THURSDAY, JULY 14, 1892.

A TREATISE ON ZOOLOGY.

Outlines of Zoology. By J. Arthur Thomson, M.A., Lecturer on Zoology in the School of Medicine, Edinburgh. (Edinburgh and London: Young J. Pentland, 1892.)

GENERAL.—The above-named volume of 604 pages small octavo, the latest of Pentland's "Students' Manuals," is divided into twenty-five chapters, with an introduction and a well-constructed index. By way of illustration, there are interleaved two-and-thirty sheets of diagrammatic sketches. It is difficult to find upon these any dozen figures which adequately represent anything in nature, and the majority of the "diagrams" are the rudest of rude sketch maps. Archetypes are well to the fore with their misrepresentations and evil influences, and such illustrations as those of the "unsegmented worm," the "spinal canal" figure of Plate 22, and others akin to them, are meaningless atrocities, conveying absolutely no idea to the mind. The Peripatus series are very suggestive; they are three in number—namely, one (bad) depicting the whole animal, another (worse) of a nephridium, and a third (unfounded) representing a conventional branched tube, spiral lining and all (*sic*). To be brief, the illustrations are mostly bad, and might well be dispensed with. Of those copied from well-known figures, many are spoilt in the copying, while the remainder are such as might have been produced in the greatest haste by a person accustomed to reading about, but not to handling, objects of the class delineated.

The book itself is written in a clear and intelligible style, and its author has been at immense pains in producing it. He deals with many difficult topics, especially when they do not involve minute structural detail, with conspicuous success. He is in some parts racy, in others flippant, *pace* the remark (p. 264) that "even a wooden leg may crumble before" the jaws of the termite; and he occasionally shows himself to be alive to difficulties of the passing moment—for example, that of the histogenesis of the nerve fibre. Some sections of the work are deplorably meagre, *e.g.* those devoted to the Ganoids, Tunicata, Rotifera, and Sponges, and especially to the Brachiopods and Polyzoa, which (following Lang) the author ranks with the Sipunculids and Phoronis as the "Prosopygii." Classifications such as that given of the Chelonia, and the adoption of the absolutely groundless term "Ornithosauria" as the ordinal name for the Pterodactyles, are bad examples of their kind. Akin to the occasional flippancy already alluded to are the descriptions of the embryonic membranes as "birth-robes," of the crystalline lens and the liver as "moored" to adjacent structures, and of the viscera as "swathed" in the mesentery. All science worthy the name must be now technical, whether set forth in the pages of a monograph or of a text-book; and when recognized terms are in daily use they should be employed. Personal names are occasionally mentioned; and it is a curious detail that, with one or two exceptions, those of workers in the Edinburgh School are alone qualified. We strongly deprecate the mention of individuals in an elementary text-book, as unnecessary and liable to abuse; but, in having adopted the course alluded to, the author displays a becoming respect for his seniors, such as we could wish were more general nowadays. His book is written for Edinburgh students; but we nevertheless note the absence of all reference to certain organisms in vogue among them—to wit, *Trochosphæra*, a knowledge of the development of which was demanded in a recent syllabus issued by authority.

The book, however, while lacking in much that is of primary importance, contains a bulk of excellent material. It is wonderfully free of really gross errors, and we therefore willingly recommend it on its general merits as a useful work of reference, believing that the author will strengthen its weaknesses as opportunity occurs.

The assertion that *Limnocodium* was "found in a tank at Kew" will probably whet the appetite of that establishment, and statements like that of the brain being "but an anterior expansion of the medullary canal," while self-explanatory, afford at least a relief to the reviewer.

Analytical.—The author tells us in his preface that his book is "intended to serve as a manual which students of zoology may use in the lecture-room, museum, and laboratory"; and, in accordance with this, he subdivides most of the chapters each into three sections, dealing respectively with what we presume he would consider a lecture equivalent, with the more didactic consideration of type-structure, and with facts usually embodying the principles of classification. A very ambitious scheme this; and it will be convenient to deal with each of the three departments separately.

First, as to the use of the book in the laboratory. The author here deals with familiar types, and supplements these here and there by the addition of wisely chosen species. His descriptions are, however, at most points insufficient and far too general, the one detailed account being made to do duty in the case of the Simple Ascidian (p. 358) for three distinct genera. This is not as it should be. The method of laboratory instruction in zoology employed in this country, with its rigid adherence to the type-system, is, in the long run, but that of teaching the alphabet whereby the student shall read; and, even were this not so, the laboratory training is one in discipline and observation, wherefore it is of the highest importance that any notes which shall be given the beginner for his guidance in it, shall be rigidly confined to actual statements of observed fact. The author partially disarms criticism under this head by remarking that his book is intended (preface) "as an accompaniment to several well-known works," which he cites (p. 88), and among which he enumerates leading laboratory treatises. Unfortunately, however, the plan of construction of those works does away with the necessity for his own as an adjunct to their utility. And we have therefore but to deplore the incorporation of generalities and ambiguities, in a portion of the author's treatise where they are calculated to encourage a general looseness, and to nullify much of the good intended by the founders of the system which he has adopted.

On passing to the two remaining departments of the book, we express ourselves at a loss to appreciate the utility of a text-book in the lecture-room. Much that passes current for scientific lecturing nowadays is mere parrot-work; and lecturing which is confined to mere text-book recapitulation (such as could alone justify the author's intention that his book should be used in the lecture-room) is no lecturing at all, but rather a poor form of dictation work. We deem it the highest aim of a scientific lecturer to teach his hearers, by example, how best to extend, systematize, and apply their knowledge of crude facts previously acquired in the laboratory. He should in all cases work out from these and lead up to generalizations; and, to the end in view, he should be up to date in his reading, and, above all, cautious in his selection of approved topics. Given this line of action, the competent teacher could not fail to present his facts in a manner in which they could not be found in any text-book. The author of the work before us has clearly realized this position, and much of his book which we presume he would regard as the equivalent of lecture material, fulfils our ideal. We note, however, a too frequent want of judgment, and a too general desire to present theories before facts. By way of example, the inter-relationships of the Echinodermata are summarily dismissed in some ten or a dozen lines, in a manner as "cocksure" as it is certainly erroneous; and the beginner is told (p. 377) that the ribs of Vertebrates "perhaps bear the same relation to the vertebræ that the visceral arches do to the skull," before he either knows sufficiently what constitutes a rib, or at all appreciates the difficulties in the way of homologizing the ribs of the leading classes of Vertebrata. And here and there the author goes out of his way to raise difficulties at the outset (*e.g.* the opening sentence in the book, and the second sentence of p. 121), when dealing with terms having a definitely accepted meaning; while, in ushering in the Mollusca with a reference (p. 299) to "a diagrammatic summary of the chief anatomical characters" and a "schematic Archi-mollusk—a reconstruction of a possible ancestor," he proceeds along a line subversive of all good discipline established either on precedent or sound sense. There is here evidence of a topsyturveydom in method, which could only be productive of disastrous results.

Concerning the more strictly text-book portion of the volume, we confess to a similar attitude of mixed judgment. There is in it much that is admirable and beneficial, and not a little that is crooked and injurious. The gastræa theory is swallowed outright, mention of equally plausible alternative ones being confined (p. 62) to five none too fortunate lines. The description of the scapula (p. 472) as "a membrane bone," of the cranial nerves of vertebrates (p. 381) as ten in number; like the assertions (p. 444) that "it is very difficult to distinguish Amphibians from Fishes," that (p. 33) Volvox "is a hollow sphere of epithelium," that the skate's egg-purse is (p. 425) "composed of a horny substance allied to that of hair and hoof"; like definitions such as that of *Balanoglossus* and *Cephalodiscus* (p. 348) as "surviving incipient Vertebrates" (of course with a "notochord"), of *Lepidosiren* (p. 428) as "only a species of *Protopterus*," simply will not do; while arrangements such as those of the Mammalia (p. 7) and Vermes (p. 149) are hardly in keeping with modern conceptions.

Retrospective.—On retrospective examination of the book before us, we seek in vain for evidence of that impress of the author's individuality as an actual worker which has so often "made" the zoological text-book of the past. The author has been too content to abstract all in his way. Obsolete classifications are placed side by side with others as audacious as they are premature, and rival theories are alike abstracted for what they may be worth. When, however, the author's method leads to the citing (p. 86) of Kropotkin as an authority on evolution; to the placing side by side, as alternative interpretations of the phenomena of Nature, those generalized statements of facts which constitute the "laws" of Darwin, and the flighty fantasies shot at a venture by certain younger "law-makers" (some of whom are sufficiently candid to admit that they are generalizing without facts), willing to risk all if, perchance, a frivolous public will but proclaim them philosophers, the experienced naturalist, in whose hand the judgment lies, steps in and demands a reconsideration. In a word, the author has insufficiently exercised his judgment in selection of material. To the teacher of science the duty of showing his scholars, by inference, what to neglect is, perhaps, of paramount importance to that of indicating upon what they are to rely. The author of the volume under review would, however, leave the discretion in the hands of the student; he writes rather as the amateur, to whom everything is equally important, and in thus acting he fails to recognize one of the highest functions of his office, to the utter confusion, if not the ruin, of his followers. In our opinion, his book, although in many respects admirable, falls short in each of its great departments which we have signalized. It will be largely used, and we wish it an ultimate success. It nevertheless contains the framework of a really serviceable text-book; and if the author will elaborate this, using a fitting exercise of judgment, and either eliminating the illustrations altogether or replacing them in others better and more numerous, he ought to produce a work of more than passing value, and he would sufficiently justify the great pains at which he has placed himself. In its present form the book is calculated to encourage a love of premature generalization, and anyone adopting its methods would teach fantasies before facts. The mental attitude which it typifies is one apt to create a bias, under which the student would suffer in his after work, as is indeed exemplified by the author himself in his treatment (pp. 178-79) of the reproductive organs of the worm. To encourage this is but to foster a growing evil. The didactic method of instruction in zoology now in vogue will unmistakably prevail in the future; but, unless its dryness be salted with work akin to the good old-fashioned field work, to the discouragement of the more modern and pedantic phylum-mongering and striving after impossibilities, better, by far, the *régime* of the past.

G. B. H.

WATTS' "DICTIONARY OF CHEMISTRY."

Watts' Dictionary of Chemistry. Vol. III. By Forster Morley and M. M. Pattison Muir. (London: Longmans, 1892.)

THE third of the four volumes of this excellent work has just appeared, and in value and interest this one does not stand behind the two previous volumes.

Amongst the articles written by eminent specialists, one, the most important, is that contributed by Prof. J. J. Thomson, of Cambridge, on the theories of the molecular structure of bodies. It is from the interpretation of chemical phenomena, by the help of exact physical research, that we may most hopefully look for insight into the true explanation of these phenomena. And although the theory of the molecular constitution of matter now universally held has been adopted as regards chemical change ever since the publication of Dalton's new system of chemistry in 1808, the crucial proof of its necessity has only recently been given. Prof. Thomson briefly but clearly explains the historical development of this proof. The first attempt was made by Cauchy, founded on the dispersion which light experiences when it passes through transparent bodies. But this attempt was an incomplete one, and a less ambiguous proof was given by Osborne Reynolds in 1879, based upon the thermal effusion of gases. Lord Kelvin, Loschmidt, and others have gone still further, not only proving that matter possesses structure, but giving limits below which the "coarse-grainedness" of matter cannot lie. These conclusions are founded upon considerations of several distinct sets of phenomena, viz. surface-tension, the difference of potential which occurs when two metals are placed in metallic connection, the amount of polarization at the surface of an electrode and of an electrolyte, and the viscosity, the diffusion, and the conductivity for heat, of gases. The discussion of the methods by which the limit is reached in the case of surface tension is next clearly given, and the result arrived at that a thickness of 10^{-8} cm. must be comparable with the range of molecular action of the water molecules. The results of the well-known researches of Quincke on silver films and on capillary elevation, as summarized in a lecture delivered before the Chemical Society of London by Prof. Rücker in 1888, are then explained, and the limits of molecular action deduced from these experiments. Having given an idea of the coarse-grainedness of matter, Thomson proceeds to consider the various theories of that structure, and gives an account of the most important of these by Lord Kelvin and Lindemann. The evidence of molecular structure afforded by the spectra of bodies, that concerning the arrangement of the atoms in the molecule on the supposition that the atoms are vortex-rings, and the electrical theory of molecular structure, first brought forward by Helmholtz in his Faraday Lecture, are all clearly discussed; and the author's own researches on the conduction of electricity by gases, which bear out the results of this latter theory, are adverted to. The whole article, which only extends over seven pages, forms an admirable exposition of a most important, if a somewhat difficult, subject, and shows what chemistry gains from the work of mathematical physicists.

Another short but excellent article is that by Mr. Shenstone, on ozone, including, as it does, the most recent work on the subject, as well as a *résumé* of the older and better known results. The question as to the relation existing between the quantity of ozone produced and the potential difference between the discharging surfaces, does not appear to have as yet been settled, though Berthelot finds that an increase of potential produces an increased yield of ozone. Nor has the exact influence of temperature and pressure been properly made out, though it appears that at a pressure of about 50 mm. ozone is alternately produced and destroyed. These facts point to the conclusion that, although much labour has already been spent upon the investigation of ozone, much yet remains to be accomplished before our knowledge of "modified oxygen" is anything like complete.

Of the recent progress made in our general chemical conceptions, none are of greater, if any are of as great, importance as the foundation of the periodic law by Mendeleeff in 1869. A Dictionary which failed to give an account, not only of the nature of this law, but also of its rise and development, would indeed be incomplete. Mr. Douglas Carnegie's article, however, does justice to his subject, and I am glad to see he has not ignored the extensions made by my lamented pupil and friend, Carnelly, which are truly said to be as much in advance of the earlier views of Dumas and Gladstone as the periodic law is in advance of the earlier disconnected schemes of classification. And I agree with the writer in his remarks that if these extensions must be regarded as bold speculations, they indicate the direction in which investigations on the *rationale* of the periodic law, and of the nature of the elements, will probably have to be prosecuted before we can hope to arrive at any explanation of the law, or of the nature of the chemical elements themselves.

The article on "Metals (rare)" is, of course, contributed by Mr. Crookes. It contains an account of the contributor's own researches on the splitting up of the rare earth metals. Many of the metals described in our treatises, and in the Dictionary itself, are probably mixtures. Some years ago I proved that an element termed philippium was in reality a mixture of two others, viz. terbium and yttrium, and Mr. Crookes's researches have since confirmed my results. It is, however, quite true, as Crookes observes, that until we know what terbium and yttrium themselves are, we have not got to the bottom of the question. And from his own work it does not appear very likely that the chemists of this generation will bottom this subject, for the more Mr. Crookes works on the separation of these bodies the more complex does the question of identification appear to become. Those who wish to form an idea of the character of work of this kind will do well to study the article.

A notable characteristic of this Dictionary is the summation of the properties of the different allied groups of chemical elements. Thus in this volume we find an excellent article by one of the editors, Mr. Pattison Muir, on the nitrogen group of elements. The relationships between the corresponding compounds of two different members are clearly set forth in tabular form, and thus the reader is able at a glance to compare the analogies and differences which these compounds exhibit both in composition and properties.

Prof. Armstrong's article on isomerism bears out the author's reputation for clear statement and complete knowledge of his subject. He fully discusses its historical development, strengthening his statements by valuable quotations from the writings of chemists of eminence, and brings the matter up to the latest views of chemists such as Van't Hoff, Victor Meyer, Wislicenus, and others, who have recently contributed to our knowledge of isomeric bodies.

For the rest, which indeed forms the bulk of the volume, I must content myself with saying that the numerous articles descriptive of organic compounds, ranging from indin on p. 1 to phenyl-tetrazole carboxylic acid on p. 858 (not to mention the inorganic compounds) are mainly contributed by Dr. H. Forster Morley, one of the editors. How far these hundreds of compounds are adequately described, or what mistakes of omission or commission the descriptions may contain, or how many printers' errors exist, must be left to be determined, if determined at all, by someone with more leisure, and, may I add, with more taste for that sort of work than I possess. But I may conclude by saying that, knowing the accuracy and care which uniformly characterize Dr. Morley's work, I do not think that any adverse critic, if such there should be, of this great addition to our chemical literature, will find it a very happy hunting-ground, for, as far as I am able to judge, the work has been carefully and accurately done.

H. E. ROSCOE.

THE ENGLISH SLÖJD.

Manual Instruction; Wood-work; the English Sloyd. By S. Barter. With 302 Illustrations. Preface by George Ricks, B.Sc.Lond. (London: Whittaker and Co., 1892.)

IT is to be regretted that the author of this very excellent and practical work should not have stated on the title-page what it really is, *i.e.* a book simply teaching carpentry, including directions for a limited amount of technical or mechanical drawing, and not have termed it "Wood-work," since by this term much is understood which is not given in his pages. Neither is there any occasion for the word which he gives in one place as *Sloyd* and in others as *Slöjd*, it being sufficiently misused already in Swedish by being confined to common incised carving and small carpenter's work, when it is properly applicable to all kinds of technical art. Since Mr. Barter has had the intelligence and boldness to declare that whatever can be done with the barbarous "*Slöjd*" knife can be better done with the chisel, it is to be regretted that, as he is with his English common-sense altogether out of and beyond *Slöjd*, he did not let the Swedish system alone altogether. There was no occasion for him to mention it or its palpable defects, to which he might have added the preposterous arrogance of its claims to be the incarnation of all that is needed to train the hand and eye to industrial art. However, since he who is fitter to be the leader humbly assumes the name, and follows the lead as an English *Slöjder*, we, of course, cannot complain, since it is to his own disadvantage that he assumes a title which detracts seriously from the merits of the treatise. He gives a very good introduction on drawing, which has, however, the serious defect of being beyond the capacity of mere boys, who, while at carpenters' work, certainly cannot be expected to devote hours to learning the meaning and application of "orthographic projection," "the assumption of the existence of parallel horizontal rays of light which project the elevation on a vertical surface," "isometric axes," and "therefore as AC is to CH : : $\sqrt{3}$: $\sqrt{2}$; but CH = A'K, which is," *et cetera*—all of which, with the diagrams, contrasts strangely with the pictures of the ten-year-old chubby youngsters who are represented as merrily sawing and planing in the frontispiece. It is true that there are little boys who can master Euclid, or its equivalents ; but an experience of years in teaching qualifies us to state that a much more simply written chapter than this, or one within the ready comprehension of "boys," would have been better adapted to the book. The forty-two pages devoted to timber are thoroughly scientific, practical, and admirable. Yet as boys seldom have any great choice of wood, and have little to do with teak, ebony, and lignum vitæ, much of the space might have been better devoted to some kind of wood-work not touched on in this book. Materials and tools are well described. We observe that in his illustrations of nails Mr. Barter makes no mention of the very best of all—the triangular, which goes home as straight as a screw, and holds like one.

