THURSDAY, JULY 31, 1902.

AUTOMOBILES.

Schule des automobil Fahrers. By Wolfgang Vogel. Pp. viii + 189. (Berlin: Schmidt, 1902.) Price m. 2·60.

MR. WOLFGANG VOGEL has moved about on his motor cars with such pleasure to himself that it has resulted in a desire to share that pleasure with others, and he addresses his book chiefly to those who are unlearned, not only in motor cars, but even in the rudiments of the usage of machines. He is right in this, for they are numerous.

Probably the largest percentage of persons who are quite ignorant of mechanical matters exists among the upper classes. The millions who work in factories, delve in mines, and direct some one or other of the innumerable agricultural appliances have had an acquaintance with machinery forced upon them. Few of these would require a diagram and many words to indicate the use of a sight feed oiler or a Stauffer lubricator, by whatever name they might distinguish them.

But among those who can buy motor cars these things are still a mystery, and it is likely that the automobile movement will cause a very important alteration in the mental attitude of the so-called cultivated classes towards machines, and thence towards mathematics and science. At present, therefore, it is reasonable that a book such as Herr Vogel's should give elementary diagrams of the Otto cycle and obvious sketches of the much-sketched induction coil.

Chapter ii. shows how explosive gas is made by spray or vapour from the liquid petrol mixed with air, how it is controlled in amount, ignited electrically, and voided noiselessly after it is burnt.

A very justifiable preference is shown for the secondary over the primary battery and for the dynamo over either for the purpose of making sparks to fire the charge; but it is remarkable how much less perfect is the electrical part of automobiles than might have been expected. Instead of working fervently in this new field, the electrician has evidently settled down to making money in his other dearly earned preserves.

If we compare the amount of energy utilised in igniting the charge in an explosion engine with the bulk and weight of the usual ignition equipment we shall feel some surprise. If we further consider how easy it is to make an electrical instrument "fool proof," especially when it is devoid of moving parts, we shall be astonished at the numbers of electrical breakdowns—the loose wires, oily contacts, broken terminals, which characterise every beginner's early motor-car runs.

It has been noted in various automobile competitions that electrical troubles were prominent in cars entered by manufacturers and agents, and almost absent from cars entered and owned by private persons, the differences being ascribed to the superior electrical knowledge of most of the amateurs who had sufficient mechanical tendencies to tempt them to what then was, in its early days, an odious sport.

There still remains much to be done to diminish the high cost, high weight, large bulk and frequent opportunities of breakdown which characterise even the most modern motor cars, but these questions of design and improvement do not exercise our author, who contents himself with instructions how to use cars as they are.

It may be mentioned that the book contains many tabulated forms, which give, in order, the necessary operations for getting the machine ready before running, for starting up, and in case of breakdown. Copies of these tables should be of great value to the beginner, and he is intended to use them until thoroughly familiar with his machine.

The "self-mover" which is more likely than any other to create a stir in the world, and which, until he is educated up to it, the pedestrian and carriage person hates, the motorist despises, and the ordinary cyclist is jealous of, is the motor bicycle. This most useful machine by no means receives its proper share of attention at the hands of our author, who ascribes to it only two pages. It will be avenged on him some day, even if it be only in the matter of the sale of his book.

In chapter iii., Herr Wolfgang Vogel divides automobiles into cycles, voiturettes and motor cars, without showing any very good reason for so doing, though he incidentally points out that the driving of a motor tricycle will probably come more easily to one who has never been accustomed to ride a bicycle. In chapter iv. he deals with brakes, and explains simply and clearly the necessity for differential gear which so often puzzles the tyro. The subsequent chapters are given over to trailers and the like. Possible breakdowns and their remedies are dealt with.

Part ii. begins by dealing with minor accessories and the repairs of pneumatic tubes. Hints are given for lengthened tours, and a table is appended which includes all the hundred and one articles which are so apt to be left behind. The reader may gather several wrinkles from this chapter; they all deserve the description of "praktisch."

