Royal Astronomical Society, at 8.—Report on the Expedition to Japan to observe the Total Solar Eclipse of 1896, August 9: W. H. M. Christie, Captain E. H. Hills, and H. H. Turner.—Report on the Expedition to Norway to observe the Total Solar Eclipse of 1896, August 9: A. A. Common.—Real Paths of 101 Meteors observed during the Ten Years ending November 1896: W. F. Denning.—Catalogue of Real Paths of Large Meteors: G. von Niessl.—Ephemeris for Physical Observations of the Moon, 1897: A. Marth.—The Theory of New Stars: W. E. Wilson.—Observations of Minor Planets at Windsor, New South Wales: John Tebbutt.—Comparison of the Sun's Longitudes for 1901, computed from Newcomb's Tables of the Sun, with those computed from Le Verrier's Tables: A. M. W. Downing.—Approximate Ephemerides of the Leonids for the First Four Months of 1897: G. Johnstone Stoney.

SATURDAY, December 12.

Essex Field Club (at Chingford), at 7.—Note on the Discovery of the Male of Prestwichia aquatica in Epping Forest: F. Enock.—The Federation Ideal for Natural History Societies, with special reference to the Eastern Counties: G. S. Boulger.—On the Diffusion and Local Extinction of Molluscs: J. French.

TUESDAY, December 15.

Zoological Society, at 8.30.—Contributions to our Knowledge of the Plankton of the Faëroe Channel: Dr. G. Herbert Fowler.—On the Genera of Rodents; an Attempt to bring up to Date the Current Arrangement of the Order: Oldfield Thomas.—On Lysechinus, a New Genus of Plesiocidaroids from the Tyrolese Trias: Dr. J. W. Gregory.

Institution of Civil Engineers, at 8.—Papers to be further discussed: Tipping and Screening Coal: James Rigg.—The Surface Plant at Kirkby Colliery: Thos. Gillott.—Paper to be read, time permitting: Steel Skeleton Construction in Chicago: E. C. Shankland.

Royal Photographic Society, at 8.—Some Probable Causes of Trouble in Photo-engraving, with Demonstrations of Methods for their Detection: Andrew Wybrandt-Penrose.

WEDNESDAY, December 16.

Geological Society, at 8.—On the Subdivisions of the Carboniferous Series in Great Britain, and the True Position of the Beds mapped as the Yoredale Series: Dr. Wheelton Hind.—Note on Volcanic Bombs in the Schalsteins of Nassau: Prof. E. Kayser.

Royal Meteorological Society, at 7.30.—An Attempt to Determine Velocity Equivalents of Wind-Forces estimated by Beaufort's Scale: Richard H. Curtis.—The Winter Climate of Egypt: Dr. H. E. Leigh Canney.

Royal Microscopical Society, at 8.

THURSDAY, December 17.

Royal Society, at 4.30.

Linnean Society, at 8.—On the Chalcididæ of the Island of Grenada: Dr. L. O. Howard.—On the Development of the Ovule of Christisonia, a Genus of the Orobancheæ: W. C. Worsdell.

Chemical Society, at 8.—On the Experimental Methods employed in the Examination of the Products of Starch-hydrolysis: on the Specific Rotation of Maltose and of Soluble Starch; on the Relation of the Specific Rotatory and Cupric-reducing Powers of Starch-hydrolysis by Diastase: Horace T. Brown, F.R.S., Dr. G. H. Morris, and W. H. Millar.

Royal Statistical Society, at 5.30.

FRIDAY, December 18.

Epidemiological Society, at 8.

Institution of Civil Engineers, at 8.—Wells, and Well-sinking: Joh W. Kitchen.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Books.—The Story of the Chemical Elements: M. M. P. Muir (Newnes).—The Parasitic Diseases of Poultry; F. V. Theobald (Gurney).—The Story of our Planet: Prof. T. G. Bonney, cheap edition (Cassell). List of the Vertebrated Animals now or lately living in the Gardens of the Zoological Society of London, 9th edition (Longmans).—The Plant-Lore and Garden-Craft of Shakespeare: H. N. Ellacombe, new edition (Arnold).—The Natural History of the Marketable Fishes of the British Islands: J. T. Cunningham (Macmillan) – The Tutorial Chemistry. Part 1. Non-Metals: Dr. G. H. Bailey (Clive).—Report on the Work of the Horn Scientific Expedition to Central Australia, Part 1 and Part 4 (Dulau).—Charles Darwin and the Theory of Natural Selection: Prof. E. B. Poulton (Cassell).—Annuaire pour l'an 1897, publie par Le Bureau des Longitudes (Paris, Gauthier-Villars).—Catalogue of the Michigan Mining School, 1894–96 (Houghton, Michigan).—Zoological Record, 1895: edited by D. Sharp (Gurney).—Le Déterminisme Biologique et la Personnalité Consciente: Dr. F. Le Dantec (Paris, Alcan).—Grasses of North America: Dr. W. J. Beal, Vol. 2 (New York, Holt).

Pamphlets.—Die Elektrodynamischen Grundgesetze und das Eigentliche Elementargesetz: F. Kerntler (Budapest, Pester Lloyd Gesellschaft).—Atmospheric Circulation in Tropical Cyclones: H. B. Boyer (Key West, Fla.).—Kite Experiments at the Weather Bureau: Prof. C. F. Marvin.—Mountain Observatories in America and Europe: E. S. Holden (Washington).

Serials.—Notes from the Leyden Museum, Vol. xviii. No. 1 (Leyden, Brill).—Geological Magazine, December (Dulau).—Cassell's Technical Educator, new edition, Part 1 (Cassell).—Geographical Journal, December (Stanford).—Fortnightly Review, December (Chapman).—Observatory, December, and Companion (Taylor).—Tübinger Zoologische Arbeiten, ii. Band, No. 1 (Leipzig, Engelmann).—Lehrbuch der Allgemeinen Chemie: Dr. W. Ostwald, Zweiten Bandes, Zweiter Teil; Erste Liefg., Zweite Auflage (Leipzig, Engelmann).—Quarterly Journal of Microscopical Science, November (Churchill).

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