"Bench-work" is the best portion of the book, being thorough, comprehensive, and manifestly written by a master of the subject. It is not beyond the comprehension of an intelligent boy who will devote to it serious attention ; therefore, for such as are somewhat advanced, it may be warmly commended, for the simple reason that intelligent minds pay most serious attention to, and remember best, what costs them some trouble. The author is evidently a very practical, serious, and earnest mechanic, who, understanding his business perfectly, describes everything as he would teach it to a class of young men who had been a while in workshops. But with his "orthographic projections" as with his whole style, he is—not invariably, nor even generally, but very often—too hard for urchins ; and, in fact, the juvenile who is depicted on p. 175 as boring a hole has appropriately the pensive air of one who is very much bored himself—probably by some difficulty in the text. Yet all of this does not detract from the fact that the work is an admirable one, that it is the best of its kind, and perfectly adapted to the use of teachers establishing classes, who are, after all, the only persons who really need or read such works, as pupils seldom look at anything of the kind unless required to. But though it is very seldom done, it would have good results if pupils in technical schools should be made to read more, and secondly, if the teacher should carefully explain to them the text.

An excellent feature in the bench work is that the author, giving the names of a majority of such objects as an amateur may expect to make, describes in detail, with excellent and abundant illustrations, how to make them. He might in some cases have gone a little further in his work. Thus it never appears to have occurred to him that parquetry, or inlaid work, can be made save by sawing out pieces of wood in their natural colours. But a large portion of French and Italian work is made by using wood which is artificially coloured, and we should not have expected this to be passed over by a writer who had the intelligence to remark that "Colour, which plays so prominent a part in design, is entirely overlooked in the Slöjd system," which it certainly is, and with it much more that is indispensable to teaching the minor arts as a system even to the youngest children. Nor does Mr. Barter mention the so-called Venetian *intarsiatura*, in which the pattern, drawn on one piece of wood, is cut half through the panel, the line being then filled with coloured mastic, and the pattern dyed. But such sins of omission are trifling, though in a book which proclaims on its title that it is devoted to wood-work we should have expected something more than carpentry, and at least a full description of Slöjd carving. And having pointed out, as in conscience bound, every defect, we feel it to be a duty to congratulate the publishers of this remarkably handsome, well-bound, and useful work on having done their best, and on having issued a manual which deserves a place in every industrial school.

But there is a word to be said as regards the preface and a portion of the introduction. It is perfectly true that manual instruction for children develops their intellects, and fits them for life far more than ordinary school studies usually do. But it is not true that this training should consist, as Messrs. Ricks and Barter virtually declare, of nothing but Slöjd, be it Swedish or English, or of carpenters' work. Such training should be for girls as well as boys, and it should be based on design and drawing, taught simultaneously in the simplest and easiest freehand; after which the pupils may take up not merely carpentry, or even Slöjd—which is nothing effectively but a minor branch of wood-carving—but also wood-carving itself, and many other arts, all of which come as one and promptly to the pupil who can design, and, when occasion favours, also can model a little. But to expect that carpentry alone, without a trace of art, is all that is needed to inspire the creative faculty is a great mistake; and what is worse is that, despite thousands of living examples of the superiority of the more artistic method for children, the British—like the American—public persists in believing that all that is needed is to teach "our boys" how to make benches and boxes.

OUR BOOK SHELF.

Thermodynamische Studien. Von J. Willard Gibbs, übersetzt von W. Ostwald. (Leipzig: Engelmann, 1892.)

THIS is a German translation of three of Prof. Gibbs's Thermodynamic Papers. These were published during the years 1873-8, in the Transactions of the Connecticut Academy (vols. ii. and iii.); and one reason which prompted Prof. Ostwald to undertake the translation of them was their inaccessibility to the general scientific public. Their importance is sufficiently attested by the fact that part of the ground covered by Prof. Gibbs has been gone over again by later writers who deemed they were themselves pioneers.

"Graphical Methods in the Thermodynamics of Fluids" is the title of the first paper. It gives for the first time a general account of the comparative advantages of using various pairs of the five fundamental thermodynamic quantities for graphical representation. The entropy-temperature and entropy-volume diagrams are discussed in considerable detail. The second paper contains the description of the volume-energy-entropy surface, which generally goes by the name of Gibbs's thermodynamic surface. Its contents are familiar to all who have studied Maxwell's "Theory of Heat."

The third paper, "On the Equilibrium of Heterogeneous Substances," fills five-sixths (344 pages) of the whole book, and is, out of question, by far the weightiest contribution which Prof. Gibbs has made to the development of thermodynamic methods. To him must be given the credit of first formulating the energy-entropy criterion of equilibrium and stability, and developing it in a form applicable to the complicated problems of dissociation. To give anything like a complete idea of the contents of this paper, with its discussion of critical points, capillarity, growth of crystals, electromotive force, &c., would mean the reproduction of Prof. Gibbs's own very full synopsis, which in the German translation forms the greater part of the table of contents of the book. It will suffice to notice the general theory of the voltaic cell, with which the paper ends. Here distinctly for the first time is it pointed out that the electromotive force of the cell depends on other factors than the variations of its energy. Von Helmholtz's theory, which differs from that given by Prof. Gibbs only in the greater fulness of detail, was not published till 1882.

Prof. Ostwald tells us that he had the benefit of the author's revision. With the exception of a few obvious corrections the original papers are most faithfully reproduced, even to certain footnotes which in these days have no particular value. In the circumstances a little license might well have been taken, and a slavish adherence to the original text departed from. For example, it is surely most desirable to use the word *isenergic* for lines of equal energy, and not the inappropriate term *isodynamic* which Prof. Gibbs made use of in his paper of 1873. Again, we question the right of any writer on thermodynamics to use the word *reversible* in other than Carnot's sense. Such double meanings tend to produce confusion, in spite of elaborate footnotes.

These blemishes apart, however, there is no doubt that Prof. Ostwald deserves great credit for his labour of love in preparing this translation. He has made it possible for the many, who know of Prof. Gibbs's work only at second hand, to acquaint themselves with the original papers, and we feel confident that the book will find its place on the shelves of all who desire a really complete library of thermodynamic literature.

Elements of Physic. By C. E. Fessenden. (London: Macmillan and Co., 1892.)

THE subject matter of this book is arranged in four chapters—Matter and its Properties, Kinematics, Dynamics (including statics, hydrostatics, and pneumatics), and Heat. It thus forms an excellent introduction to a more extended study of physical science. The treatment of the subject is based largely on simple experiments to be performed by the student himself, whose reasoning powers the author seeks to draw out as far as possible by suggestive questions interspersed through the text. The following example will give a good idea of the style of treatment:—

". . . All experience teaches that *no two portions of matter can occupy the same space at the same time.* This property which matter possesses of excluding other matter from its own space, is called *impenetrability.* It is peculiar to matter, nothing else possesses it. These facts being known, let us proceed to put certain interrogations to nature. Is air matter? Is a vessel full of air a vessel full of nothing? Is it 'empty'? *Can matter exist in an invisible state?*

"*Experiment* 1.—Float a cork on a surface of water, cover it with a tumbler, or tall glass jar, and thrust the glass vessel, mouth downward, into the water. . . . State *how* the experiment answers each of the above questions and what evidence it furnishes that air is matter, or, at least, that air is like matter.

"*Experiment* 2.—Hold a test tube for a minute over the mouth of a bottle containing ammonia water. Hold another tube over a bottle containing hydrochloric acid. The tubes become filled with gases that rise from the bottles, yet nothing can be seen in either tube. Place the mouth of the first tube over the mouth of the second, and invert. Do you see any evidence of the presence of matter? Was this matter in the tubes before they were brought together? If not, from what was it formed? Which of the proposed questions does this experiment answer? How does the experiment answer it?"

In many cases the questions asked are beyond the powers of the average beginner to answer, but this is not a serious objection if the book is used, as seems to be intended, for class instruction in schools. For such use it is admirably well adapted. Numerous questions and examples are scattered throughout the text; in the sections of kinematics and dynamics geometrical treatment alone is adopted, the student being supposed to be acquainted with Euclid but not with trigonometry.

The style is concise, but clear and accurate, and as the book has not been written with the view of preparing the student for any special examination it is refreshingly free from any tendency towards cram. H. H. H.

Recette, Conservation, et Travail des Bois. Par M. Alheilig. (Paris: Gauthier-Villars et Fils, 1892.)

THIS little book belongs to the useful series entitled "Encyclopédie Scientifique des Aide-Mémoire." The author presents a remarkably clear summary of the principal facts relating to wood, regarded from an industrial point of view. Although iron and steel have to so large an extent taken the place of wood in various great constructions, wood is still, of course, needed in vast quantities, and instruction in the proper way of dealing with it for industrial purposes must always form an important department of technical education. M. Alheilig has supplied a good text-book, the most valuable characteristic of which is that its practical details rest on a sound basis of scientific principle. He is especially successful in the chapters on the tools and machinery used in the working of wood.

Country Thoughts for Town Readers. By K. B. Baghot de la Bere. (London: Simpkin, Marshall, and Co., 1892.)

THE greater part of this book consists of imaginary conversations between a Canon and "a city lawyer," who spends two days with him in the country. The Canon lectures his friend with an air of authority and patronage which would not be particularly agreeable to ordinary mortals. The city lawyer, however, is never tired of thanking the great man for the knowledge he communicates. The Canon's information is made up chiefly of scraps of scientific commonplace, which, if they can be of no particular service to any class of readers, are at least harmless.

A Synoptical Geography of the World. (London: Blackie and Son.)

NO effort has been made by the compiler of this handbook to present geography in an attractive form. The volume consists of a number of bald statements which, as here given, could neither excite interest nor form any real addition to knowledge. It is not intended, however, that the book shall be used apart from other means of instruction. It is meant to be taken "in conjunction with a fuller text-book or the teacher's lectures." Used in this way it may be of some service to students in the revision of their work before examination. A good many maps have been specially engraved to accompany the text.

LETTERS TO THE EDITOR.

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An Acoustic Method whereby the Depth of Water in a River may be measured at a Distance.

ABOUT two years ago, I wished to know from time to time the rate at which a river was rising after a fall of rain. The river was at a considerable distance from the spot where its height was to be known. By means of the combination of two organ pipes, and a telephonic circuit, described in the following lines, I have been able to make the required measurement within rather close limits. At the river station, an organ pipe was fixed vertically in an inverted position, so that the water in the river acted as a stopper to the pipe, and the rise or fall of the water determined the note it gave, when blown by a small bellows driven by a very small water-wheel. A microphone was attached to the upper end of the organ pipe; this was in circuit with a wire leading to a town station at some distance; at the town station there was an exactly similar organ pipe, which could be lowered into a vessel full of water while it was sounding. By means of the telephone the note given by the pipe at the river was clearly heard at the town station; then the organ pipe at this station was lowered or raised by hand until it gave the same note. The lengths of the organ pipes under water at the two stations were then equal, so that the height of the water in the distant river was known.

The determination can be made in less than a minute by any one who can recognize the agreement of two similar notes. The arrangement when first tested was so placed that the height of water at two places near together might be easily compared. I found that a lad with an average ear for musical sounds was able to get the two heights to agree within one-eighth of an inch of each other, while a person with an educated ear adjusted the instrument immediately to almost exact agreement. The total height to be measured was 17 inches. A difference of temperature at the two stations would make a small difference in the observed heights. For example, taking a note caused by 250 vibrations per second, a difference of 10° C. between the temperatures of the two stations (one not likely to occur) would make a difference of about 0·02 feet in the height, a quantity of no moment in such a class of measurements. The organ pipes were of square section, and made of metal to resist the action of the water.

FREDERICK J. SMITH.

Trinity College, Oxford, June 28.

Waterspouts in East Yorkshire.

ON June 9, 1888, a waterspout was seen traversing the Yorkshire wolds in the neighbourhood of Langtoft, which finally spent its fury on the north-eastern side of a large basin-like range of valleys, where a steep declivity barred its further progress. A single cutting or trench was made in a slight hollow of the hill, and in this three large holes were scooped out of the chalk, which was here composed of much rubble, about seven feet in diameter and depth.

On July 3 of the present year, another waterspout has been developed, and has again expended its energy on the same hill as the previous one in 1888, a few yards only further south of the former site, and, taking a trifle more easterly course, has cut three parallel ditches or elongated pits in the solid chalk, two of them twenty to thirty yards in length, and seven to ten feet deep in the deepest portions, scattering the whole of the expelled rock, amounting to many tons, to the foot of the hill.

Serious floods were consequent, and the village of Langtoft, which is situated lower down the valley, was terribly inundated with a volume of water seven to ten feet in height, an immense amount of damage being done, including the total demolition of two cottages and a workshop. Fortunately no lives were lost beyond several pigs, sheep, and a few hundred fowls.

Driffield, July 9. J. LOVEL.

On the Line Spectra of the Elements.

PROF. STONEY seems to agree with me that I have given an obvious example of a motion for which the theorems in chapter iv. of his memoir do not hold good. Theorem B, page 591, runs thus: "Any motion of a point in space may be regarded as the co-existence and superposition of one *definite* set of partials which are the pendulous elliptic motions determined as above, &c." It is indeed obvious that a uniform motion in a straight line cannot be regarded in this manner, not even approximately for any length of time, if the set of partials are required to be *definite*. I might have given an example of a limited motion, *e.g.* $x = \sin t^2$, which equally contradicts the theorem, but I thought a more obvious example would convince Prof. Stoney more easily. I think, indeed, that the reasoning in chapter iv. of his memoir is erroneous. But I do not say that therefore Prof. Stoney's views on the cause of the line-spectra are wrong. They may be right, although the argument in chapter iv. is not. Why this criticism is not legitimate I do not see. For no slight alterations or additions would set those theorems right, as there is a palpable mathematical error at the bottom of it.

Technische Hochschule, Hanover, July 9. C. RUNGE.

The Grammar of Science.

THE exposition of the Newtonian laws as given by Thomson and Tait has unfortunately been taken as the basis for the treatment of the laws of motion by all elementary text-book writers in the English tongue since the publication of the great "Treatise on Natural Philosophy." When that exposition is attacked we are told that Newton introduced a qualifying context which has been omitted from the exposition. In other words the current statement of elementary dynamical principles is thrown overboard in favour of Newton pure and simple. On the other hand when Prof. Tait uses an expression which is totally opposed to that principle of the "subjectivity of force" which C.G.K. claims that Prof. Tait was the first, or among the first, to propound, we are told that this expression was obviously suggested by "Newton's own anthropomorphic language." C.G.K., I take it, admits that the Newtonian Laws of Motion are illogical and unphilosophical when stated by Thomson and Tait without Newton's modifying context. I propose therefore to shortly publish a criticism of the laws of motion as accompanied by that context of Newton's which does not appear in Prof. Tait's text-books. I trust C. G. K. will not then turn round on me and say, "Oh, yes, but this has nothing to do with Prof. Tait; it is Newton's own anthropomorphic language."

Lastly, as to the origin of the doctrine of the "subjectivity of force," which to my mind is just as much or as little valid as the "subjectivity of matter," I would remind C. G. K. that the first two parts of Kirchhoff's "Mechanik" were published in 1874, and were then only the publication of lectures of an earlier date. Philosophers before Kirchhoff taught the doctrine of subjectivity, but he, and not the author of the "Dynamics of a Particle," was the physicist who first helped many of us out of the mental obscurity as to dynamical principles produced by our study of the expositions of the laws of motion due to the Edinburgh school. KARL PEARSON.

"Are the Solpugidæ Poisonous?"

IN reference to this question, propounded by Mr. Bernard in your last issue, I should be inclined to answer in the negative. I captured several specimens of *Solpuga chelicornis* in the Transvaal, and on one occasion witnessed a persistent attack made on this "spider" by a bird which appeared to be the Cape wagtail (*Motacilla capensis*). Had the *Solpuga* possessed poisonous qualities the attack would probably not have been made.

The specimens taken by myself exhibited no signs of pugnacity, but always sought refuge in headlong flight to the nearest cover. W. L. DISTANT.

Russell Hill, Purley, Surrey, July 8.

Hairlessness of Terminal Phalanges in Primates.

I OBSERVE that, in your report of the proceedings of the Zoological Society, you allude to my paper on "a seemingly new diagnostic feature of the order Primates," viz. that the terminal phalanges are destitute of hair.

Since the paper was read I have found that this feature is not of ordinal value. But it is of sufficiently general occurrence to merit inquiry touching its distribution in different species.

Therefore I have withdrawn publication of the paper for the present. GEORGE J. ROMANES.

Oxford, July 1.

Mental Arithmetic.

REFERRING to the articles on "Mental Arithmetic" in NATURE, vol. xlv. p. 78 and 198, I beg to state that there also exists a very clearly written little text-book on arithmetic founded entirely on the principles mentioned by Mr. Clive Cuthbertstone. The title is "Neuer Unterricht in der Schnellrechen-Kunst," by C. Jul. Giesing, Editor, Carl Schmidt, in Doebeln (Saxony). Price 1 mark 80 pf. G. DAEHNE.

Dresden-Blasewitz, "Isis," July 9.

Jackals.

THE incident of the jackals entering Howrah brings to my memory that this winter jackals entered the suburban town of Bournabal, in the Smyrna district of Western Asia Minor. This last winter being severe, it was noticed in the papers that rabies had extended to wolves and jackals, and to this circumstance was attributed their entering the villages and attacking people, and also their attacking the domestic animals.

HYDE CLARKE.

WEIGHT.

THE following remarks are presented with the object of reducing the increasing gap which is growing between the treatment of the fundamental ideas of Dynamics, as taught in our academical text-books from the standpoint of verbal abstraction, and the ideas and language of those who have to deal with the actual phenomena of Nature as a reality.

1. According to the precise legal definitions of all our successive Acts of Parliament on "Weights and Measures," the *weight* of a body is the quantity of matter in the body, as measured out by the operation of weighing it in the scales of a correct balance.

The body to be weighed is placed in one of the scales, and is equilibrated by standard lumps of metal, stamped as pound weights, or kilogramme weights, or hundred weights, or ton weights, and the sum of these weights is called the *weight* of the body.

In the words of the Act of Parliament, 18 and 19 Victoria, c. 72, July 30, 1855, the British pound weight is defined as a weight of platinum, marked P.S., 1844, 1 lb., deposited in the Office of the Exchequer; and the Act goes on to say that this lump of metal "shall be the legal and genuine standard measure of weight, and shall be and be denominated the Imperial Standard Avoirdupois Pound, and shall be deemed to be the only standard of weight from which all other weights and all other measures having reference to weight shall be derived, computed, and ascertained, and one equal seven thousandth part of such pound avoirdupois shall be a grain, and five thousand seven hundred and sixty such grains shall be and be deemed a pound troy."