Chapters iii. and iv., which are devoted to the description of tours from Berlin to the Rhine, Switzerland and Italy, made by the author, are lightly and interestingly written, and give the reader an excellent idea of the pleasures and difficulties incidental to such tours. The run over the Stilfser Joch, the highest bit of road in Europe, seems likely to provide as much excitement as modern man could desire.

The necessity for being provided with enough money of the various countries passed through and an ample number of spare parts is pointed out, with illustrations from the author's own experience of delays at an exacting Customs Office. A knowledge of languages is, of course, desirable.

The author proffers an admirable suggestion that continental automobile clubs should compile a register of the hotels which have suitable "stabling" for motor cars, and not confine their attention to the places where petrol can be procured. He is, of course, not cognisant of the good work done by the English Automobile Club both in this and in every other direction for road and route improvement.

The author favours petrol cars, and, according to him, the purchase of a motor cycle only engenders the

desire for a voiturette, which had better have been satisfied from the first. If he were to sit on one or two committees of the English club above named, he would learn to his astonishment that a number of members who already possess a luxurious car are adding a motor cycle to their "stable," a fact which is hardly in accord with his opinion.

From the brevity of part iii., which deals with electromotors, and of part iv., which devotes to steam cars the short space of four pages, he would appear to be less than kind to the formidable competitors of his favourite petrol explosion engine.

On the whole, the book gives in a very simple and interesting manner a large amount of information which must prove invaluable to the beginner, and may with advantage be studied even by those who are more conversant with the vagaries of the motor car.

The author's style is unusually understandable to English readers, and with a little judicious "skipping" the sense can easily be followed, owing to the number and clearness of the illustrations, without the laborious necessity of using a dictionary.

MERVYN O'GORMAN.

COMPARATIVE ANATOMY OF ANIMALS.

An Introduction to the Study of the Comparative Anatomy of Animals. Vol. ii. By G. C. Bourne, M.A., D.Sc. Pp. xv + 321. (London: G. Bell and Sons, 1902.) Price 4*s.* 6*d.*

DR. BOURNE'S work is divided into thirteen chapters, which, though serial with those of the preceding volume, are separately paged. In addition, there is a short "conclusions" chapter—in reality a concise summary of the contents of the book, with some good advice to the student—and also an excellent index.

The text treats of the cœlomate Metazoa, with a special leaning to the developmental side, which the author regards as indispensable to "a just appreciation of the problems of comparative anatomy." Of the thirteen chapters, the first is restricted to the Platyhelmia, with especial reference to the liver fluke; the second and third to the earthworm alone; the fifth mainly to the mussel; the sixth to the snail; the eighth to the crayfish; the ninth to the cockroach; and the eleventh to the dogfish. The two concluding chapters are devoted respectively to the development of the frog and a very general survey of the field of mammalian morphology; while the three which remain are in turn given to the Annelida, Crustacea, and Cephalochorda in general, to Apus and Amphioxus in particular.

In the selection of material, the author has been guided by the requirements of the "preliminary and intermediate science examinations in the universities of Great Britain." By way of illustration he gives us seventy-seven text figures, many of which are new and meritorious. The researches of Benham, von Boutin, Ehlers, Fraipoint, Hatschek, Kowalevsky, Lacaze-Duthiers, Reichenbach, Vejdovsky, Wilson, and others, have been duly laid to account, with acknowledgment, such as might well have been similarly accorded to certain English workers upon whose labours the author has drawn. Of the author's own diagrams, those illustrating the development of the mammal may be cited as excellent; but even here clearness might well have been further ensured, had the alimentary canal been delineated in outline, as giving rise to the allantois and yolk-sac.

The book is fully up to date and well worthy its predecessor and its author's reputation, and one of its chief attractions is its literary style. Such criticism as we offer must needs be detailed. For example, in defining the urinogenital organs of the mammal, the uterus masculinus is regarded as the persistent lower end of the Müllerian duct, with an accompanying illustration which most nearly recalls the condition in the rabbit. It might have been advantageous to point out that in this animal the organ generally thus named has been proved, by von Kölliker, Pallin, and others, to be a product of fusion of the vesiculæ seminales, and no uterus masculinus at all. Similarly, a little more precision might well have been given to both description and figure of the crayfish nervous system, by directing attention to the approximation of ganglia about the sternal artery, which this genus so instructively exhibits, as a determining feature of the decapod type. With the crayfish, again, the statement that the "gastrolith" "is supposed to form a reserve of calcareous matter to supply material for the new armour formed after ecdysis" is most certainly erroneous, and mention might rather have been made of the evidence for its association with this very function. Nor is the author more fortunate in his treatment of the decapod mandible, the wholly endopoditic nature of the "palp" of which cannot be maintained in knowledge of the facts recorded by Boas. And when we come to questions of doubt, we cannot accept the declaration of the supposed composite nature of the "cerebral ganglion-pair" in Anodon, deduced, as it would seem to be, by analogy from Pelseneer's statements for Nucula.

As to terminology, while the author is at most points sound, we consider him in error in the term "demibranch" as defining the gills of sharks; *hemi*branch it should surely be, since the root noun is Greek. Again, we much prefer the term *thoracic* to dorsal, as applied to the mid-trunk vertebræ of the mammal; and while we consider the description of the mammalian coracoid inadequate, we can only refer to the statement that the corpus callosum is characteristic of the mammalian brain as misleading, since the Eutheria alone possess it as now defined, viz. as a tract of neopallial commissural fibres invading the alveus.

The foregoing amounts almost to hypercriticism, where all else is so well done; and we would rather congratulate the author on the production of a book which, while professedly written up to the requirements of an examination system, is thoroughly trustworthy and eminently readable and instructive. It fully realises our expectations, expressed on reviewing its companion volume (NATURE, vol. lxii. p. 364); and, as an additional recommendation, it may be said that, in order to ensure clearness and continuity, details are in places suppressed, reference being given to authoritative sources whence they may be found already described.

There is an interesting erratum of a page and a quarter which calls for special comment, viz. a corrected figure and description of the synangium of the frog,

which, as now described, is in line with previous knowledge and most recent investigation. The figure in the first volume which it is to replace, incomprehensible as it stands, is now admitted by the author to have been due to confusion, in the attempt to reconstruct his own rough drawings during the intervals of military duty. If only for this we forgive him, despite his somewhat emphatic contentment with the original, now condemned. An attractive elegance is a leading feature of this book, and by this it is calculated to draw the reader to its subject. In this respect it contrasts both forcibly and favourably with the baldness of expression and lack of culture which characterise many of its would-be competitors.

THE CLASSICS OF PHYSICAL SCIENCE.

Scientific Memoirs. Edited by J. S. Ames, Ph.D. Fifteen volumes, prices varying from .60 to 1.00 dollar. each. (New York: American Book Company, 1898 to 1902.)

IT is refreshing to meet with this series. Not that the contents are novel, though recent things are not lacking. It is the aim of the series which is stimulating. Our students are gradually being degraded into a reliance upon text-books for nourishment instead of being brought up on a study of scientific classics. It was not ever thus. Time was when text-books were almost unknown, and knowledge of science had to be acquired by a study of original sources. The more modern craze for, and reliance upon, examinational tests has altered all that. Nowadays a man must know a little bit of every branch of the rapidly extending circle of sciences in order to take a county scholarship or a degree. And text-books spring up by the dozen to supply the very special wants of any newly created examination. It is possible, and it is to be hoped, that the new regulations in the University of London will tend to remedy this state of affairs. Much greater stress is to be laid upon a knowledge of recently published work, and the habit of mind that is so induced is bound to be a healthy one. We wish, too, that for the less recent workmen were more encouraged to put text-books on one side and study some one branch at least in the original memoirs.