In defining the unit of length, the standard yard, the temperature must be defined, 62° F. in the Act of Parliament; but in defining the pound weight, there is in the Act no mention of temperature, height of barometer, height above sea-level, latitude, longitude, date and time of day, establishment of the port, &c., or of any other cause tending to alter the local value of g.

Details of the temperature and density of the air are only required when defining the volume of the gallon of 10 lbs. of water, or when making accurate copies of the standard platinum pound weight in some other metal—brass or iron, for instance—when a correction for the buoyancy of the air must be made; and it is to cover this detail that the words *in vacuo* have been added in the most recent Acts of Parliament on "Weights and Measures" (41 and 42 Victoria, 1878).

2. We now pass on to the investigation of the motion set up in a body of given weight due to the action of specified forces; we use the word *weight* advisedly, so as to agree with the terminology of the Acts of Parliament.

As the field of force in which we live is that due to the attraction of the Earth, it was natural to begin by taking the attraction of the Earth on our standard weight as the unit of force; and we find that in all Statical problems of architecture and engineering the unit of force employed is the force with which a pound weight, or a kilogramme weight, or a ton weight, is attracted by the Earth.

The engineer calls these forces the force of a pound, of a kilogramme, or of a ton; he does not add the word weight, reserving the word *weight* to denote the quantity of matter in the body which is acted upon, in accordance with the language of the Act of Parliament on "Weights and Measures."

In the Dynamics of bodies on the surface of the Earth, the same gravitational unit of force is universally employed in practice; and now, to take a familiar problem, we may investigate the motion of a train, weighing W tons, on a straight level railway, pulled by an engine exerting a tractive force of P tons, by the bite of the driving wheels on the rails.

Neglecting passive resistances, and the *rotary inertia* of the wheels, the train will acquire from rest a velocity v feet per second in s feet, given by

$$Ps = \frac{Wv^2}{2g} \text{ (foot-tons)}.$$

The velocity growing uniformly, the average velocity will be half the final velocity v; so that if the train takes t seconds to go the first s feet,

$$s/t = \tfrac{1}{2}v,$$

and

$$Pt = \frac{Wv}{g} \text{ (second-tons)}.$$

The word *second-tons* has been formed by analogy with the word *foot-tons*, to express the product of a force of P tons and t seconds, the time it acts; just as foot-tons expresses the product of a force of P tons and s feet, the distance through which it acts.

While Ps, the *work* in foot-tons done by the force P tons acting through s feet, has a mechanical equivalent, $\frac{Wv^2}{2g}$, called the *kinetic energy* of the train in foot-tons; so Pt, which we may call the *impulse* in second-tons of the force P tons acting for t seconds, has a mechanical equivalent $\frac{Wv}{g}$, the *momentum* communicated to the train in second-tons.

We merely state these theorems, with the addition of the proposed new name of *second-tons*, as these theorems are found in all dynamical treatises, being direct corollaries of Newton's Second Law of Motion.

We have measured W and P in tons, as would be natural in any railway-train problem, but the same equations of course hold when W and P are given in cwt., pounds, kilogrammes, or grammes; and then impulse or momentum will be given in second-cwt., second-pounds, second-kilogrammes or second-grammes; while work or kinetic energy will be given in foot-cwt., foot-pounds, or metre-kilogrammes, or centimetre-grammes, on changing to the metre or centimetre as metric unit of length, and changing at the same time the numerical measure of g.

3. The presence of g in the denominator of W in the dynamical equations will be remarked, and this constitutes a difficulty to the student, which our teachers of Dynamics have done their best to obscure.

The quantity g makes its appearance, not because W/g is an invariable quantity, as is generally taught, but because the unit of force in which P is measured is variable, being proportional to the local value of g.

With a foot and second as units of length and time, we may take the value of g at the equator as 32, increasing gradually to about one-289th part more, or about $\frac{1}{3}$ per cent. greater at the poles, in consequence of the Earth's rotation.

The force of a pound, meaning thereby the force with which the Earth appears to attract a pound weight, is thence about $\frac{1}{3}$ per cent. greater at the poles than at the equator; and this does not allow for the increase in g due to the ellipticity, which by Clairaut's theorem would make the total increase about $\frac{1}{2}$ per cent.

But to say that a body has gained in weight one-289th part, or $\frac{1}{3}$ per cent., in going from the equator to the pole is absurd and misleading; for if we carry our standard weights and scales with us, we shall find that the body weighs exactly the same.

When the theorist tells us that a body gains or loses one-289th part of its weight in being taken from the equator to the pole, or back again, he means that the indications on a spring balance, graduated in latitude 45° by attaching standard weights, will be about $\frac{1}{6}$ per cent. in error at the equator and at the poles.

But such a spring balance would be illegal if used according to its graduations in any other latitude than the one in which it was constructed; and the user would lose in all cases; he would lose at the equator by selling $\frac{1}{6}$ per cent. too much by weight; and he would lose at the poles the fines incurred from the Inspector of Weights and Measures, who would test his spring balance by attaching standard weights, composed of lumps of metal.

The spring balance graduated in latitude 45°, and employed alternately at the equator and the pole, is equivalent to a beam balance, of which the beam stretches over a quadrant of the meridian of the Earth from the equator to the pole, with a fulcrum in latitude 45°, but such an abnormal balance is not contemplated in the Act.

4. If we could transport ourselves to the surface of the Moon, Sun, or any planet, with our weights and scales, Newton's Law of Universal Gravitation teaches us that we should still find the body of exactly the same weight in the balance, the attraction of the Moon, Sun, or planets on the body and on the weights being still equal.

The magnitudes of these equal attractions would, however, have changed, since the attraction is proportional to the local value of g; on the surface of the Moon it is calculated that g is about 5·4; on the surface of the Sun it is about 30 times the value on the surface of the earth, while on Jupiter it is calculated that g is about 71.

These values of g are inferred from observation of the diameter of the celestial body, and from its weight, measured in terms of the weight of the Earth, or using the Earth as the standard weight; and calculated by Kepler's Third Law from the period and distance of a satellite, compared with the period and distance of our satellite, the Moon.

The weight of the Earth itself is inferred from the Cavendish Experiment, in which the attraction of gravitation between two given weights is measured.

According to Newton's Law of Universal Gravitation, the attraction between two spherical bodies, arranged in spherical strata, the Sun and Earth for instance, weighing S and E g (grammes) when their centres are a cm apart, will be proportional to SEa^{-2}; with C.G.S. units, this attraction may be expressed as CSEa^{-2} dynes, and then C is called the *constant of gravitation;* and the Cavendish experiment is devised for the purpose of measuring C.

Denoting by g the acceleration of gravity (in C.G.S.

spouds), then on the surface of the Earth we may take, in round numbers,

$$g = CE/R^2, \text{ or } CE = gR^2,$$

R denoting the radius of the Earth in cm, taken as $10^9 \div \frac{1}{2}\pi$, the quadrant being 10^9 cm.

With mean density ρ, the weight of the Earth, E, in g, is given by

$$E = \frac{4}{3}\pi\rho R^3,$$

so that

$$\frac{4}{3}\pi RC\rho = g,$$

or

$$C\rho = \frac{3}{8}g \times 10^{-9};$$

so that ρ is known from C, and *vice versâ*.

For instance, with $\rho = 5{\cdot}5$, and $g = 981$,

$$C = 10^{-8} \times 6{\cdot}688.$$

We are awaiting with great interest the quantitative results of Mr. C. V. Boys, with his improved form of apparatus; but meanwhile we may take a mean density of 5·5, the mean of Cornu's and Poynting's results, which is about half the density of lead. It is very extraordinary that this should agree so exactly with Newton's conjecture, *Principia*, lib. iii., prop. x.:—"Unde cum terra communis suprema quasi duplo gravior sit quam aqua, et paulo inferius in fodinis quasi triplo vel quadruplo aut etiam quintuplo gravior reperiatur: verisimile est quod copia materiæ totius in Terra quasi quintuplo vel sextuplo major sit quam si tota ex aqua constaret; præsertim cum Terram quasi quintuplo densiorem esse quam Jovem jam ante ostensum sit."

5. A short numerical calculation will now give us the *weight* of the Earth (Hamilton, "Lectures on Quaternions"); also of the Moon, Sun, &c.

We assume that the Earth is a sphere, whose girth is 40,000 kilometres, so that R, the radius of the Earth, is $10^7 \div \frac{1}{2}\pi$ m (metres), and the volume, V, is $\frac{4}{3}\pi R^3$ m³, while the weight, E, is ρV t (metric tonnes of 1000 kg, or 2205 lbs.), where $\rho = 5{\cdot}5$.

Four-figure logarithms will suffice for our calculations; and now

$$\begin{aligned}
\log 10^7 &= 7{\cdot}000\\
\log \tfrac{1}{2}\pi &= {\cdot}1961\\
\log R &= 6{\cdot}8039,\ R = 10^6 \times 6{\cdot}366 \text{ m},\\
\log R^3 &= 20{\cdot}4117\\
\log \tfrac{4}{3}\pi &= {\cdot}6221\\
\log V &= 21{\cdot}0338,\ V = 10^{21} \times 1{\cdot}081 \text{ m}^3,\\
\log \rho &= {\cdot}7404\\
\log E &= 21{\cdot}7742,\ E = 10^{21} \times 5{\cdot}946 \text{ t},
\end{aligned}$$

or 6×10^{21} metric tonnes in round numbers.

The weight of the Moon, M, generally taken as one-80th of the Earth, will be $10^{19} \times 7{\cdot}432$ t.

To determine S, the weight of the Sun, we employ Kepler's Third Law, which gives

$$\frac{S + E + M}{E + M} = \frac{n^2a^3}{n'^2a'^3},$$

where n, n' denote the mean motions of the Sun and Moon, and a, a' their mean distances from the Earth.

Since M is insignificant compared with E, and E compared with S, we may write this

$$\frac{S}{E} = \frac{n^2a^3}{n'^2a'^3},$$

where $n'/n = 13$, the number of lunations in a year, and $a/a' = 390$, the ratio of the mean distances of the Sun and the Moon, this being the ratio of 57′ to 8″·8, the inverse ratio of the parallaxes.

Now

$$\begin{aligned}
\log a/a' &= 2{\cdot}5911\\
\log (a/a')^3 &= 7{\cdot}7733\\
\log (n'/n)^2 &= 2{\cdot}2279\\
\log S/E &= 5{\cdot}5454,\ S/E = 351{,}100;
\end{aligned}$$

so that the weight of the Sun is about 350,000 times the weight of the Earth, or about 2×10^{27} t, or 2×10^{33}g.

To determine the value of G the acceleration of gravity on the surface of the Sun, compared with g, the value on the surface of the Earth, we have

$$\frac{G}{g} = \frac{S}{E}\left(\frac{\text{diameter of earth}}{\text{diameter of sun}}\right)^2 = \frac{S}{E}\left(\frac{8{\cdot}8}{960}\right)^2,$$

since the apparent semi-diameter of the Sun as seen from the Earth is about 960″, while the apparent semi-diameter of the Earth as seen from the Sun, in other words the solar parallax, is taken as 8″·8.

Now

$$\begin{aligned}
\log 960 &= 2{\cdot}9823\\
\log 8{\cdot}8 &= {\cdot}9445\\
\log (960 \div 8{\cdot}8) &= 2{\cdot}0378\\
\log (960 \div 8{\cdot}8)^2 &= 4{\cdot}0756\\
\log S/E &= 5{\cdot}5454\\
\log G/g &= 1{\cdot}4698,\ G/g = 29{\cdot}49.
\end{aligned}$$

6. According to Newton's Law of Universal Gravitation, the operation of weighing out the quantity W in the balance gives the same result wherever the operation is carried out in the universe, assuming that the balance and the body to be weighed are of ordinary moderate dimensions.

It is otherwise with the quantity denoted by P, because the magnitude of the gravitation unit of force varies, being proportional to the local value of g.

Suppose we write the first two equations

$$Pgs = \tfrac{1}{2}Wv^2,\quad Pgt = Wv,$$

and now put $Pg = Q$; this is equivalent to taking a new unit of force, $1/g$th part of the former unit; this is an invariable unit.

Now our dynamical equations become

$$Qs = \tfrac{1}{2}Wv^2,\quad Qt = Wv,$$

from which g has disappeared.

The first suggestion of the change to this new absolute unit of force is due to Gauss, who found the necessity of it when comparing records of the Earth's magnetic force, made at different parts of the Earth's surface, and all expressed in the local gravitation unit.

It is curious that this suggestion of an absolute unit of force, the same for all the universe, did not originate with the astronomers; but Astronomy remains mere Kinematics until an accurate determination of the Gravitation Constant has been made.

On the F.P.S. (British foot-pound-second) system, this absolute unit of force is called the *poundal*, a name due to Prof. James Thomson; so that

$$Qs = \tfrac{1}{2}Wv^2 \text{ (foot-poundals)},\quad Qt = Wv \text{ (second-poundals)}.$$

On the C.G.S. (Metric centimetre-gramme-second) system, this absolute unit of force is called the *dyne*, the centimetre-dyne of work being called the *erg*, and the second-dyne of impulse being called the *bole*; and now

$$Qs = \tfrac{1}{2}Wv^2 \text{ (ergs)},\quad Qt = Wv \text{ (boles)}.$$

These absolute units are always employed in the statement of dynamical results in Electricity and Astronomy, where cosmopolitan interests are considered.

7. The disappearance of g from the dynamical equations is such a comfort to the algebraist, that he now makes a new start *ab initio* in dynamics, and gives a new definition of the absolute unit of force.

He defines the *poundal* as the force which, acting on a pound weight, makes the velocity grow one foot per second every second; and he defines the *dyne* as the force which, acting on a gramme weight, makes the velocity grow one centimetre per second every second; and now if W lbs. or g is acted upon by a force of Q poundals or dynes, the acceleration a is given by

$$a = Q/W \text{ (*celoes* or *spouds*)},$$

and

$$Q = Wa,$$

leading to the original equations

$$Qs = \tfrac{1}{2}Wv^2 \text{ (foot-poundals or ergs)},$$
$$Qt = Wv \text{ (second-poundals or boles)}.$$

These definitions of the absolute unit of force are very elegant and useful so long as we confine ourselves to calculations on paper, but they will not satisfy legal requirements. There is no apparatus in existence which will measure a *poundal* or *dyne* from these academic definitions within, say, 10 per cent. For accurate definition we must return to the old gravitation measure, and define the *poundal* or *dyne* as one-gth part of the force with which the Earth attracts a pound weight or a gramme weight, the value of g (in celoes or spouds) being determined by pendulum observations; and now the standard weight and the value of g are capable of measurement to within, say, one-100th per cent., an accuracy sufficient to prevent litigation.

In the recent report of the Committee on Electrical Standards we find the *ohm* defined as the equivalent of a velocity of ten million metres (one quadrant of the Earth) per second, to satisfy theoretical requirements; but as this definition would be useless for commercial purposes, Dr. Hopkinson insisted that it was essential that an alternate definition should be given, legalizing certain bars of metal as standard ohms.

In converting absolute and gravitation measure, we must notice that there are, strictly speaking, three different g's in existence: (1) the g of pure gravity of a body falling freely; (2) the g determined by a plumb-line, or by a Foucault pendulum of which the plane of oscillation is free to rotate; (3) the g determined by a pendulum oscillating in a fixed vertical plane, about a fixed axis; this is the legal g, so to speak, although practically undistinguishable from the g given in (2).

Sir W. Thomson's Standard Electrical Balance Instruments are graduated in gravitation measure, so that, if calibrated at Glasgow, they are one-25th per cent. in error in London, and about one-7th per cent. in error at the equator, and a corresponding correction imust be made.

An absolute Spring Balance instrument would possess a spurious absoluteness, in consequence of the deterioration of temper of the spring, and of its variation of strength with the temperature, as experienced in the Indicator.

8. There is no advantage or gain of simplicity by the use of absolute units in dynamical questions concerning motion which is due to the gravitational field of force; the only change being the removal of g from the denominator on the right hand side of our dynamical equations to the numerator on the left-hand side.

For this reason engineers and practical men invariably employ the gravitation unit of force in the dynamical questions which concern them; measuring, for instance, their forces in pounds, pressures in pounds per square foot or square inch, while at the same time measuring the quantity of matter in the moving parts by pound weights.

The absolute unit of force has only recently made its way into dynamical treatment, principally in consequence of the development of Electricity. Previously the gravitation unit was universally employed, with the consequence that W in the equations of motion always appeared qualified by a denominator g, in the form W/g.

9. Noticing that W never appeared alone, but always as $\frac{W}{g}$ (for instance, that if a celoes is the acceleration which a force of P pounds causes in a weight of W lbs., then

$$P = \frac{W}{g}a, \text{ or } a = \frac{P}{\frac{W}{g}}\Bigg),$$

early writers on Dynamics were unfortunately tempted to make an abbreviation in writing and printing, by replacing $\frac{W}{g}$ by a single letter M; so that the dynamical equations could be printed

$$P = Ma \text{ (pounds)},$$
$$Ps = \tfrac{1}{2}Mv^2 \text{ (foot-pounds)},$$
$$Pt = Mv \text{ (second-pounds)},$$

each occupying one line of print.

This quantity M was variously called the *mass* of the body—a quantity *sui generis*—the *massiveness* of the body, the *inertia*, or the *invariable quantity of matter* in the body.

But if M denotes the invariable quantity of matter, we have this awkwardness, that M, the invariable quantity, is measured in terms of a variable unit, g pounds; while the force P, which varies with g, is always measured by means of a definite lump of metal, the pound weight.

This awkwardness is rectified if we change the unit of force, and measure P in absolute units, poundals, and M in lbs., but now M becomes the same as W, formerly; and its introduction only causes confusion, because M is still taken by most writers on Dynamics as defined by

$$M = \frac{W}{g};$$

thus making $W = Mg$, the source of all the confusion in our dynamical equations.

If weight W is measured in pounds, as the Act of Parliament directs, and if the unit of mass is one pound, so that M is also measured in pounds, then, if W and M refer to the same body, $W = M$, and not Mg.

If $W = Mg$, and W is measured in lbs., then M is measured in units of g lbs., a variable unit, unsuitable for a cosmopolitan question.

But if $W = Mg$, and M is measured in pounds, then weight W is measured in units of one-gth part of a pound, or *poundals*, which is illegal according to the Act on Weights and Measures, c. 19, 41 and 42 Victoria: "Any person who sells by any denomination of weight or measure other than one of the imperial weights or measures, or some multiple or part thereof, shall be liable to a fine not exceeding forty shillings for each such sale."