This handy series in fifteen volumes is a move in the right direction. It consists of translations or reprints (in English) of memoirs dating from the rise of physical science to the present day. Each volume is confined to one subject, has a separate editor, who writes a very short preface—in part historical, in part elucidatory—and also a brief biographical sketch of each of the writers whose memoirs are selected from. The first volume consists of papers by Gay-Lussac, Joule, and Wm. Thomson and Joule on the "Free Expansion of Gases." In the brief introductory sketch it might have been well if the editor had pointed out the essential distinction between the earlier and the later experiments. Thus, while the absence of a fall of temperature in Gay-Lussac's experiments is so far a proof of Mayer's hypothesis, its absence in Joule and Thomson's experiments would not have proved it. In fact, the editor is labouring under a very common mistake in thinking that the experiments all satisfy the condition of zero performance of external work; this is the case in the first but not in the last. It is a pity that the expression "free expansion" is not reserved for cases which satisfy the above condition, and some other term (*e.g.* throttle expansion—the term of the refrigerating engineer) be employed where the conditions are those which obtain in porous plug experiments or the "wire drawing" of steam.

The other volumes are as follows:—

Vol. ii. "Prismatic and Diffraction Spectra." Papers by Fraunhofer and Wollaston.

Vol. iii. "Röntgen Rays." The now historical papers of Röntgen and Stokes (the Wilde Lecture) and J. J. Thomson.

Vol. iv. "The Modern Theory of Solutions." Pfeffer, van 't Hoff, Arrhenius and Raoult.

Vol. v. "The Laws of Gases." Robert Boyle and Amagat.

Vol. vi. "The Second Law of Thermodynamics.' Carnot, Clausius and Thomson.

Vol. vii. "The Fundamental Laws of Electrolytic Conduction." Faraday, Hittorf and Kohlrausch.

Vol. viii. "The Effects of a Magnetic Field on Radiation." Faraday, Kerr and Zeeman.

Is it a fact, as stated by the editor, that in the Hall effect "the stream lines of an electric current flowing through a thin conducting sheet transverse to a magnetic field are deflected"? That the lines of electric force are deflected is, of course, certain; but the two statements are not equivalent.

Vol. ix. "'The Laws of Gravitation." Newton, Bouguer, Cavendish, with abstracts from others.

Vol. x. "The Wave Theory of Light." Huygens, Young and Fresnel.

Vols. xi. and xii. "The Discovery of Induced Electric Currents." Joseph Henry and Faraday.

Vol. xiii. "The Foundations of Stereo-chemistry." Pasteur, van 't Hoff, Le Bel and Wislicenus.

Vol. xiv. "The Expansion of Gases by Heat." Dalton, Gay-Lussac, Regnault and Chappuis.

Vol. xv. "The Laws of Radiation and Absorption." Prévost, Stewart, Kirchhoff, and Kirchhoff and Bunsen.

The editor attributes to Kirchhoff the first rigorous proofs of the celebrated law connecting emission and absorption. This is the common view; but in the light of Rayleigh's recent vindication of Stewart in the *Philosophical Magazine* this attribution is inadmissible.

It will be seen from the above very brief summary what the kind of selection has been. Other editors might very well have selected differently without effecting any improvement.

If a criticism may be attempted, it is that objection may be easily raised to the abridgment which several of the papers have undergone. Much may, of course, be urged in favour of this pruning when carefully done; but the necessity for it is certainly to be regretted. It recalls the similar process which novels have been obliged to submit to—a process which suggested to *Punch* the brilliant idea of republishing pictures with parts deleted The editors carefully point out, however, when they have applied the knife, and they appear to have used it with care.

At the end of each volume is a bibliography, in which reference to allied papers is made.

With this our task is done. This is not the time to discuss the matter of the papers themselves. Let it only

be said that they are all classics, and we ask the student to decide in favour of reading them in preference to some brief text-book summary. He will find no great mathematical difficulty in any of them which would make it impossible for him to understand them thoroughly without being otherwise helped.

PURE AND APPLIED BACTERIOLOGY.

Traité de Bactériologie pure et appliquée à la Médicine et à l'Hygiène. Par MM. P. Miquel et R. Cambier. Pp. xv + 1059. (Paris: C. Naud, 1902.) Price fr. 45.

THIS work, comprising more than one thousand pages and a comprehensive index, is a valuable addition to the already extensive literature of the subject of bacteriology. As the title of the work indicates, it deals with bacteriology, not only from the purely scientific point of view, but also from the technical and applied, inasmuch as its application to industry and to sanitation forms an important part of the work. The book is divided into four principal divisions. The first division treats of the morphology, the chemical, physical and other conditions concerning the composition, growth and reproduction of bacteria, and capable of affecting them favourably or unfavourably. It deals, further, with the methods used in cultivation, the culture media, their preparation and their physiological action in the human and animal body. In the same division is found an account of the methods of staining bacteria, their spores and cilia, both from cultures and from animal tissues. And lastly, the optical instruments used in the study of bacteria (microscopes, photomicrographs, magnifying glasses, &c.) are treated in chapter ix.

All these subjects are treated in a clear and comprehensive manner, very useful and sufficient for the student of bacteriology, and in many instances brought up to the most recent times, so that both student and original worker have the advantage of the most recent improvements in the methods of the study of bacteria. While, therefore, the reader has in the 236 pages constituting this first part all that it is of real importance to know concerning the most modern methods in bacteriology, he misses a good deal concerning some modern views of the morphology and classification (Migula, Meyer).

The second part, comprising in five chapters about 325 pages, is the one which for the student of medicine and hygiene is the most important, since it describes the different species of pathogenic bacteria of diseases of man and animals.

This part of the book will be found less satisfactory than the first, because in our opinion it is in several respects somewhat imperfect; the descriptions of the different species, their characters and actions might be more detailed; it is deficient in the theories of immunity, and notably in regard to suitable and representative illustrations. The absence of proper and accurate illustrations, not only in this, but in other portions of the book, seems inexplicable. The authors devote time and trouble to teaching photomicrography, yet there is not in the whole book a single photomicrograph to illustrate a single species of the many hundreds described. We have no fault to find with the use of schematic drawings, such as occur in this book, when it is a question merely to illustrate general characters as to the aspect and morphology of the bacteria, but we fail to understand the value of such illustrations as occur in this second portion of the work ("Pathogenic Bacteria"), where, in total disregard of all natural conditions, a few tinted dots or a few tinted lines are here produced to represent cocci or bacilli. Another subject in this section seems to us deserving of explanation. It is this. All text-books, all writers and all those who have contributed to their discovery have recognised and described as "bacilli" the various species that cause "hæmorrhagic septicæmia" in different animals, yet here in this book we are suddenly brought to a full stop, and for no adequate reason, by having all these different bacilli (fowl cholera, swine plague, swine fever, wildseuche, duck cholera, grouse disease, &c.) grouped amongst "Microcoques Pathogènes."

The third and fourth portions of the work (pp. 568–888 and 888–1038 respectively) in our opinion are excellent, both as regards treatment and arrangement, and denote the hand of the master, and considering the known works and reputation of M. Miquel, this is quite what was to be expected. The third part deals with the important processes of fermentations caused by bacteria, as lactic, acetic, butyric, pectic, &c.; with the production of pigment; with the bacteria of air, water and soil; with putrefaction; with the bacteria occurring in the different parts of human and animal bodies, and with phosphorescent bacteria.

The fourth and last part deals with the principal methods of analysis of air, water and soil as practised and applied by the authors and others in their own systematic work; further, with the purification of potable waters; and last, but not least, with the most efficient means of disinfection.

As stated already, these two sections of the book form, by their clear and concise descriptions and by their complete treatment, an advance over all existing books, and we venture to say that the book on this account alone deserves to be, and will doubtless become, of universal use.

There is one further merit in this book not to be taken lightly, and that is the copious references to the original works of other authors, notably French and German. There are references also to English and American workers, but, as is usual with most German and French writers, to which we in England have become by this time well accustomed, references to English and American literature occur rather sparingly and are treated in a somewhat stepmotherly fashion.