10. The theoretical writer overrides these difficulties by giving a new definition of Weight, not contemplated or mentioned in the Act of Parliament:

"The weight of a body is the force with which it is attracted by the Earth."

Let us examine this definition closely.

In the first place, it does not appear to contemplate the use of the word *weight*, except in reference to bodies on or near the surface of the Earth.

According to this definition, what is the weight of the Moon, or of a body on the Moon? Must the Moon be brought up to the surface of the Earth in fragments, or must the weight be estimated at the present distance of the Moon?

What, again, is the weight of the Sun, or of a body on the Sun? and what is the weight of the Earth itself?

And what does Sir Robert Ball mean when he writes that "the weight of Algol is about double the weight of the Sun"?

Considering, however, merely bodies of moderate size on the surface of the Earth, the attraction of pure gravity of the Earth is only to be found in a body falling freely; the tension of a thread by which a body is supported is influenced by the rotation of the Earth.

Again, the local value of g is, theoretically speaking, influenced by the position of the Moon and Sun; it is true that the influence is insensible on the plumb-line, although manifest on such a gigantic scale in its tide-producing effects.

Suppose, then, we employ the gravitation unit of force in the theorist's definition of the weight of a body. The definition now becomes an inexact truism asserting that the Earth attracts W lbs. with a force of W pounds, and inexact, because it neglects the discount in g due to the rotation of the Earth; and to say that "the weight of a body is the force with which it is attracted by the Earth" conveys no additional information.

Having introduced the word *mass*, primarily as a mere abbreviation in printing, and having subsequently changed the unit of mass so as to make the mass the same as the weight, the theorist is now trying to dislodge the word *weight* from its primary meaning, which it has possessed for thousands of years, as meaning the quantity of matter in a body, and is trying to degrade it into a subsidiary position, to express a mere secondary idea, the attraction of gravity; and that only on the surface of the earth, and even then not clearly defined.

We might as well define the pound sterling by its purchasing power in any locality, instead of by its proper definition as a certain quantity of gold.

11. So long as the gravitation unit of force alone was employed, the same number, which expressed the number of the weights which equilibrate the body, also expressed the number of pounds of force with which the Earth appeared to attract the body; and it is only in this sense that the weight of a body is "the force with which it is attracted by the Earth"; it is essential that the unit of force should be the gravitation unit, when this definition is employed.

We say, for instance, in Hydrostatics, that a ship is buoyed up by the water with a force equal to the weight of the displaced water, which is also equal to the weight of the ship, when in equilibrium.

Again, the head of water which will produce a pressure of 150 lbs. on the sq. inch, is always

$$150 \times 144 \div 62{\cdot}5 = 345{\cdot}6 \text{ feet},$$

whatever the local value of g; the numerical measure is always the same, although the amount may differ in consequence of the variation of g and the unit of force. A boiler tested to 150 lbs. on the square inch is tried one-25th per cent. more severely in Glasgow than in London. This variation, at most $\frac{1}{2}$ per cent., is not likely to lead to litigation—*De minimis non curat lex*.

There is no particular harm in the use of the word *mass*, provided it is always measured in the standard units of weight; there is this drawback, that there is no verb to "mass"; we can say that the body weighs W lbs., but we cannot say it "masses" M lbs.

Again, the Acts of Parliament do not regulate "Masses and Measures," but "Weights and Measures," "Poids et Mesures," "Maasse und Gewichte," "De Ponderibus et Mensuris."

The French language possesses the two words *Poids* and *Pesanteur*, both of which we translate by Weight.

Poids may be translated *mass*, or quantity of matter, *copia materiæ*; but that does not justify the degradation of *weight* down to the meaning of *pesanteur*, and that merely the *pesanteur* on the surface of the Earth; having already invented *mass*, the theorist must invent a new word to translate *pesanteur*; the word *heft* has been suggested, but the word *weight* must be left alone, to do double duty occasionally.

A libellous story of the Hudson Bay Company says that in their former dealings with the Red Indians, the weight of the factor's fist was always one pound; a good illustration of weight as meaning both *poids* and *pesanteur* to ignorant minds.

An amusing instance of the confusion of using *weight* in the double sense of *poids* and *pesanteur*, when not restricted to the provincial gravitation unit of the surface of the Earth, on which the human race is imprisoned, occurred in a lecture last year on Popular Astronomy. To illustrate the fact that g on the surface of the Sun is about 30 times greater than it is here (§ 5), the lecturer said, "An ordinary middle-aged man of this audience, if transported to the surface of the Sun, would *weigh about two tons*; but his reflections on this difficulty would be cut short by the immediate prospect of being converted into *two tons of fuel*."

12. Maxwell unfortunately lent his powerful aid to the attempt to degrade the word *weight* to mean merely *pesanteur*.

In a review of Whewell's "Writings and Correspondence," edited by Todhunter, Maxwell writes that—

"Finding the word weight employed in ordinary language to denote the quantity of matter in a body, though in scientific language it denotes the tendency of that body to move downwards, and at the same time supposing that the word mass in its scientific sense was not sufficiently established to be used without danger in ordinary language, Dr. Whewell endeavoured to make the word weight carry the meaning of the word mass. Thus he tells us that—the weight of the whole compound must be equal to the weight of the separate elements."

"It is evident that what Dr. Whewell should have said was—the mass of the whole compound must be equal to the sum of the masses of the separate elements."

But Whewell was quite right, because, at the time he wrote, mass was merely the printer's abbreviation for

$$\frac{W}{g}.$$

"We are reminded by Mr. Todhunter that the method of comparing quantities by weighing them is not strictly correct." (Compare this statement of Todhunter with that of Dr. Harkness in his article on "The Art of Weighing and Measuring," NATURE, August 15, 1889, p. 381, where it is pointed out that weighings can be carried out to within one 10-millionth part.)

Again, in Maxwell's "Theory of Heat" (p. 85), we read "In a rude age, before the invention of means for overcoming friction, the weight of bodies formed the chief obstacle to setting them in motion. It was only after some progress had been made in the art of throwing missiles, and in the use of wheel-carriages and floating vessels, that men's minds became practically impressed with the idea of mass as distinguished from weight. Accordingly, while almost all the metaphysicians who discussed the qualities of matter, assigned a prominent place to *weight* among the primary qualities, few or none of them perceived that the sole unalterable property of matter is its *mass*."

The question in dispute resolves itself, then, merely into a difference of terminology; and the metaphysicians are using the language universally employed up to the middle of this century, and are justified on all sides in their usuage: Maxwell might as well have criticized the traditional names which astronomers employ for the heavenly bodies.

Maxwell would even have edited the authorized and revised version of the New Testament; in ὡσεὶ λίτρας ἑκατόν—translated "about an hundred pound *weight*"—(John xix. 39), he proposed the omission of *weight*, probably inserted in the version to make a distinction from pounds *sterling*.

This addition of the word weight is common elsewhere, thus, "His Majesty's Warrant, August 19, 1683, to cause 3 barrels of fine pistol powder, 3 cwt. weight of pistol bullets, and 3 cwt. weight of match to be delivered to John Leake, Master Gunner, for the use of the 3 troops of Granadiers, &c." ("Notes on the Early History of the Royal Regiment of Artillery," by Colonel Cleaveland).

Dr. Lodge says that the term hundredweight bears marks of confusion on its surface, and had better be avoided; what does he say to this use of hundredweight weights, not intended to mean pull of gravity?

This Warrant is dated four years before the first edition of the "Principia," in which the downward tendency of a weight was first clearly demonstrated as due to the attraction of the Earth, although mere surmises had been propounded by early astronomers, and in "Troilus and Cressida" we have—"As the very centre of the earth, drawing all things to it."

But Acts of Parliament on "Weights and Measures" were extant hundreds of years before the first appearance of the "Principia"; and when the standard pound weight was defined in these Acts, it was the lump of metal preserved at the Exchequer that was described, and not the pressure on the bottom of the box in which it was kept.

13. Formerly, the words *vis inertiæ*, or *inertia*, were used instead of the modern word *mass* (often used in ordinary language as the equivalent of *bulk*). But it is useful to notice that inertia is not always the same thing as weight or mass, or even proportional to them.

Thus the inertia of a body is increased by the presence of the surrounding medium; the inertia of a sphere moving in a frictionless incompressible liquid is increased by half the weight of the liquid displaced, and of a cylinder moving perpendicular to the axis by the weight displaced; while an elongated projectile requires rotation about an axis for stability of flight, in consequence of its inertia being different for different directions of motion.

The inertia of a pendulum, or of the train in § 2, is increased to an appreciable extent by the presence of the surrounding air.

Again, the inertia of a rolling hoop is twice its weight, of a cylinder is half again as great, of a billiard ball is 40 per cent. greater; and the inertia of a bicycle, or of the train we have considered in § 2, when the *rotary inertia* of the wheels is taken into account, must be increased by a fraction of the weight of the wheels and axles equal to k^2/a^2, where a is the radius of a pair of wheels, and k the radius of gyration of the wheels and axle about the axis of rotation.

For the same reason the centre of inertia does not always coincide with the centre of gravity, or centre of mass. The buffers of a railway carriage should be at the height of the centre of inertia; and this is easily seen to be at a height

$$h \Big/ \left(1 + \frac{w}{W}\frac{k^2}{a^2}\right)$$

above the axles, w denoting the weight of the wheels, W of the body of the carriage, and h the height of its centre of gravity above the axles.

The recommendations of the A.I.G.T., in their "Syllabus of Elementary Dynamics," will only serve to widen the increasing gulf between theoretical treatises and the Applied Mechanics which engineers use, unless the Committee of the A.I.G.T. will set to work to invent a totally new word, such as *heft*, to express the pull of gravity on a given weight, as an equivalent of the French word *pesanteur*; it is hopeless to attempt todegrade the, old word *weight* into the subsidiary secondary meaning so long as in commerce, and in the Acts of Parliament, *weight* invariably means quantity of matter, *copia materiæ*.

A. G. GREENHILL.

APHANAPTERYX AND OTHER REMAINS IN THE CHATHAM ISLANDS.

IN a former letter I sent you some account of the finding of the *Aphanapteryx* in the Chatham Islands. I have now gone more carefully over the bones I collected there, and some additional notes may not be without interest. I find that, of the heads I have obtained, a number are much larger than that of *Aphanapteryx broeckei* (Schlegel), and are therefore rightly assigned, I think, to a distinct species. The tarso-metatarsus, as figured by M. Milne-Edwards, however, may, I think, prove to belong not to *Aphanapteryx*, or at any rate not to a species with so robust a tibia. I found several tarso-metatarsi in near relation to the tibiæ and femora, and heads of *A. hawkinsi*, and they are all without exception much shorter and stouter bones in proportion to the tibiæ and femora. Out of the same strata which contained *Aphanapteryx*, I obtained a number of the bones of the skeleton of a *Fulica* very nearly related to *F. newtoni*. Like the *Aphanapteryx* bones, they vary very much in size, some being equal, others much larger than those of *F. newtoni*. So much so that I am inclined to recognize them as different species, or at least different races. The larger species I have named *F. chathamensis*. The portions I have had before me are the pelvis, the femur, the tibia, and metatarsus. I have portions of a large ralline skull, which may be that of this *Fulica*, but it is rather too imperfect to enable me to speak more confidently at present. The tarso-metatarsi of this bird agree much more closely with the tarso-metatarsus assigned in M. Milne-Edwards's plate to *Aphanapteryx*. Of the *Aphanapteryx* I possess the complete cranium, femur, tibia, metatarsus, humerus, and pelvis. Among the other interesting specimens so far identified, are the humeri and pelvis of a species of Crow half as large again as *C. cornix*. They agree closely with those of a true *Corvus*. I have designated it as *Corvus moriorum*, as I found some of these bones among the remains scattered round a very ancient Moriori cooking-place, which had become uncovered by the wind in the strata in which *Aphanapteryx* occurs. Indeed, in this kitchen-midden I gathered portions of the *Aphanapteryx*, of a large swan, of several species of ducks, and of a *Carpophaga* indistinguishable from the species now living on the islands —a species (*Carpophaga chathamica* mihi[1]) new to science. I may say that it is easily distinguished from *C. novæ-zealandiæ* by the breast-shield in both sexes being altogether duller than, and not extending so far ventr ally as, in the latter. The head, neck, and breast are of the same colour—a dull green, with purple and green metallic reflections when viewed with the bird between the light and the eye. It is, however, most markedly distinguished by the pale lavender colour of the external border of the wings, the much paler colour of the lower back and rump, and by the black on the under surface of the tail feathers being prominent on all the rectrices except on the anterior portions of the outer tail feather on each side, and passing under the tail coverts in a broad wedge. Mr. Travers relates that he was informed by one of the early settlers on Pitt Island that he remembered the first appearance of the pigeon in the islands. This statement cannot well be accepted in face of the presence of the bird's bones in a midden so ancient as that I have referred to above. In the *Aphanapteryx* beds, I obtained also the portions of a skull of a species of *Columbidæ*, apparently of a *Columba*, of which I can say little till I am in possession of more material. I have obtained also bones of the small hawk (*Harpa*), showing that it existed on the islands, whereas it is now unknown there, although *Circus gouldi* is not uncommon.

At about 3 feet below the floor of a small cave, which the weathering limestone has deposited, I obtained portions of a pigmy Weka (*Ocydromus pygmæus*), and also the limb bones of a rat. If they have been gradually covered to this depth by the fall of particles from the roof, as there seems no reason to doubt, their age must be very great; but whether that would take us back to a date antecedent to the arrival of the Morioris in the Chatham Islands is a more difficult question to answer with our present data.

So far, the birds of whose presence in the Chatham Islands till now we have had no knowlege, are: *Harpa ? ferox*, *Nestor meridionalis* and *? N. notabilis*, *Corvus*

[1 ? *Carpophaga chathamensis* of Rothschild, P.Z.S. 1891, p. 312, pl. xxviii. —ED.]

moriorum, *Ocydromus pygmæus*, *Fulica newtoni*, *F. chathamensis*, *Aphanapteryx hawkinsi*, *Ap.*? spp., *Chenopis sumnerensis*, *Carpophaga chathamica*, *Columba* sp.

HENRY O. FORBES.

Canterbury Museum, April 2.

ADMIRAL MOUCHEZ.

WE have already referred to the loss which French science has recently sustained in the sudden death of the director of the Paris Observatory, at the age of 71. It falls to the lot of few sailors in any country to take so large a share in scientific progress as did Admiral Mouchez, or to combine great administrative capacity with thorough knowledge and power of initiation.

His love for astronomy and geodesy first made itself felt when he was at the Collège Louis le Grand. Appointed to the navy in 1843, he was captain of a frigate in 1861, but three years before this he had communicated to the Academy of Sciences observations of the partial eclipse of the sun seen by him at Buenos Ayres on September 7, 1858. He was then in that locality constructing the hydrographical map of the eastern coast of South America. A year or two later he presented to the Academy a map of Paraguay, and he was presented as a candidate for filling the seat vacated by the untimely death of Bravais in 1863. But he was outvoted, and he continued his hydrographical work. He published a description of the coast of Brazil, and he observed an annular eclipse of the sun (on October 30, 1864) at San Catharina, Brazil.

When in 1872 expeditions were being organized by all countries to observe the transit of Venus in 1874, Mouchez was placed in command of the party which was destined for the island of Saint Paul. The climatic conditions of this island—either the winds are very violent, or the heaven is nearly always overcast—did not seem to favour the observers. The head of the expedition had the greatest difficulty in reaching his post, and it was in the middle of a violent storm that he had to approach the large volcano which was to be his station.

The evening of the day before the transit the rain fell in torrents; but the next day, at the moment wished for, by quite a fortunate chance, the storm cleared in consequence of a change of wind, and the veil of mist which covered the sky suddenly vanished; the observation was thus made under most favourable conditions. Mouchez was able to recognize the atmosphere of Venus very distinct from that of the Sun at the moment of contact.

The astronomical expedition which he commanded was composed of naturalists as well as astronomers; it has furnished science with interesting accounts of the geology, zoology, and botany of the islands of St. Paul and Amsterdam its neighbour.

On Mouchez's return to France he was promoted Commander of the Legion of Honour at the same time that he was nominated a member of the Academy of Sciences in the place of the astronomer Mathieu. In October 1875, at the annual public séance of the five academies, he gave an account of his expedition to the island St. Paul.

In 1878 he obtained from the French Admiralty the funds required for establishing at Montsouris, with the same instruments used by him at St. Paul, a school of astronomy for the use of marine officers and masters. This school is in full prosperity, and every year about a dozen men are trained in conducting astronomical and magnetical observations.

When Le Verrier died, on September 13, 1877, Mouchez, then commander, was appointed to the directorship of the National Observatory, and nearly simultaneously with this Commander Mouchez received the rank of Rear Admiral. He was put on the Reserve List in 1880.

Admiral Mouchez showed himself, at the Observatory, an active administrator. He brought about many marked improvements in the different branches of the establishment. He suggested the establishment of a practical school of astronomy, which has been worked for eight years consecutively, and has furnished all the French observatories with a remarkable supply of young astronomers. Thirty have passed through the two years' course.

Admiral Mouchez always encouraged useful researches, and the magnificent work undertaken with so much success by the brothers Henry in celestial photography, and the development of the *equatorial coudé*, under the fostering care of M. Loewy, must be specially mentioned here.

But by far the most important result of this kind which we owe to the Admiral's clear foresight and power of dealing with men is to be found in the Chart of the Heavens, which will remain as one of the memorable works of the science of the nineteenth century. It was on the proposal of the director of the observatory that the Academy of Sciences convoked foreign astronomers to take part in the Congress which, on three different occasions, assembled with so much success at the Paris Observatory.

This vast undertaking would have been impossible without the genius of the French nation and without such a man as Mouchez. It is essentially an international work which England should have started, but alas! in such matters our science is scarcely national; it is parochial, and so it must remain until the relations between science and the Government are changed.

Admiral Mouchez was a very zealous promoter of colonial observatories. He travelled to Algiers in order to preside over the inauguration of the large establishment erected by M. Trépied. This very year, having travelled to Tunis to recruit his failing health, he had taken steps for creating an astronomical station in the town of Zaghouan, and he was advocating the building of observatories at Tahiti and Tananarivo at the time of his death.

There are few astronomers who will not feel the death of Admiral Mouchez as the loss of a dear friend, and one in whom loyalty, honesty, and simplicity of character were so blended that the great services rendered by the savant were almost forgotten in the esteem felt for the man.

NOTES.

M. HECKEL, the President of the Botanical Section of the French Association for the Advancement of Science, proposes, as special subjects for discussion at the approaching meeting of the Association, to be held at Pau, the flora of the Alps and of the Pyrenees, and a comparison between them; and the best means of arranging and preserving botanical collections.

PROF. T. H. HUXLEY has been elected President, and Sir Henry Roscoe and the Master of University College, Oxford, two of the Vice-Presidents, of the Association for Promoting a Teaching University for London. Motions on the whole favourable to the plans of the Association have been carried by the Senate of the University of London and the Council of University College.

PROF. RAMSAY, in his report as Dean of the Faculty of Science in University College, London, has to record many changes during the past session. Reference is, of course, made to the retirement of Prof. Croom Robertson from the Chair of Philosophy, and to the appointment of Dr. James Sully as his successor. Prof. Ramsay's predecessor as Dean, Prof. Lankester, expressed to him his regret that he had not taken steps to ascertain the number of original investigations carried out during the time of his Deanship; and it occurred to Prof. Ramsay that no more fitting task could devolve on the Dean than to chronicle how far the progress of science is due to those, students and teachers, who work in University College. His colleagues have responded to his inquiries, and he has thus been able to lay before the Council a list of publications amounting in all to 84 separate memoirs or books. They contain accounts of researches in which professors, assistants, students, former students who are still at work in the College have taken part; and Prof. Ramsay maintains that in this, as well as in the routine of teaching, the College fulfils the duties of a true University. The record, he contends, equals, if it does not surpass, that of any University in the kingdom.

Since Saturday last Mount Etna has been in a state of eruption, and many severe shocks of earthquake have been felt in the surrounding country. From midnight till six o'clock on Saturday evening there were eleven distinct shocks. About noon on Saturday a great fissure opened on the summit of the mountain, from which lava began to issue with great rapidity. During the following night the eruption assumed alarming proportions, and huge quantities of lava streamed down the sides of the mountain. This rapidly flowed in two streams—one going in the direction of Nicolosi and the other towards Belpasso. There was a severe earthquake shock in the immediate vicinity of the volcano on Saturday night. On Sunday the people of Nicolosi assembled for mass outside the cathedral, and remained kneeling in the open air, being afraid to enter owing to the continued shocks of earthquake. At five o'clock in the evening the shocks continued, and very loud subterranean rumblings were heard, giving the impression of a terrible storm. Twelve houses and a portion of a church were destroyed. The eruption continued very active. On Monday it was stated that the rumblings had grown less frequent, and there were indications that the eruptions from the newly-formed fissure were about to cease. The principal crater, however, showed signs of renewed activity. On Tuesday the following telegram was despatched from Catania through Reuter's agency:—"The eruption of Mount Etna is again rapidly increasing in volume and intensity. Five craters at different points on the mountain are showing great activity. Loud explosions occur continually, and this morning there was a strong shock of earthquake. Giarre, on the coast to the north of Catania, has been reduced to ruins, and the whole country round has suffered severely, A number of engineers who have been sent to the points immediately threatened express fears that the wells will blow up on contact with the lava. There is no panic, and in the circumstances the people maintain a fairly calm demeanour."

A terrible disaster has happened in the neighbourhood of the sulphur springs of St. Gervais, a little way off the road from Geneva to Chamonix. According to a Reuter's telegram, despatched from Bonneville, Haute Savoie, on July 12, the calamity was due to the fact that the lower end of the glacier of Bionnay became detached from Mont Blanc and fell into the torrent beneath. It carried away with it the little village of the same name. The masses of ice and the wreck of the village formed a dam which held up the waters for some time, until they suddenly broke through the obstruction and burst like a cataract into the mountain stream, known as the Bon Nant, which flows by St. Gervais les Bains. These thermal springs, the medicinal virtues of which attract many visitors to the hotel during the year, rise in the wooded ravine of Montjoie, through which the Bon Nant or "Good Stream" passes on its way down to meet the river Arve. The gorge in which the Etablissement des Bains, erected at an altitude of 2066 feet above the level of the sea, stands, or rather stood, is narrow, and the hotel consisted of five separate buildings joined together by walls of stone roughly hewn from the mountain side. At a quarter past two on Tuesday morning or thereabouts, the people in the hotel were awakened by a terrific noise of rushing water, and the crashing of rocks one against the other. Then a furious gust of wind drove through the gorge. The next moment a torrent of water, carrying with it fragments of rock, trees, and débris of all descriptions, hurled itself upon the hotel. Of the five buildings, three were utterly destroyed, another was nearly so, while the fifth remained almost unhurt, owing its safety to its position, which was high above the course of the Bon Nant. Passing down the valley, the torrent struck the village of Le Fayet, which was almost entirely demolished. The wreckage of the houses was swept down the stream for miles into the river Arve, on the surface of which corpses and débris of all kinds were seen floating all day on Tuesday. According to the latest calculations on Tuesday evening, there were no fewer than 200 victims, more than half of whom were staying at the bathing establishment of St. Gervais.

The following are among the Civil List pensions granted during the year ended June 20:—to Mrs. Caroline Emma Carpenter, £100, in consideration of the services rendered by her late husband, Dr. Philip Herbert Carpenter, F.R.S., to science, and of the sad circumstances in which she was left by his death; to Mr. Thomas Woodhouse Levin, £50, in consideration of the services he has rendered to education and philosophy and mental science, of his blindness, and of his inadequate means of support; to Dr. George Gore, F.R.S., £150, in consideration of his services to chemical and physical science; to Mr. Henry Dunning Macleod, M.A., £100, in consideration of his labours as a writer upon economical subjects; to Mr. Henry Bradley, £150, in consideration of his labours in connection with the "New English Dictionary"; to Miss Letitia Marian Cole, £30, Miss Henrietta Lindsay Cole, £30, and Miss Rose Owen Cole, £30, in recognition of the services rendered by the late Sir Henry Cole to the cause of artistic and scientific education; and to Mrs. Jeanie Gwynne Bettany, £50, in consideration of the services rendered to the spread of scientific knowledge by the numerous writings of her husband, the late Mr. G. T. Bettany, M.A.

Mr. Thomas Hanbury has presented to the Botanical Institute at Genoa the very rich collection of vascular plants made by the late Prof. Willkomm, of Prague. It comprises as many as 14,472 species, the greater number being European or from the adjacent districts of Asia and Africa. It is especially rich in plants of the Spanish Peninsula, and includes most of Willkomm's original type-specimens.

The Society of Natural History of St. Petersburg has despatched Dr. K. N. Denkenbach on a mission to explore the flora of the Black Sea.

The death is announced of Prof. Giovanni Flechia, Vice-President of the Reale Accademia delle Scienze of Turin.

The series of fifteen water-colour paintings of the volcanic district in New Zealand, which were lent by Miss Constance F. Gordon Cumming to the Indian and Colonial Exhibition, are now lent to "The Castle" at Nottingham, where they will be shown for some little time. They were in the Indian and Colonial Exhibition at the time of the great eruption of Mount Tarawera, which destroyed the beautiful Terraces.

The weather during the past week has been changeable, with frequent rain, more particularly in the north and west; 1·7 inch was measured on the west coast of Ireland on the morning of the 12th instant. At the time of our last issue a deep depression lay over the north of Scotland, the barometer being below 29 inches, while a moderate westerly gale was blowing in the

Channel, with a high sea; and other depressions have subsequently travelled to the northward of our islands. The weather, however, remained fair, but cloudy, in the southern parts of the kingdom, and fog prevailed on the north-east coast on Monday. The distribution of barometrical pressure has, for the most part, been favourable to westerly winds, the high barometer being situated over the north of France. A change, however, set in on Monday, accompanied by strong easterly winds and a falling barometer, the highest readings having shifted northward, with their centre situated to the eastward of our islands. These conditions were followed by fresh disturbances, accompanied by rainy and unsettled weather. Temperature has been lower than of late, although but little below the average; the highest day readings have seldom reached 70°. The *Weekly Weather Report* issued on the 9th showed that, for that week, bright sunshine continued fairly prevalent over the eastern and southern districts, and that there was a considerable excess of rainfall in Ireland and the northern and western parts of Scotland.

THE United States Weather Bureau has just published Bulletin No. 1, containing some interesting notes on the climate and meteorology of Death Valley, California. This valley lies between lats. 35° 40′ and 36° 35′ N. and longs. 116° 15′ and 117° 5′ W., and owes its name to the fate of a party of immigrants, who, about 1850, perished from thirst. The principal feature of interest about the place is that, although situated about 200 miles from the sea, it is said to lie 100 feet or more below the sea level, as determined from barometrical observations. The observations now published were commenced by the Geological Survey and the Signal Service, and were continued by the Weather Bureau during five months from May to September, 1891, and we believe these are the only regular observations, with trustworthy instruments, that have been made there. The principal meteorological features are the excessive heat and dryness; the temperature rises occasionally to 122° in the shade, and rarely falls during the hot season below 70°. It is said that the thermometer has sometimes reached 130°, and once even 137°. The diurnal range of the barometer is characteristic of the form found in continental valleys, being of the purest single maximum type, and has the largest amplitude known. The rainfall was extremely light, and was always either a slight sprinkle or a thunderstorm. The total fall for the five months was only 1·4 inches. It showed a distinct diurnal frequency; nearly all the hours of rain being during the night. Sand storms were also observed on several occasions.

THE Deutsche Seewarte has just issued Part IV. of their meteorological observations made at distant stations. The observations are made three times daily, and monthly means are added in the form agreed upon for international meteorological publications. These observations are especially valuable both on account of the remoteness of the places and of the details which are given about the stations and the instruments used. This volume contains observations made (1) at six stations in Labrador for 1887; (2) at Walfisch Bay for 1889; (3) in the Cameroon estuary, from April 1889 to June 1890; (4) at Bismarckburg, Togoland, West Africa, from June 1889 to May 1890; (5) at Chemulpo, Korea, from July 1888 to December 1889; (6) at Mohammera, mouth of the Euphrates, from June to August 1885; and (7) at Bushire, from September 1885 to March 1886. In some cases the introductory text contains general remarks relating to the tides and prominent features of the climate.

IN February 1888, Dr. E. Etienne was sent to Banana by the Congo Free State to direct the sanitary service, and he made regular meteorological observations there, six times daily from December 1, 1889, to May 16, 1891, which have now been published by the State. The range of temperature during the year 1890 presented great regularity, the absolute maximum, 93°·6, occurred in March, and the minimum, 61°·9, in July; the lowest maximum was 73°·9 in July, and the highest minimum, 79°·2, in April. The greatest monthly variability (the difference of the monthly mean from one month to another) was 5°·0 between May and June. The winds are very uniform: a land breeze from south-east to south at sunrise, then calm till about 11h. a.m.; a sea-breeze from south-west till about 7h. p.m., and a second calm about 10h. p.m. The rainy season of 1889–90 numbered fifty days, with a mean daily fall of 0·49 inch. The most remarkable fall was 1·2 inch in 45 minutes. The rainy season of 1890–91 differed considerably from the former; the number of wet days was only 29, with a mean daily fall of 0·52 inch, the total amount being about five-eighths of that in the previous year. In addition to the above there is a very small amount of rain in the dry season.

THAT iron is always present in small quantities in chlorophyll has been asserted over and over again in botanical text-books. Dr. H. Molisch, who has recently investigated the subject of the presence of iron in plants, disputes this, and asserts that he has never found a trace of iron in the ash of chlorophyll. He states that iron occurs in plants in two forms—in that of ordinary iron-salts, and in the "masked" condition, in which it is so closely combined with organic substances that the ordinary re agents fail to detect it. In this form iron occurs both in the cell-wall and in the cell-contents, but it does not enter into living protoplasm.

IN one of the alcoves of the Museum of the Academy of Natural Sciences, Philadelphia, there are various fossil bones of extinct animals belonging to the Pleistocene period, and along with them a human bone. These "finds" were presented to the Academy in 1846 by Dr. Dickeson, who discovered them in a single deposit at the foot of the bluff in the vicinity of Natchez, Mississippi. Specimens—one from the human bone, the other from one of the bones of a Mylodon—have been submitted for analysis to Prof. F. W. Clarke, chemist of the U.S. Geological Survey; and the result is reported by Dr. Thomas Wilson, of the Smithsonian Institution, in the current number of the *American Naturalist*. The human bone is in a higher state of fossilization than the Mylodon. It has less lime and more silica. In their other chemical constituents they are without any great difference. Of lime the bone of the Mylodon has 30·48 per cent., while that of man has but 25·88 per cent. Of silica the Mylodon has 3·71 per cent., while man has 22·59 per cent. Dr. Wilson refers to the ordinary uncertainty of this test when applied to specimens from different localities and subjected to different conditions, but points out that in the present case no such differences exist. The bones were all encased in the same stratum of blue clay, and were subjected practically to the same conditions and surroundings.

MR. A. J. COOK, of the Agricultural College, Michigan, has been making experiments to determine how much honey is needed to enable bees to secrete one pound of wax, and he has found that the amount is eleven pounds of honey. This is less than the amount given by Huber, and more than that stated by Viallon and Hasty. An account of the experiments and of many other interesting facts relating to apiculture will be found in a report included in Bulletin 26 of the U.S. Department of Agriculture.

AN interesting memoir of John Hancock, with portrait, opens the latest instalment (vol. xi. Part 1) of the Natural History Transactions of Northumberland, Durham, and Newcastleupon-Tyne. The writer, Dr. Embleton, gives an excellent account of Hancock's masterly power of mounting animals. He notes also Hancock's remarkably intimate knowledge of the characters and habits of birds. "He could describe and imitate their motions and sounds so vividly, by feature, voice, and posture, as to be most instructive and at the same time amusing, whilst he convinced his auditors of the naturalness of his pantomime."

A PAPER on the Tertiary Rhynchophora of North America, by Mr. Samuel H. Scudder, has been reprinted from the Proceedings of the Boston Society of Natural History (Vol. 25). The assortment of the mass of Tertiary insects from American western deposits, upon which Mr. Scudder has been engaged for many years, has brought to light an unexpectedly large number of Rhynchophora, about eight hundred and fifty specimens having passed through Mr. Scudder's hands; of these, however, fully a hundred have proved too imperfect for present use or until other specimens in better condition may show what they are. Seven hundred and fifty-three specimens have served as the basis of a Monograph now being printed. More than half (431) of these specimens come from the single locality of Florissant, Colo., and excepting a single specimen from Fossil, Wyo., and another from Scarboro', Ontario, the others are divided between three localities not widely removed: the crest of the Roan Mountains in western Colorado, the buttes on either side of the lower White River near the Colorado-Utah boundary, and the immediate vicinity of Green River City, Wyoming. One hundred and ninety-three species are determined, divided among ninety-five genera, thirty-six tribes or sub-families, and six families, by which it will be seen at once that the fauna is a very varied one. It is richer than that of Europe, where there have been described (or merely indicated) only one hundred and fifty species, of which nine come from the Pleistocene. The older Tertiary rocks of America, therefore, are found to have already yielded nearly twenty-eight per cent. more forms than the corresponding European rocks. Although it is evident to any student of fossil insects that even in Tertiary deposits we possess but a mere fragment of the vast host which must have been entombed in the rocks, Mr. Scudder contends that we have already discovered such a variety and abundance of forms as to make it clear that there has been but little important change in the insect fauna of the world since the beginning of the Tertiary epoch.

IN a paper on artesian water in New South Wales, printed in the current number of the Journal and Proceedings of the Royal Society of that colony, Prof. Edgeworth David says that water rises to the surface in many parts of the east-central portions of Australia from mud or mound springs. These occur chiefly in strata of Cretaceous age. The most remarkable groups are perhaps those on the Lower Flinders, which have been described by Mr. E. Palmer in the Proceedings of the Royal Society of Queensland. The springs erupt thin mud and hot water intermittently, and thus gradually build up around their orifices mounds of mud of a rudely crateriform shape. At Mount Browne, on the Lower Flinders, several feet above the general level of the plain, is a mud spring mound covered with gigantic tea-trees (*Melaleuca leucodendron*), among the matted roots of which the hot water steams in clear shining crystal pools. At the top of the mound is a large basin of hot water, stated to be fathomless. The roots and branches of the tea-trees lying in this water become coated with a soft green vegetable substance, with air bubbles clinging to them. Innumerable small bubbles of carbon-dioxide are continually rising to the surface of the basin. The water is too hot for the hand to bear for any length of time, but when cooled it is good for use and always bright and clear, and free from any taste, while that in the adjoining cold springs is extremely disagreeable. The temperature of the water in two of these hot springs at Mount Browne is 120° F. No change has been observed in the hot springs as regards level or temperature since 1865, when a cattle station was settled there.

AMONG the curiosities in the mines and mining building at the Chicago Exhibition will be a solid gold brick, weighing 500 pounds, and worth 150,000 dollars. It will be exhibited by a mine owner at Helena, Mon.

DR. C. F. MACDONALD, who has been present at the seven executions by electricity in New York State, has submitted to the State authorities a report, in which he contends that experience has thoroughly justified the abolition of hanging. When the new method is used, death, he maintains, occurs before any sensation of pain or shock can be conveyed to the brain of the condemned. Dr. MacDonald's conclusions are endorsed by a hundred physicians who have acted as witnesses at different executions.

THE raisin industry is being gradually developed in Victoria, and promises shortly to be sufficient to supply the requirements of the colony. So says Mr. J. Knight, who writes on the subject in the new Bulletin of the Victoria Department of Agriculture. Extensive planting, he says, is going on in various parts of the colony, from the extreme west at Mildura along to the east as far as Wangaratta, the largest plantation being in the well-known Goulburn Valley. In this locality not only has the manufacture of raisins received attention during the last six years, but the products of the currant vine also are now being placed on the market.

THE second volume of the *Photographic Annual* has been issued. It includes a vast number of advertisements, but contains also some able articles, among which we may especially note Mr. Albert Taylor's general view of the progress of astronomical photography during 1891.

IN 1891 wide-spread alarm was caused in America by the presence of several species of destructive locusts in different parts of the country, particularly in the Western States. A general summary of these incursions was given in Mr. C. V. Riley's annual report for 1891, and now a Bulletin has been issued by the U S. Department of Agriculture giving the detailed reports of the agents who carefully examined the invaded districts.

A CATALOGUE of the marine shells of Australia and Tasmania, compiled by John Brazier, F.L.S., is being printed by order of the trustees of the Australian Museum, Sydney. The first part, dealing with Cephalopoda, has been issued. The task cannot be accomplished very quickly, as it entails the examination of many thousands of specimens, both dry and in spirits. The catalogue will include not only the species represented in the general Museum collection, but also those in the Hargreave's collection presented to the trustees by the late Mr. Thomas Walker, and those recently purchased from Mr. Brazier.