E. KLEIN.

OUR BOOK SHELF.

General Investigations of Curved Surfaces of 1827 *and* 1825. By Karl Friedrich Gauss. Translated with Notes and a Bibliography by James Caddall Morehead, A.M., M.S., and Adam Miller Hiltebeitel, A.M. Pp. viii + 127. (Princeton, N.J., U.S.A.: The Princeton Library Publishing Association, 1902.) Price 1·75 dollars.

THIS is an English translation of the classic memoirs of Gauss on the theory of surfaces. The first paper is that which was presented to the Royal Society of Göttingen in

1827, and is still regarded as the most finished and useful introduction to the study of infinitesimal geometry. The translation is based on a copy of the original paper, but in the work of preparing it and the present notes all the other editions were consulted. This is followed by a translation of the abstract presented by Gauss to the Royal Society of Göttingen. Under the title of "*New* General Investigations of Curved Surfaces," the translators next give a paper really written by Gauss at an earlier date (1825), but which was not published until the eighth volume of Gauss's works appeared in 1900. Both papers contain the fundamental properties of what is now known as Gauss's measure of curvature, the theorem that the spherical excess of a geodesic polygon is proportional to the corresponding area on the auxiliary sphere, and the proof that the locus of points the geodesic distances of which from a fixed point are equal cuts these geodesics orthogonally. The paper of 1825, however, contains introductory matter on curvature in a plane which was omitted by Gauss from his 1827 paper, and while, in 1825, Gauss used geodesic polar coordinates only, in 1827 he introduced the notion of generalised coordinates p and q. It will thus be seen that the order in which the papers have been printed is the reverse of chronological order.

A large number of notes have been inserted by the translators, those on the 1827 paper occupying twenty-eight pages. Many of these notes contain proofs of results merely stated by Gauss; others consist of explanatory matter, restatements of Gauss's conclusions, or simple corollaries. The "bibliography" contains a list of 343 papers dealing chiefly with the following subjects:—Curvilinear coordinates, geodesic and isometric lines, curvature of surfaces, deformation of surfaces, orthogonal systems and the general theory of surfaces. A large proportion of the papers listed are of comparatively recent date, thus affording a guide to the literature about curved surfaces which has grown up in the development of methods first laid down by Gauss.

The Elements of Mind. By H. J. Brooks. Pp. xviii + 312. (London: Longmans, Green and Co., 1902.) Price 10*s.* 6*d.* net.

THE author claims to have made the correlation of chemistry physiology and psychology possible by the discovery of the "simple elementary substances of mind" which, according to him, "when compounded with those of force and matter, constitute the mysterious substance we call life." It is not easy to gather his exact meaning, as his definitions of his fundamental terms are partly defective, partly circular. Matter and force he leaves undefined; of life he simply says that he "uses it in its ordinary sense." Mind—when not further defined by a restricting adjective—is "everything that is not matter," a definition which would include, *e.g.*, space, time and the series of natural logarithms. As an instance of a definition which is circular as well as obscure, "By Ego I mean that which is known as the personality of the brain. . . . Personality I employ in the ordinary sense of a person's physical and mental characteristics." Substance, again, should have been defined with special accuracy by a writer who attaches so much importance to his professed discovery of the "elementary substances" of mind. Yet all that Mr. Brooks has to say of it is that "substance is philosophically described as that which exists and remains." Now space and time may be said to "exist and remain"; are they substances or are they not? Mr. Brooks, of course, knows whether he means to say that they are, but a reader is nonplussed. And finally, what exactly does Mr. Brooks mean by an "element"? By "elements of matter," as his examples show, he means chemically undecomposable constituent parts; but what exactly are meant by the "elements" of force, which "scientists with somewhat less success have described"? So far as the absence of precise definition permits us to form a judgment, Mr. Brooks's doctrine seems to agree with the "mind-stuff" theory of W. K. Clifford. He quotes Prof. James's trenchant refutation of this theory of the composition of a unitary consciousness out of atomic constituents and attempts to turn its edge. He does not, however, seem to realise its full force. The case of "light" is no exception to James's contention that "all the combinations which we know are effects wrought by the units said to be combined" upon something other than themselves. Still less is the relation between an organism and its members the same as that between an aggregate and its parts. I confess that I have been unable to discover in Mr. Brooks's book any one consistent theory of the relation between his elements and the single whole which he calls the "greater Ego." Sometimes this whole is spoken of as controlling, dominating and using the elements, sometimes as built up by their mechanical interaction. So with his general metaphysical theory. He appears sometimes to hold that "mind," "force" and "matter" are things which can compound quasi-chemically, sometimes that they are different "aspects" of a single reality. Where I do understand him, he appears to be expounding in novel language a psychology of the extreme associationist type, though not without moments of deeper insight in which he seems to uphold the ultimate identity of mind and body. A. E. T.