MR. R. ETHERIDGE, JUN., gives, in the latest instalment of the Transactions of the Royal Society of Victoria, an interesting account of a fine specimen of an unusually large species of the genus Belonostomus, obtained in 1889 by Mr. George Sweet, of Brunswick, Melbourne, in the Rolling Downs formation (Cretaceous) of Central Queensland. The fossil exhibits a long, slender fish, with deep, narrow ganoid scales and feeble fins, bent upon itself at about the middle point, and wanting the greater part of the head. Species that are apparently allied have been recorded from the Upper Cretaceous of Western Europe, India, and Brazil, and Mr. Etheridge notes that the present discovery is of great interest as extending still further the ascertained geographical range of the genus during Cretaceous times.

THE very extensive alterations in botanical nomenclature proposed in Kuntze's "Revisio Generum" has prompted a proposal, emanating from the four eminent German botanists, Ascherson, Engler, Schumann, and Urban, with the assent of a number of their colleagues, for a revision of De Candolle's "Lois de Nomenclature Botanique." The essential points of the propositions are that the starting-point for the priority of genera, as well as of species, shall be the year 1753, the date of the publication of Linnæus's "Species Plantarum"; that "nomina nuda" and "semi-nuda," *i.e.* names without a diagnosis, or with only a very imperfect diagnosis, shall be rejected, as well as figures without a diagnosis; that no generic name shall be rejected because of its similarity to another generic name, even if it differ only in the last syllable, but that, if the difference be in spelling only, the later name must be rejected; that the names of certain large and universally known genera be retained, even though they would have to be rejected by the strict rules of priority. English botanists are invited to signify their assent or otherwise to these propositions.

AT the meeting of the Linnean Society of New South Wales, on May 25, Mr. Pedley exhibited a very fine and perfect saw, about 5 feet long, of the saw-fish *Pristis zysron*, Bleeker. The fish, without the saw, was about 19 feet long, and was captured in a net at Evans River, N.S.W. The number of pairs of rostral teeth for this species is usually given as from 26–32; the specimen exhibited had only 25 pairs, all in place. At the same meeting, Mr. Hedley exhibited, on behalf of Mr. Rainbow, a spider of the family *Epeiridæ*. This rare and remarkable insect furnishes an addition to the fauna of Australia, and it is supposed that a new genus may be required for its reception.

MR. W. A. ROGERS, writing to *Science* from Colby University, Waterville, Me., confirms testimony given by Mr. Kunz as to the fact that the hardness of diamonds is not perceptibly reduced by cutting and polishing. In the earlier years of Mr. Rogers's experience in ruling upon glass he was accustomed to select a gem with a smoothly-glazed surface, and, the stone being split in a cleavage plane inclined at a rather sharp angle to the natural face selected, this split face was ground and polished. In this way he was able to obtain at several points short knife-edges, which gave superb results in ruling. It was soon found, however, that after ruling several thousand rather heavy lines the diamond was liable to lose its sharp cutting-edge, and this experience became so frequent that he was compelled to resort to the method now employed, that of grinding and polishing both faces to a knife-edge. He has one ruling diamond prepared in this way, which has been in constant use for four years, and its capacity for good work has not yet been reduced in the slightest degree. A diamond prepared by Mr. Max Levy, of Philadelphia, has given even better results, and so far it shows no evidence of wear.

THE *Bulletin de la Société des Naturalistes de Moscou* (1891, Nos. 2 and 3) contains a very interesting paper, in French, by Prof. A. Pavloff and Mr. G. W. Lamplugh, on the Speeton clays and their equivalents. These clays, which have long occupied the attention of geologists, have acquired of late a new interest owing to close resemblance between their fauna and that of similar deposits in other countries, even as far distant as Russia. The work consists of three parts: the first part, devoted to the description of the Speeton clays and their Lincolnshire equivalents, has been written by Mr. Lamplugh, and will, no doubt, be published in English as well. The second part, by Prof. Pavloff, is devoted to the description of the Cephalopods found in these clays, the Speeton forms being compared with those of other countries, and especially those of Russia. A table giving the succession of the subdivisions of the Jurassic and Cretaceous deposits, with their leading fossils, in the two Russian localities where they are best represented (Moscow and the lower Volga), is given by the author, and it differs from a previous table by the introduction of a new series, named Petchorian, which, although it has the thickness of but a few inches, has nevertheless a very peculiar fauna, of a well-determined character. However, for the present it is not possible to classify it either under the Jurassic or the Cretaceous formation. The table is followed by a detailed description of twenty-five species of Belemnites, of which eight are new, the chief interest of this description being in the attempt to give in each case the genealogical relations of closely allied species, and in a special chapter devoted to the geological history of Belemnites generally and the descent of various species supposed to have originated from the *Belemnites tripartitus* of the middle Jurassic and Lias epoch. In a subsequent paper, which will contain the third part of the work—namely, a comparison of the Speeton clays with those of other localities—the author proposes to describe in the same way the Speeton Ammonites, which are even more interesting than the Belemnites; and he hopes to be able then to give a more positive answer as to where the separation must be taken between the Jurassic and the Cretaceous deposits of the Speeton clays and analogous deposits.

MR. MATTHIAS DUNN writes to us from Mevagissey, Cornwall, that the fishing-boat *Mispah* landed a large shark there lately which had got entangled in her mackerel nets. Its length was 11 feet 2 inches, and in its stomach were two considerable-sized congers. The creature proved to be Couch's Ponbeagle Shark, or *Lamna cornubica* of Cuvier.

THE additions to the Zoological Society's Gardens during the past week include a Tiger (*Felis tigris* ♂ jr.) from Amoy, China, presented by Mr. Robert Bruce; two Mountain Ka-kas (*Nestor notabilis*) from New Zealand, presented by the Earl of Onslow, K.C.M.G.; a Chilian Sea Eagle (*Geranoaetus melanoleucus*) from Chili, presented by Mr. Edward Jewell; a Broad-fronted Crocodile (*Crocodilus frontatus*) from West Africa, presented by Mr. G. T. Carter; a Common Boa (*Boa constrictor*) from South America, presented by Mr. A. E. Oakes; a Macaque Monkey (*Macacus cynomolgus* ♀) from India; a Kinkajou (*Cercoleptes caudivolvulus*) from Demerara, deposited; a Hippopotamus (*Hippopotamus amphibius* ♂) bred in Antwerp; sixteen Common Boas (*Boa constrictor*) from South America, purchased; an Indian Muntjac (*Cervulus muntjac* ♂) born in the Gardens.

OUR ASTRONOMICAL COLUMN.

LUNAR PHOTOGRAPHY.—Dr. L. Weinek, of the Prague Observatory, has been the recipient of several photographs of the moon from Prof. Holden for the purpose of making enlargements from them. The photographs were obtained with the large equatorial of the Observatory at Mount Hamilton, and an illustration of one of the enlargements is given in *L'Astronomie* for July. The photograph is of the large crater Petavius, 153 kilometres in length. With M. Weinek's apparatus the photograph was enlarged twenty times, giving a lunar image of nearly three metres in diameter. At first sight the photograph looks as if the enlargement had been carried a little too far, but when held at arm's length the effect is very fine. The most striking features noticeable are the narrow river-like lines, which are numerous and very alike in appearance. Whether these are really photographic or not of course we cannot say, as we have not seen the original negatives, but they seem to be rather too distinct and natural to be taken for any impression other than photographic. What these rivers, if we may use such a term, are composed of is at present a subject of mere conjecture, but the day is not far off when a very careful systematic study will have to be undertaken to settle some of the questions that have been recently raised in respect to our satellite's surface.

COMET SWIFT (1892 MARCH 6).—The ephemeris of this comet for the ensuing week, taken from the *Edinburgh Circular*, No. 28, is as follows:—

Berlin Midnight.

1892.	R.A. h. m. s.	Decl. ° ′	log Δ.	log *r*.	Br.
July 14	0 58 26	+49 20·8			
15	59 6	49 31·4			
16	0 59 44	49 41·8	0·2459	0·2776	0·15
17	1 0 19	49 51·9			
18	0 52	50 1·8			
19	1 22	50 11·5			
20	1 49	50 21·0	0·2488	0·2884	0·14

Brightness at time of discovery taken as unity. The comet ıes in the southern extremity of the constellation of Cassiopeia.

OPPOSITION OF MARS.—All observatories which have the necessary equipment are especially invited by the United States Naval Observatory to join with them in making observations of the coming opposition of Mars. Observations should commence on June 20 to September 23, this period being divided into three parts, the comparison stars for the first section being O.A.S. 20970, η Capricorni, 27 Capricorni, ϕ Caoricorni, Lacaille 8851, 41 Capricorni, D.M. – 20°, 6923, Lalande 42700. It may be mentioned that observations made in accordance with the special circular which the U.S. Observatory has issued will be reduced by them.

SUN-SPOTS.—*Himmel und Erde* for July contains two very good photographs of the sun at the time of the great spot in the month of February. They were photographed by Dr. Lohse, at the Astrophysical Observatory at Potsdam. One was taken on February 13 at 10h., and shows the large group near central transit with a smaller group on the limb; while in the other, the large group is nearer the western limb. A small disc represents the relative size of the earth for comparison.

REMARKABLE PROMINENCES.—The sun's atmosphere this year has been subject to many violent disturbances, indicated to us by the presence of spots, prominences, &c. The spots, with special reference to the February group, have already received much attention, but not so with the prominences. From a set of forty observations of the latter made between March 1 and May 31, 1892, by M. Trouvelot, 23 of these, as he says, belonged to the most interesting type, *i.e.*, eruptive. On April 6, 1892, there appeared an arched like prominence on the sun's limb, extending through 12°, the length of its base being 144,932 and its height 92,664 kilometres; to give an idea of the size of this arch, it may be stated that as many as 22 globes the size of our earth might have simultaneously passed under it. At 10h. 54m., on the 8th of the same month, a huge column of light, in shape rather like a candle flame, rose to a height of 115,830, extending, in a little over half-an-hour, to 169,884 kilometres. A prominence of far greater length, occupying 34° of the solar limb, but of much less height than those mentioned above, was visible on April 15. Its base covered 410,632 kilometres, thus exceeding ten times the circumference of our earth.

GEOGRAPHICAL NOTES.

AT the last meeting of the Council of the Royal Geographical Society for the present session, it was unanimously agreed to admit women as Fellows on the same terms as men. There is nothing in the society's charter to limit the membership to men, and the proposal of admitting ladies has been made several times, and on the last occasion—two years ago—was nearly carried. As there will not be another meeting of the society until the opening of next session, the election of the first lady F.R.G.S. cannot take place until November.

THE Annual Congress of the French Geographical Societies meets this year at Lille in the first week of August, for the consideration of questions relating mainly to France and its colonies. The French Association for the Advancement of Science will hold its meeting at Pau, as we have already announced, in the third week of September. Its Geographical Section will be presided over by M. E. Anthoine, head of the French Map Department and of Graphic Statistics under the Minister of the Interior. In all departments of geography there is a remarkable revival of interest among Frenchmen at the present time, although the narrow or national aspect of the subject predominates over the wider or cosmopolitan.

A CURIOUS account of the piratical Tugere tribe of New Guinea has been published in most of the continental geographical journals on the authority of "an English medical missionary, Dr. Montague," who was picked up by a Dutch war-vessel near the boundary of Dutch and British New Guinea. This gentleman told a remarkable narrative of his capture and imprisonment by the Tugere, but as no English missionary of his name is known to be in New Guinea, nor has any mission station been recently raided by the Tugere, there is no doubt that some mistake has been made. It is impossible that so serious an incident as the imprisonment of an English missionary could be unknown in this country, and unless strong evidence were forthcoming, it is difficult to believe that such a thoroughly piratical people as the Tugere could show the diligence in agriculture and the relatively high civilization with which the story credits them.

M. E. A. MARTEL continues his researches into the subterranean geography of France. In March last he descended the "unfathomable" Creux-Percé on the plateau of Langres, proving it to be only 180 feet deep. It is a hollow in Jurassic limestone, and, although open to daylight, forms a natural ice-house, having a temperature of 28°F. when the external air was at 58°. In June he examined the still more remarkable Creux de Souci in the department of the Puy de Dôme. It proved to be a rounded cavity in recent basalt, 115 feet deep, having the appearance of being formed by a great gas bubble. A stagnant pool occupied the bottom of the pit, and above it the air was so much impregnated with carbonic acid that a candle would not burn. In this instance also the temperature fell as the distance from the surface increased, that of the external air being 51°, of the air at the bottom of the shaft 34°, and the water itself 34°·3. The Paris Society of Commercial Geography recently awarded a medal to M. Martel on account of the practical value of his researches in leading to the regulation of the underground drainage of Greece.

EASTER ISLAND.

THE prehistoric remains of Easter Island make it for archæologists one of the most interesting islands in the Pacific. They will therefore read with interest an elaborate paper in the Report of the U.S. National Museum for 1888–89, which has just been issued. The paper is entitled "Te Pito Te Henua, or Easter Island," and is by William J. Thomson, Paymaster, U.S. Navy. It records the results of researches made by Mr. Thomson during a visit paid to Easter Island by the American vessel, the *Mohican*, towards the end of 1886. The *Mohican* anchored in the Bay of Hanga Roa on the morning of December 18, 1886, and remained till the evening of the last day of the year, when she sailed for Valparaiso. Mr. Thomson and some of his comrades, interested in the relics of a past phase of life in the island, made the most of the short time at their disposal, and his essay will certainly rank among the most important contributions which have been made to our knowledge of the subject with which it deals.

He begins with a general account of Easter Island, and in this part of his work has succeeded in presenting compactly and clearly much valuable information. Of the geological features of the island he says that they are "replete with interest." The formation is purely volcanic, and embraces every variety pertaining to that structure. The tufaceous lavas form the most prominent element in the physiognomy of the island. To them, with the action of the trade-winds and heavy rains, is due the fact that Easter Island is surrounded by precipitous cliffs, rising in some cases to a thousand feet in height. The formation is extremely friable, and by the action of the elements enormous masses are continually disappearing beneath the waves that beat on the unprotected shore. Both on the coast-line and in the interior there are many natural caves. Some of these are of undoubted antiquity, and bear evidence of having been used by early inhabitants as dwellings and burial-places. It is reported that small images, inscribed tablets, and other objects of interest have been hidden away in such caves and lost through land-slides.

The climate is not unlike that of Madeira, with one wet and one dry season. Yams, potatoes, and taro are cultivated, the young plants being protected from the fierce heat of the sun by a mulching of dried grass gathered from the uncultivated ground. Bananas are grown, and so is sugar-cane, but the natives do not extract the juice for the purpose of making sugar. A wild gourd is common, and constituted the only water-jar and domestic utensil known to the islanders. Mr. Thomson saw no flowering plants indigenous to the soil, but ferns of many varieties are common, and grow in profusion in the craters of the volcanoes. Except in a few exposed places, the slopes of the hills and the valleys are covered with a perennial grass resembling the Jamaica grass (*Paspalum*). This natural growth supplies ample pasturage for cattle and sheep.

The only quadrupeds peculiar to the island are several varieties of rodents. Fish abounds in the surrounding sea, and has always been the principal means of support for the islanders. Turtles are also plentiful, and are highly esteemed. The turtle occupies a prominent place in tradition, and is frequently represented in the hieroglyphics. It appears also on sculptured rocks.

According to the traditions of the natives, the island was discovered by King Hotu-Matua, who came from the land in the direction of the rising sun, with two large double canoes and three hundred chosen followers. Mr. Thomson thinks there may have been more than one migration of people to the island, and that their traditions may have been mingled together; but there can, he believes, be no reasonable doubt about the progenitors of the present islanders being of the Malayo-Polynesian stock. The people were shockingly treated by some of the early voyagers, and in 1863 the majority of the able-bodied men were kidnapped by Peruvians, who carried them away to work in the guano deposits of the Chincha Islands and the plantations in Peru. Just before the arrival of the *Mohican* a complete census of the population had been taken by Mr. Salmon, who found that the total number of natives was 155. The children are not much darker than Europeans, but the skin assumes a brown hue as they grow up and are exposed to the sun and trade-winds. The eyes are dark brown, bright, and full, with black brows and lashes not very heavy. The countenance is usually open, modest, and pleasing. In disposition the natives are cheerful and contented. They all profess Christianity, but there are now no missionaries among them, and they display a tendency to return to the old Pagan ideas. Tattooing is no longer practised, but every islander advanced in life is ornamented in all parts of the body.

At one time the island must have been densely populated, and the surviving monuments show that the inhabitants had attained to a higher civilization than that of other Polynesians. The ancient stone houses at Orongo were thoroughly explored by Mr. Thomson and his party. These curious dwellings seem to have been built for the accommodation of the natives while the festival of the "sea-birds' eggs" was being celebrated. During the winter months the island is visited by great numbers of sea-birds, most of which build their nests among the ledges and cliffs of the inaccessible rocks. Some, however, choose two islets lying a few hundred yards from the south-west point of Easter Island, and the natives are believed to have selected Orongo as a convenient spot for watching for the coming of the birds. The fortunate person who obtained possession of the first egg, and returned with it unbroken to the expectant crowd, became entitled to certain privileges and rights during the following year. Near Orongo are the most important sculptured rocks in the island. They are covered with carvings intended to represent human faces, birds, fishes, and mythical animals, all very much defaced by the time and the elements. The most common figure is a mythical animal, half human in form, with bowed back and long claw-like legs and arms. According to the natives, this symbol represented "Meke-Meke," the great Spirit of the sea.

On the high bluff west of Kotatake Mountain the party discovered the ruins of a settlement extending more than a mile along the coast-line and inland to the base of the hill. These remains bear unmistakable evidences of being the oldest habitations on the island. The houses are elliptical in shape, with doorways facing the sea, and were built of uncut stone. Some of the walls are standing, but the majority are scattered about in confusion. Each dwelling was provided with a small cave or niche at the rear end, built of loose lava stones, which was in a number of instances covered by an arch supported by a fairly shaped key-stone. The recesses were "undoubtedly designed to contain the household gods."

Mr. Thomson has, of course, much to say about the stone images with the idea of which Easter Island is intimately associated in the minds of all who have devoted any attention to its antiquities. Every image in the island was counted, and the list shows a total of 555 images. Mr. Thomson says:—

"Of this number forty are standing inside of the crater, and nearly as many more on the outside of Rana Roraka, at the foot of the slope where they were placed as finished and ready for removal to the different platforms for which they were designed; some finished statues lie scattered over the plains as though they were being dragged toward a particular locality but were suddenly abandoned. The large majority of the images, however, are lying near platforms all around the coast, all more or less mutilated, and some reduced to a mere shapeless fragment. Not one stands in its original position upon a platform. The largest image is in one of the workshops in an unfinished state, and measures 70 feet in length; the smallest was found in one of the caves, and is a little short of three feet in length. One of the largest images that has been in position lies near the platform which it ornamented, near Ovahe; it is 32 feet long, and weighs 50 tons.