A Graduated Collection of Problems in Electricity. By Prof. Robert Weber, D.Sc. Translated from the third French edition by E. A. O'Keeffe, B.E., M.I.E.E. Pp. xv + 351. (London: E. and F. N. Spon, Ltd.; New York: Spon and Chamberlain, 1902.) Price 7*s.* 6*d.* net.

THIS book is intended to be a help to the teacher of physics, and consists of a collection of problems of varying difficulty in almost all the branches of electrical work. The third edition differs chiefly from the previous ones in the inclusion of some fresh problems and in the careful revision and correction of errors which has been made. The author has adopted the plan of giving the solution immediately after each problem, and though objections may be urged against this method, we think on the whole it is the most satisfactory for a book of this kind. Those interested in electricity from its practical side will regret that most of the problems are of an academic character. Thus, to quote one example, the section on glow lamps gives the impression that lamps are usually made for 40 or 50 volts and that lighting is carried out by means of primary batteries. Occasionally one comes across a problem in which the data are not sufficient in reality. Apart from a few minor defects of this sort, the book is a very useful one, as the questions are well calculated to show whether or not the student has really grasped the meaning of the work he is doing, which should be the principal aim of a teacher. The addition of a short section on units and a number of tables enhances the value of the work. M. S.

Junior Chemistry and Physics. By W. Jerome Harrison. Pp. vi + 224. (London: Blackie and Son, Ltd, 1902.) Price 1*s.* 6*d.*

SOME of the fundamental principles of physics and chemistry are simply described in this book. Common objects are used as subjects of observation and experiment, and an attempt is made to show the scientific aspects of familiar things. The first few pages seem out of place in a book of this character. Pupils beginning the study of science ought not to be troubled with such statements as "The universe is composed of matter," "We have given the name of *ether* to an extremely rare kind of matter," "Matter has extension," "Matter is indestructible," &c. These subjects belong to the later stages of natural philosophy.

LETTERS TO THE EDITOR.

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

Penetrating Rays from Radio-active Substances.

THE permanent radio-active substances uranium, thorium and radium all give out two types of rays, one easily absorbed and non-deviable by a magnetic field and the other more penetrating in character and deviated by a magnetic field. In addition to these rays, Villard, using the photographic method, first drew attention to the existence of some very penetrating rays from radium non-deviable by a magnetic field. This result was confirmed by Becquerel.

I have recently examined all these radio-active substances by the electrical method, and have found that thorium, and also the excited radio-activity produced by thorium and radium, emit some rays as penetrating in character as those from radium. Uranium, in comparison with thorium and radium, emits little, if any, of this radiation.

These rays are extraordinarily penetrating in character, and pass readily through great thicknesses of matter. They are certainly as penetrating as the most penetrating rays given out by a hard X-ray tube. The amount of ionisation produced by them is only a very small fraction of that produced by the other two types of radiation. Using testing vessels of ordinary size, the ionisation due to the penetrating rays is of the order of 1 part in 100 of that due to the deviable rays and 1 part in 10,000 of that due to the easily absorbed rays.