"Images representing females were found. One at Anakena is called 'Viri-viri Moai-a-Taka,' and is apparently as perfect as the day it was finished; another, on the plain west of Rana Roraka is called 'Moai Putu,' and is in a fair state of preservation. The natives have names for every one of the images. The designation of images and platforms as obtained from the guides during the exploration was afterwards checked off in company with other individuals without confusion in the record. The course gray trachytic lava of which the images were made is found only in the vicinity of Rana Roraka, and was selected because the conglomerate character of the material made it easily worked with the rude stone implements that constituted the only tools possessed by the natives. The disintegration of the material when exposed to the action of the elements is about equivalent to that of sandstone under similar conditions, and admits of an estimate in regard to the probable age. The traditions in regard to the images are numerous, but relate principally to impossible occurrences, such as being endowed with power to walk about in the darkness, assisting certain clans by subtle means in contests, and delivering oracular judgments. The legends state that a son of King Mahuta Ariiki, named Tro Kaiho, designed the first image, but it is difficult to arrive at an estimation of the period. The journals of the early navigators throw but little light upon the subject. The workshops must have been in operation at the time of Captain Cook's visit, but unfortunately his exploration of the island was not directed towards the crater of Rana Roraka.

"Although the images range in size from the colossus of 70 feet down to the pigmy of 3 feet, they are clearly all of the same type and general characteristics. The head is long, the eyes close under the heavy brows, the nose long, low-bridged, and expanded at the nostrils, the upper lip short and the lips pouting. The aspect is slightly upwards, and the expression is firm and profoundly solemn. Careful investigation failed to detect the slightest evidence that the sockets had ever been fitted with artificial eyes, made of bone and obsidian, such as are placed in the wooden images.

"The head was in all cases cut flat on top, to accommodate the red tufa crowns with which they were ornamented, but the images standing outside of the crater had flatter heads and bodies than those found around the coast. The images represent the human body only from the head to the hips, where it is cut squarely off to afford a good polygon of support when standing. The artists seem to have exhausted their talents in executing the features, very little work being done below the shoulders, and the arms being merely cut in low relief. The ears are only rectangular projections, but the lobes are represented longer in the older statues than in those of more recent date.

"The images were designed as effigies of distinguished persons, and intended as monuments to perpetuate their memory. They were never regarded as idols, and were not venerated or worshipped in any manner. The natives had their tutelary genii, gods, and goddesses, but they were represented by small wooden or stone idols, which bore no relation to the images that ornamented the burial platforms. The image-makers were a privileged class, and the profession descended from father to son.

Some of the natives still claim a descent from the image-makers, and refer to their ancestors with as much pride as to the royal family.

"The work of carving the image into shape, and detaching it from the rock of which it was a part, did not consume a great deal of time, but the chief difficulty was, in the absence of mechanical contrivances, to launch it safely down the slope of the mountain and transport it to a distant point. It was lowered to the plain by a system of chocks and wedges, and the rest was a dead drag accomplished by main strength. A roadway was constructed, over which the images were dragged by means of ropes made of indigenous hemp, and sea-weed and grass made excellent lubricants. The platforms were all built with sloping terraces in the rear, and up this incline a temporary road-way was constructed of a suitable height, upon which the statue could be rolled until the base was over its proper resting-place. The earth was then dug away to allow the image to settle down into position, the ropes being used to steady it in the meantime."

Interesting as these monuments are, they are less remarkable than the incised tablets which show that the Easter Islanders had worked out for themselves a kind of writing. The following account of the tablets is given by Mr. Thomson. Their existence "was not known until the missionaries settled upon the island, Numerous specimens were found in the possession of the natives. but no especial attention appears to have been directed towards them. Several persons, belonging to vessels that were wrecked at Easter Island, report having seen such tablets, but the natives could not be induced to part with them. The three hundred islanders who emigrated to Tahiti had in their possession a number of tablets; they created some attention on account of the remarkable skill with which the figures were executed, but they were highly prized by the owners, and no effort was made to secure them because their real value was not discovered. The Chilian corvette *O'Higgins* visited Easter Island in January 1870, and Captain Gana secured three tablets, two of which are on deposit in the National Museum at Santiago de Chili, and the third was sent to France, but does not appear to have reached its destination. Paper impressions and casts were taken from the Chilian tablets for the various Museums of Europe. Those sent to the English Ethnological Society created some interest after a time, but others sent to Berlin were regarded as stamps for marking native cloth (*Mittheilungen*, July 1871). Seven of these tablets are now in the possession of Tepano Jansser, Bishop of Axieri, all in excellent state of preservation.

"While the *Mohican* was at Tahiti, the Bishop kindly permitted us to examine these tablets and take photographs of them. These tablets were obtained from the missionaries who had been stationed on Easter Island, and they ranged in size from 5½ inches in length by 4 inches broad, to 5½ feet in length and 7 inches wide. Diligent search was made for specimens of these tablets during our visit to Easter Island. At first the natives denied having any, but Mr. Salmon knew of the existence of two, and these were finally purchased after a great deal of trouble and at considerable expense. The tablets obtained are in a fair state of preservation. The large one is a piece of drift-wood that from its peculiar shape is supposed to have been used as a portion of a canoe. The other is made of the toromiro wood indigenous to the island. In explanation of the disappearance of these tablets, the natives stated that the missionaries had ordered all that could be found to be burned, with a view to destroying the ancient records, and getting rid of everything that would have a tendency to attach them to their heathenism, and prevent their thorough conversion to Christianity. The loss to the science of philology by this destruction of valuable relics is too great to be estimated. The native traditions in regard to the incised tablets simply assert that Hotu-Matua, the first king, possessed the knowledge of this written language, and brought with him to the island sixty-seven tablets containing allegories, traditions, genealogical tables, and proverbs relating to the land from which he had migrated. A knowledge of the written characters was confined to the royal family, the chiefs of the six districts into which the island was divided, sons of those chiefs, and certain priests or teachers, but the people were assembled at Anekena Bay once each year to hear all of the tablets read. The feast of the tablets was regarded as their most important *fête* day, and not even war was allowed to interfere with it.

"The combination of circumstances that caused the sudden arrest of image-making, and resulted in the abandonment of all such work on the island, never to be again revived, may have had its effect upon the art of writing. The tablets that have been found in the best stage of preservation would correspond very nearly with the age of the unfinished images in the workshops. The ability to read the characters may have continued until 1864, when the Peruvian slavers captured a large number of the inhabitants, and among those kidnapped were all of the officials and persons in authority. After this outrage, the traditions, &c., embraced by the tablets, seem to have been repeated on particular occasions, but the value of the characters was not understood, and was lost to the natives.

"A casual glance at the Easter Island tablets is sufficient to note the fact that they differ materially from other kyriologic writings. The pictorial symbols are engraved in regular lines on depressed channels, separated by slight ridges intended to protect the hieroglyphics from injury by rubbing. In some cases the characters are smaller, and the tablets contain a greater number of lines, but in all cases the hieroglyphics are incised, and cover both sides as well as the bevelled edges and hollows of the board upon which they are engraved. The symbols on each line are alternately reversed; those on the first stand upright, and those on the next line are upside down, and so on by regular alternation.

"This unique plan makes it necessary for the reader to turn the tablet and change its position at the end of every line; by this means the characters will be found to follow in regular procession. The reading should commence at the lower left-hand corner, on the particular side that will bring the figures erect, and followed as the characters face in the procession, turning the tablet at the end of each line, as indicated. Arriving at the top of the first face, the reading is continued over the edge to the nearest line, at the top of the other side, and the descent continues in the same manner until the end is reached. The Boustrophedon method is supposed to have been adopted in order to avoid the possibility of missing a line of hieroglyphics."

A man called Ure Vaeiko, one of the patriarchs of the island, professed to have been under instructions in the art of hieroglyphic reading at the time of the Peruvian visit, and claimed to understand most of the characters. The photographs of the tablets owned by the Bishop were submitted to this old man, who related with fluency and without hesitation the legend which he declared to be appropriate to each. "The story of all the tablets of which we had knowledge," says Mr. Thomson, "was finally obtained, the words of the native being written down by Mr. Salmon as they were uttered, and afterwards translated into English."

Ure Vaeiko's tales, with the translations, are printed in Mr. Thomson's paper; and, as they are manifestly not the reciter's own invention, they have a certain interest for students of anthropology. But whether they represent the meaning of the inscriptions on the mysterious tablets is another question. It is noteworthy that, although Ure Vaeiko's fluent interpretation of the tablets was not interrupted, "it became evident that he was not actually reading the characters." "It was noticed that the shifting of the position did not accord with the number of the symbols on the lines, and afterwards, when the photograph of another tablet was substituted, the same story was continued without the change being discovered." These facts raise a doubt as to the trustworthiness of his pretensions to knowledge. However, Mr. Thomson does not seem to have yet presented a full account of the work accomplished in connection with this curious problem. "Results of an extremely interesting nature," he says, "are barely outlined at present, and not in shape to be presented herewith. It is not considered expedient to attempt an explanation of the symbols until the subject can be treated exhaustively."

It remains for us only to say that the paper is richly illustrated, and accompanied by a map of Easter Island.

EMBRYOGENY OF GNETUM.

THE remarkable observations of Treub on the mode of fertilization in the *Casuarinaceæ*,[1] have been followed by some almost equally interesting, by Herr Karsten, on the formation of the embryo in *Gnetum*. The following is a summary of the more important points, as described in the *Botanische Zeitung*.

The inner integument of the ovule develops into a long tube leading to the apex of the nucellus, and projecting far beyond

[1] See NATURE, vol. xlv. p. 548.

the other two integuments; it forms, at its apex, a drop of sweet fluid whieh captures the pollen-grains carried by the wind or possibly by insects. The outermost very thick integument becomes fleshy and bright-coloured, and is attractive to herbivorous animals. In the division of the cells of the nucellus at an early stage there is no evident predestination of one, as there is in most Angiosperms, as the mother-cell of the embryo-sac. In *Gnetum Gnemon* and *neglectum* there are usually two, three, or even more embryo-sacs which appear equally capable of further development; while in *G. edule*, and allied forms, the author found only one. In the division of the contents of the embryo-sac no differentiation of a female apparatus takes place in any of the species examined; no corpuscles or special ovum-cells are formed, and no antipodals; but the protoplasm of the embryo-sac divides into a parietal layer of primordial cells, which appear to be altogether equivalent, and which represent so many ovum-cells capable of fertilization.

As the pollen-tube lengthens, its nucleus gives off a smaller vegetative nucleus, probably soon after the entrance of the tube into the tissue of the nucellus. The two nuclei remain very near one another; the vegetative nucleus or prothallium cell remains unchanged, while the generative nucleus increases greatly in size and divides into two. In *G. edule* the apex of the pollen-tube has now entered the apex of the embryo-sac; while in *G. neglectum* it appears to make a curve to avoid the apex of the sac, and becomes closely applied to its lower portion. After the pollen-tube has entered the embryo-sac its vegetative nucleus disappears, while each of the two generative nuclei surrounds itself with a membrane of protoplasm, and the nucleus of each of these generative cells divides into four or eight. The actual coalescence of the male and female nuclei was not observed; but a number of small nuclei were detected in the male generative cells, in addition to its four (or eight) comparatively large male nuclei, which the author regards as the nuclei of the primordial ovum-cells which have wandered into the male generative cells; and the coalescence must take place within the male generative cell. After the entrance of the pollen-tube, the parietal layer of protoplasm of the embryo-sac, in which the female primordial cells are imbedded, breaks up into an endosperm tissue.

The author regards *Gnetum* as representing a higher type of the order *Gnetaceæ* than the other genera, *Welwitschia* and *Ephedra*; the fact that no endosperm is formed before fertilization indicating an advance on other Gymnosperms. The presence of a large number of embryo-sacs, and the absence in them of antipodals, may indicate some analogy with *Casuarina*. The processes described above finally negative, in the opinion of the author, the theory that the antipodals are a survival of the female prothallium of Vascular Cryptogams; they appear, rather, to be a degenerate and functionless female sexual apparatus. According to this view, there are, in the embryo-sac of Angiosperms, two female sexual apparatuses of similar origin, the vegetative nuclei of which coalesce in each; but one of the two apparatuses is altogether abortive. Both the antipodals and the egg-apparatus or embryonic vesicles consist of an archegone reduced to a single cell. A. W. B.

INTERNATIONAL CONGRESS OF EXPERIMENTAL PSYCHOLOGY.

THE second session of the above Congress will be held in London on Monday, August 1, 1892, and the three following days, under the presidency of Prof. H. Sidgwick. The Congress will assemble in the rooms of University College, Gower Street (kindly lent for the purpose), from 10 to 1 and from 2 to 4.30. The following papers have been arranged for:—

Dr. ALEXANDER BAIN ...	"The Respective Spheres and the Mutual Aids of Introspection and Experiment in Psychology."
Prof. M. BALDWIN ...	"Suggestion and Will."
Prof. BEAUNIS	"Psychological Questioning" (Des questionnaires psychologiques).
Dr. BÉRILLON	"The Applications of Hypnotic Suggestion to Education."
Prof. BERNHEIM	"The Psychical Character of Hysterical Amblyopia."
M. BINET	"The Psychology of Insects."
Prof. DELBŒUF	"The Appreciation of Time by Somnambulists."
Dr. DONALDSON	"Laura Bridgman."
Dr. VAN EEDEN... ...	"Principles of Psycho-Therapeutics."
Prof. EBBINGHAUS ...	"Theory of Colour-perception."
Dr. GOLDSCHEIDER ...	"Investigations into the Muscular Sense of the Blind."
Prof. STANLEY-HALL ...	"Recent Researches in the Psychology of the Skin."
Prof. HENSCHEN... ...	"The Visual Centre in the Cortex of the Calcarine Fissure."
Prof. HEYMANS	"Inhibition of Presentations."
Prof. V. HORSLEY ...	"The Degree of Localization of Movements and Correlative Sensations."
Prof. PIERRE JANET ...	"Loss of Volitional Power (l'aboulie)."
Prof. N. LANGE	"A Law of Perception."
Prof. LIÉGEOIS	"The Female Poisoner of Aïn-Fezza."
Prof. LEHMANN	"Experimental Inquiry into the relation of Respiration to Attention."
Dr. LIGHTNER-WITMER	"The Direct and Associative Factors in Judgments of Æsthetic Proportion."
Prof. LOMBROSO	"The Sensibility of Women, Normal, Insane, and Criminal."
Dr. MENDELSSOHN ...	"Investigations into the Parallel Law of Fechner."
Prof. LLOYD MORGAN ...	"The Limits of Animal Intelligence."
Prof. G. E. MÜLLER ...	"The Experimental Investigation of Memory."
Prof. MÜNSTERBERG ...	"The Psycho-Physical Basis of the Feelings."
Mr. F. W. H. MYERS ...	"The Experimental Induction of Hallucinations."
Dr. W. R. NEWBOLD ...	"The Characteristics and Conditions of the Simplest Forms of Belief."
Prof. PREYER	"The Origin of Numbers."
Prof. RIBOT	"General Ideas."
Prof. RICHET	"The Future of Psychology."
Prof. SCHÄFER	"The Anatomical and Physiological Relations of the Frontal Lobes."
Mrs. SIDGWICK	"Experiments in Thought-Transference."
Dr. E. B. TITCHENER ...	"Binocular After-images."
Prof. TSCHISCH	"Relation of Reaction-time to the Breadth of Perception."
Dr. VERRIEST	"The Physiological Basis of Rhythmic Speech."
Dr. WALLER	"On the Functional Attributes of the Cerebral Cortex."

The Meetings of the Congress will be General and Sectional. It is provisionally arranged that the General Meetings will be held on Monday or Thursday, and on the afternoons of Tuesday and Wednesday; and that the Sectional Meetings will be held on Tuesday and Wednesday Mornings, and if necessary on Thursday Morning. There will be two Sections at least: Section A, Neurology and Psychophysics; and Section B, Hypnotism and Cognate Questions. Under Section A will fall, for example, the papers of M. Binet, Profs. Henschen, Horsley, Schäfer, Waller, &c.; under Section B will fall the papers of Dr. Bérillon, Profs. Bernheim, Delbœuf, Liégeois, Dr. Van Eeden, Mr. F. W. H. Myers, and Mrs. Sidgwick.

Reports will be given in by Profs. Sidgwick and James and M. Marillier of the results of the census of hallucinations which it was decided to carry out at the first Session of the Congress (Paris, 1889).

A Committee of Reception has been formed, which includes, among others, the following names:—Dr. A. Bain, Dr. D. Ferrier, Mr. F. Galton, Dr. Shadworth Hodgson, Prof. V. Horsley, Dr. Hughlings Jackson, Dr. Charles Mercier, Prof. Croom Robertson, Dr. G. J. Romanes, Mr. Herbert Spencer, Mr. G. F. Stout, Dr. J. Ward, and Dr. de Watteville.

The fee for attendance at the Congress is ten shillings, which will entitle to a printed report of the proceedings. Any intending members who have not yet paid the fee are requested to send it to Prof. Sully.

During the Congress letters may be addressed to Members at the Council Room, University College, Gower Street, London, W.C., where each Member is requested to inscribe his name, on his first attendance at the Congress.

F. W. H. MYERS,
Leckhampton House, Cambridge.

JAMES SULLY,
East Heath Road, Hampstead, London, N.W.

SCIENTIFIC SERIALS.

THE current number of the *Royal Agricultural Society's Journal* is, perhaps, of more than usual interest. The first article is on Vermin of the Farm, by J. E. Harting, and is followed by an editorial note on the same subject. The plague of "mice" on the hill pastures of Scotland this spring gives a special interest to these articles. It appears that the Scotch plague is caused not by mice, but by fieldvoles (*Arvicola agrestis*), and the destruction they have wrought in the hill pastures of Scotland arises from the fondness of these voles for the delicate white stems of the hillside herbage. Judging from the reports of similar plagues in previous years it would appear that the natural enemies of the vole—the short-eared owl and the kestrel hawk—are far more efficacious remedies than any artificial means yet devised for the destruction of the voles; hence a paper on Wild Birds in relation to Agriculture, by Earl Cathcart, is very opportune, protesting as it does against the careless destruction of such birds as the owl, the hawk, and the rook. The Journal also contains a second paper by Mr. Dan Pidgeon on the Evolution of Agricultural Implements. A suggestive paper by Mr. William E. Bear on Desirable Agricultural Experiments advocates extensive experiments to test the economy of nitrogenous manuring by means of leguminous crops. Other papers in this number are Contagious Footrot in Sheep, by Prof. G. T. Brown; Variations of the Four-course System, by Gilbert Murray; and the Trial of Ploughs at Warwick, by F. S. Courtenay.

SOCIETIES AND ACADEMIES.

Oxford University Junior Scientific Club, May 27.—The biennial conversazione of the Club was held in the University Museum, when an address inaugural to the recently founded "Robert Boyle lectures of the O.U.J.S.C." was delivered by Prof. Sir Henry W. Acland, Bart., K.C.B., F.R.S., on Robert Boyle, his life, work, and influence on science. A very interesting series of exhibits was shown by the various departments of the Museum and by the University Observatory, illustrating recent progress in their particular branches of science. Of special interest were the exhibits by the Rev. F. J. Smith on shadow and objective spark photography, illustrated by pictures of objects in rapid motion; by Mr. Cecil Carus-Wilson, of natural and artificial musical sands; by the University Observers, of a series of splendid photographs illustrating recent improvements in astronomical and spectral photography; by the National Telephone Company, of telephonic apparatus; by Dr. Hunt, of preparations and cultivations illustrating the methods of isolation and identification of bacteria; by Mr. B. V. Darbishire, of a series of lantern views in the Caucasus and in the British East Africa Company's territory, the slides for which were kindly lent by the Royal Geographical Society. The Club is much indebted to the Royal Society, the Pharmaceutical Society, the Right Hon. the Earl of Cork and Orrery, Prof. Wyndham R. Dunstan, Prof. Odling, and other gentlemen for the loan of oil paintings, engravings, and relics of Robert Boyle and his contemporary men of science in Oxford.

June 3.—The President, Mr. W. Ramsden, in the chair.—The following papers were read:—The sub-salts of the alkali metals, by Mr. W. Pullinger.—The action of silicon-tetrachloride on benzene, by Mr. C. H. H. Walker.—Marriages of consanguinity, by Mr. H. Anglin Whitelocke.—A new and improved form of rotatory hypsometer, by Mr. S. A. Sworn (Balliol). Mr. C. J. Romanes was elected an honorary member of the Club.

June 14.—The President, Mr. W. Ramsden, in the chair.—The following papers were read:—The action of iodine on a mixture of sulphites and thiosulphates, by Mr. H. A. Colefax.—On marine nests, by Mr. W. B. Benham.

EDINBURGH.

Royal Society, June 20.—Dr. Traquair exhibited some remains of animals occurring in volcanic tuff at Teneriffe.—Dr. Hunter Stewart read a paper on the variations in the amount of carbonic acid gas in the ground air.—Dr. Buchan discussed the diurnal variations of barometric readings in the polar regions during summer. From observations made in the summer of 1876 and the two succeeding summers, in the central part of the North Atlantic, between 62° and 80° north latitude, he showed that only one maximum and one minimum occur during the day. Observations made by the *Challenger* staff in high antarctic latitudes during summer give the same result. A single maximum and a single minimum are also found in the interior parts of the polar continents, but these occur at different times of the day from the ocean maximum and minimum. Superposition of the two sets of variations gives a variation like that ordinarily observed.

July 4.—The Hon. Lord Maclaren, Vice-President, in the chair.—Dr. A. W. Hughes read a paper on the rotatory movements of the human vertebral column. Among other results he points out that while the lumbar vertebræ cannot rotate much about a vertical axis, the dorsal vertebræ are capable of considerable rotation—the total rotation of this part of the vertebral column being 45° or more—and the cervical vertebræ are still more free—the total amount being at least 90°.—Mr. R. Kidston discussed the genus *Lepidophloios*, Sternb.—Prof. C. G. Knott and Mr. A. Shand communicated some further notes on the volume effects of magnetization. Five iron tubes, with bores varying from 16·0 to 3·5 mm. diameter, but otherwise identical in form and substance, were subjected to a series of magnetizing forces. In low fields the thinner-walled tubes experienced the greater dilatations of internal volume; but in high fields the narrower bored tubes showed much the greater dilatations. For example, in field 1400 the dilatations of the tubes in order, beginning with the one of widest bore and thinnest wall, were +4, −3, −20, −53, and −129—each being multiplied by 10^{-7}. With the two tubes of widest bore, the change of volume had reached its limit at this high field, the substance being practically saturated; but with the tubes of narrowest bore there was no evidence of a limit being reached, the innermost layers of iron being evidently far from practical saturation. Some interesting illustrations of magnetic after-effect were also described.—Dr. A. B. Griffiths submitted a paper on the blood of the invertebrata.—Prof. Tait communicated the second part of a paper on the laws of motion. If we assume the principles of inertia of matter and conservation of energy (the energy of a self-contained system consisting of the kinetic energy of all its parts supposed to be moving with the speed of its centre of inertia, the kinetic energy of relative motion of its parts, and the potential energy of its parts), the fact that we cannot attach any definite meaning to the principle of conservation, except when the motion of the system is Galilei-wise, leads at once to the first and third laws of motion, since the centre of inertia moves uniformly in a straight line; and the second law becomes merely a definition of the word "force" as used in the first law, and as used instead of "action" and "reaction" in one interpretation of the third.

PARIS.

Academy of Sciences, July 4.—M. d'Abbadie in the chair.—On local disturbances produced underneath a heavy load uniformly distributed along a straight line normal to the two edges, on the upper surface of a rectangular beam: experimental verifications, by M. J. Boussinesq.—Resemblances in the march of evolution on the old continent and the new, by M. Albert Gaudry.—Experimental researches on falling bodies and the resistance of air to their motion: experiments performed at the Eiffel Tower, by MM. L. Cailletet and E. Colardeau. Metallic spheres were let fall from the second platform of the Eiffel

Tower, and their exact time of describing certain distances was measured to a hundredth of a second by means of an electric chronograph. The body was fixed to a very light thread wound round a set of inverted cones, each of which held 20m. of thread. The latter passed from one cone to another through two fine springs in contact, which contact was broken by the string pulling through, thus producing a mark on the chronograph. The retardation produced by the string was independently determined and found to be less than 0·001 per cent. The following laws were verified: that the resistance of the air is proportional to the area of the resisting surface; and that it is independent of the form of the surface. That it is also proportional to the square of the velocity was not found to be strictly true, since the resistance increased rather more rapidly. The amount of fall after which the velocity of the weights employed became uniform ranged from 60m. to 100m. Contribution to the study of the function of camphoric acid, by M. A. Haller.—A new contribution to the history of morbid associations; anthrax and paludism, by M. Verneuil.—Fixation of ammoniacal nitrogen on straw, by M. de Vogüé.—On the nature of the rotation of the knife-edge of a pendulum on its plane of suspension, by M. G. Defforges. This rotation is not a simple rolling, as was assumed by Euler and Laplace, but is compounded with a sliding motion, whose existence can be proved by means of interference fringes. The sliding is proportional to the amplitude and up to six or seven kgr. to the weight.—On the influence of the place of the external thermometer in observations of zenith distances, by M. Périgaud. In calculating the error due to refraction by Arago's method, the density of the layer of air in the neighbourhood of the objective is measured by a thermometer placed outside the room, near the north side of the observatory. It was sought to fulfil the conditions of the problem more rigidly by suspending a thermometer quite close to the objective. The zenith-distances, calculated on the basis of its indications, showed a difference of 0·2 to 0·8 from those obtained by Arago's method, which made the zenith distances too large. The writer's method has been adopted at the great transit-instrument of the Paris Observatory. —On the primary forms of linear differential equations of the second order, by M. Ludwig Schlesinger.—On the precise determination of the critical density, by M. E. Mathias. This determination is aided by the law of the rectilineal diameter, according to which in the curve of temperatures and densities the locus of the midpoints of the chords parallel to the axis of the ordinates is a straight line. This law, recently confirmed by Young's experiments, implies that the critical density is equal to the ordinate of the diameter which corresponds to the critical temperature. Calculated according to this law, the critical densities of methyl, ethyl, and propyl alcohol are found to be the same.—Influence of the mass of the liquid in the phenomena of heating, by W. A. Witz.—Measurement of the dielectric constant by electromagnetic oscillations, by M. A. Pérot. By the method described, the constant K was determined for glass, and found to range from 2·71 if charged for $72{\cdot}6 \times 10^{-10}$ sec. to 5·727 if charged for $453{\cdot}7 \times 10^{-10}$ sec.—On the composition of water and Gay-Lussac's law of volumes, by M. A. Leduc. The writer's researches on the densities of gases have led him to adopt the value 23·24 for the percentage of oxygen in the air. The density of oxygen was determined by a modification of Dumas's process, in which the hydrogen was absorbed by finely-laminated electrolytic copper. The atomic weight deduced was 15·88, while the mean of the best values for the density is 15·90. This shows that Gay-Lussac's law of volumes is only approximate.—On the nitrogen salts of platinum, by M. M. Vèzes.—Researches on the sodic pyrogallols, by M. de Forcrand.—On acetono-resorcine, by M. H. Causse.—Utilization of roasted iron pyrites for the manufacture of iron salts, by MM. A. and P. Buisine.—On the alterations of ferruginous waters, by M. F. Parmentier.—Reproduction of pure potassic nepheline, by M. André Duboin.—On the passage of dissolved substances through mineral filters and capillary tubes, by M. C. Chabrie.—On hæmocyanine, by M. Léon Frédéricq. —On the physiological determinism in the metamorphosis of the silk-worm, by M. E. Bataillon.—On a new *Temnocephala*, a parasite of *Astacoides madagascariensis*, by M. A. Vayssière. —Earthworms and tuberculosis, by MM. Lortet and Despeignes. Proving that worms can bring the bacillus to the surface, preserving all its virulent properties.—On the Californian disease, a disease of the vine caused by *Plasmodiophora californica*, by MM. P. Viala and C. Sauvageau.—An essay on vegetable statics, by M. Augustin Letellier.—On the cavern called the Creux de Souci (Puy-de-Dome), by MM. E. Martel, A. Delebecque, and G. Gaupillat.—On the lakes of the central plateau of France, by MM. A. Delebecque and E. Ritter.

BERLIN.

Physical Society, June 3.—Prof. Schwalbe, President, in the chair.—Dr. Gross continued his remarks on the subject of entropy.—Dr. Wien gave an account of experiments on the measurement of high temperatures, made in conjunction with Dr. Holborn, with a view to testing Le Chatelier's platinum and rhodium thermo-elements. They were first compared with an air-thermometer. The latter consisted of a glazed porcelain tube containing slightly rarefied air, the temperature being recorded by a manometer. The thermo-element was introduced into the cavity of the air-thermometer, and the readings of the respective instruments were compared between -80° and $+1500^\circ$. Below 500° the thermo-element was not very sensitive, and is hence of use only for high temperatures. Alloys of platinum with 9, 10, 11, 20 and 40 per cent. of rhodium were tried. It was found that the E.M.F. increased with the increased percentage of rhodium, but that the most suitable alloy was that containing 10 per cent. of rhodium as recommended by Le Chatelier. The above experiments necessitated the determination of the co-efficient of linear expansion of Berlin porcelain. This was found to be ·000004. In some final experiments the melting-point of gold was determined to be 1073° and 1067°, of silver 972° and 968°, and of copper 1082°.

June 17.—Prof. Kundt, President, in the chair.—Prof. Vogel exhibited a remarkably fine series of coloured prints of oil paintings, &c., prepared in accordance with his method by Messrs. Vogel and Ulrich. The method consists in first taking a red, a yellow, and a blue negative of the object on plates specially sensitized for colours. The three negatives are then printed on to one and the same paper by means of complementarily coloured rollers or stones. In order to obtain the colours exactly complementary to those of the negatives, the colours used for printing were either the coloured sensitizers themselves or some substance whose equivalence to these had been determined spectroscopically. The application of the physical principles involved in the above yielded an approximate reproduction of the natural colours which was surprisingly complete, and will become more so as more and more coloured substances are discovered suitable as sensitizers.—Prof. Koenig described his new spectrophotometer. Its chief improvement consists in the introduction of Lummer and Brodhun's glass-cube, which is, however, so modified as to admit of the measurement of the relative intensities of the parallel rays falling into it.

Physiological Society, June 24.—Prof. du Bois Raymond, President, in the chair.—Prof. Kossel communicated the results of some experiments made by Dr. Monti on the absorption of oxygen by the tissues after death, using for this purpose their reducing action on photographic plates. The suprarenals, spleen, and thymus reduced most actively, while brain-substances produced but little effect. Dr. Lilienfeld had investigated the distribution of phosphorus in various tissues by means of micro-chemical reactions with ammonium molybdate and pyrogallol. The presence of phosphorus was usually strongly marked in the nuclei as compared with the cell-substance, except in the case of the cerebral ganglia, in which the reverse was frequently observed. Prof. Gad drew attention to a phenomenon, brought to his notice by Prof. Litten, which may be observed during normal human respiration, and consists in the downward passage of an obvious wave over the wall of the thorax at each inspiration aud the upward passage of a similar wave at each expiration.

AMSTERDAM.

Royal Academy of Sciences, June 25.—Prof. van der Waals in the chair.—Prof. T. Forster spoke (1) On the action of heat upon tuberculous matter. According to former investigations by "pasteurizing" (*i.e.*, warming liquids to a temperature of 60 to 80° C. for a short time and cooling them immediately), bacteria of Asiatic cholera and typhoid-fever are killed at about

60°. From a hygienic point of view it is of still more importance to discover what is the lowest temperature at which the bacilli of tuberculosis are destroyed. It is established that tuberculosis is produced by the consumption of milk secreted by tuberculous cows. Meat also, coming from tuberculous cattle, sometimes contains infectious matter. By boiling heat, indeed, the bacilli of tuberculosis are killed. But if meat is prepared in the usual manner, even small pieces of it are not warmed thoroughly at 100° C.; milk, on the other hand changes in taste if boiled, so that most people do not like boiled milk. By a series of experiments, recently made, Prof. Forster has settled that the bacilli of tuberculosis are destroyed by a temperature of 60° C. acting during one hour, and by the action during six hours of a temperature of 55° C. Higher temperatures than 60°, for instance, 80, 90 or 95° C., destroy the infectious matter in milk from tuberculous cows, if they act during *ten* minutes; "pasteurizing," however, at 80° during *one* minute does not hurt the bacilli of tuberculosis. (2) On the development of bacteria at a temperature of melting ice. He had formerly demonstrated cultivations of bacteria, which produce light of phosphorescence. The same kind of bacteria are also able to develop and to multiply at a temperature of 0° C. He found that bacteria which have this peculiar quality, so interesting from a biological point of view, not only live in the sea, but are met with in brackish and fresh water, upon victuals, manures, etc., etc. This agrees with the fact that victuals, kept for some days in an ice-chamber, gradually assume a disagreeable smell and taste; and that meat can be preserved from putrefaction for days but not for weeks. If foods are to be preserved at a low temperature for a long time, beside cold a second agent is necessary—dryness. In the cooling rooms of the most modern establishments (slaughterhouses, stores, etc., etc.) no use is made of ice, which after melting moistens the atmosphere and the objects in the ice-chambers, but arrangements are made by which the atmosphere is cooled to a low temperature and at the same time kept perfectly dry.—M. Beyerinck spoke of the culture of organisms of nitrification on agar-agar and on gelatine. First it was stated, in accordance with the discovery of Warington and Winogradsky, that nitrification consists in two processess—the formation of nitrous acid from the ammonsalt by a specific bacterium and the oxidation of the nitrite into nitrate by another and independent species of bacterium. Secondly, that both these processes occur only when soluble organic matter is reduced to a minimum such as has been proved by the classic researches of Winogradsky and the Franklands. Even 0·1 per cent. of calcium-acetate retards nitrification strongly. Thirdly, it was found that organic matter in the solid state does not in the least interrupt or retard nitrification. Therefore an attempt was made—and successfully—to cultivate the nitrous and nitric bacteria on agar-agar, fully extracted with distilled water and afterwards boiled with the inorganic salts needed for nitrification. If with these salts some pure precipitated carbonate of lime was added to the agar it was possible to obtain a "chalk-agar-plate," whereon the nitrous bacteria of the soil, after their growth into colonies, could directly be numbered. For this purpose the chalk-agar is poured into a glass-box, and some soil suspended in sterilised water brought on the surface of the solidified plate. After three to four weeks the colonies become visible as the centres of clear, transparent, perfectly circular diffusion figures, formed by the solution of the carbonate of lime in the nitrous acid, the very soluble calcium-nitrite diffusing in all directions in the agar-plate. In this way it was found, for example, that out of c.a. 10 millogrammes soil taken from under a sod of white clover in a garden at Delft, thirty colonies of the nitrous bacterium could be cultivated. The species is the same as that described as the European form by Winogradsky, growing, as well as zooglœa, quite free, and possessing the form of a small, moveable mikrokok with one cilium. Gelatine, prepared with the same precautions as the agar, can also be used, but therein the production of nitrous acid soon ceases. The nitrous bacterium does not liquefy the gelatine. Though it does not grow or oxidize when organic matter is present, it does not lose these powers by this contact, as shown when brought anew under adequate conditions. The nitric bacterium was also isolated on fully extracted agar, to which 0·1 per cent. potassium-nitrite and some phosphate was added. The colonies are very small and coloured light yellow. They consist of very small non-moving mikrokoks or short ellipsoids. They lose their power of oxidizing nitrites by the contact of soluble organic matter, without thereby losing their power of growth. The nitric bacterium does not oxidize ammonsalts. It is also without action on potassium rhodanate and hydrochloric-hydroxylamine. It therefore does not seem to produce free acid such as the nitrous bacterium. A simple method for the formation of sterile plates of silica, with and without carbonate, was also described. Many preparations were demonstrated.

BOOKS AND SERIALS RECEIVED.

Books.—Grasses: C. H. Jones (S.P.C K.).—A Synoptical Geography of the World (Blackie).—London Matriculation Directory, No. xii., June 1892 (Clive).—The Case against Bimetallism: R. Giffen (Bell).—The Birds of Devon: W. S. M. D'Urban and Rev. M. A. Mathew (Porter).—Universal Atlas. Part 16 (Cassell).—Photography Annual, 1892 (Iliffe).—Muséum d'Histoire Naturelle des Pays Bas; tome xi., Cat. Systématique des Mammifères: F. A. Jentink (Leide, Brill).—The Applications of Elliptic Functions: A. G. Greenhill (Macmillan and Co.).—Sunshine: A. Johnson (Macmillan and Co.).—Theory of Numbers, Part 1: G. B. Mathews (Bell).—Alcohol and Public Health: Dr. J. J. Ridge (Lewis).—Murray's Hand-book; Norway, 8th edition (Murray).

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