In the experiments on radium, 0·7 gram of radium chloride, of activity 1000 times that of uranium, was used. The radiation from this, after its passage through 1 cm. of lead, caused a rapid movement of the needle in the sensitive electrometer employed. The radium was placed in a thick-walled lead vessel and a piece of aluminium waxed tightly over the top to prevent the escape of the emanation. The following numbers illustrate the diminution of the rate of leak in a testing vessel, placed above the radium, with the thickness of the lead traversed by the radiation :—

Thickness of lead.	Current.
·72 cm.	1
·72 + ·62 cm.	·60
,, + 1·24 ,,	·37
,, + 1·86 ,,	·25
,, + 2·50 ,,	·16

The current with ·72 cm. of lead over the radium is taken as unity. It will thus be seen that the current falls off approximately in a geometrical progression with the thickness traversed, and that after passing through 1·86 cm. of lead the intensity is reduced to about one-quarter.

The following table shows the thickness of different metals traversed before the intensity is reduced to one-half :—

Metal.	Thickness in cm.
Mercury	·75
Lead	·9
Tin	1·8
Copper	2·2
Zinc	2·5
Iron	2·5

Assuming this law of absorption to hold, the rays would pass through a thickness of about 7 cm. of lead, 19 cm. of iron and about 150 cm. of water before the intensity would be reduced by absorption to one per cent. of its original value.

The amount of the penetrating radiation from thorium is about the same as for radium, taking into account the ratio of their radio-activities. As the radium employed was about 1000 times as active as thorium, it was necessary to work with a kilogram of thorium nitrate to obtain about the same amount of rays as from the ·7 gr. of radium.

Experiments were also made to see if the excited radio-activity, due to thorium and radium, which gives out deviable and non-deviable rays, also emits these penetrating rays. In order to get measurable effects, it was necessary to obtain intense excited activity. For this purpose a zinc plate was exposed as kathode in a closed vessel containing 300 gr. of thoria. A lead wire was also made very active by exposure as kathode for six hours in a vessel containing a large amount of radium emanation, obtained by bubbling air through a solution of radium chloride. The excited radiation from these two sources was found to include rays about as penetrating in character as those from radium and thorium. The intensity of these rays diminished with the time, rapidly for radium and more slowly for thorium excited radiation. This diminution with time is probably directly connected with the rate of decay of the other known types of radiation from excited bodies.

Since the penetrating rays are present in thorium and radium, and also in the excited radiations due to these bodies, and are absent in uranium, it seems probable that the penetrating rays in both radium and thorium are due to the excited radio-activity, produced in the mass of the compound by the emanations which are unable to escape into the air. According to this view, the production of penetrating rays is a function of that portion of radio-active matter which causes excited radio-activity.

Connection between Absorption and Density.—Some experiments were made to see how the absorption of the rays by matter varied with the density. The coefficient of absorption λ was determined by noting the ratio of the intensities of the rays after passing through a known thickness of matter. The following table illustrates the results :—

Substance.	Penetrating rays.		Deviable rays from uranium.	
	λ	$\frac{\lambda}{\text{density}}$	λ	$\frac{\lambda}{\text{density}}$
Water	·033	·033	—	—
Glass	·086	·035	14·0	5·7
Iron	·28	·036	44	5·6
Zinc	·28	·039	—	—
Copper	·31	·035	60	7·7
Tin	·38	·052	96	13.2
Lead	·77	·068	122	10·8
Mercury	·92	·068	—	—

A comparison table on the right is added for the deviable rays given out by uranium. It will be seen that the quotient of absorption by density is in neither case a constant, but the differences are no greater for the non-deviable penetrating rays than for the deviable rays of uranium. It is interesting to observe that the value of λ divided by the density is for both types of rays twice as great for lead as for glass or iron. It will be seen from the above table that the penetrating rays from radium, compared with the deviable rays of uranium, pass through a thickness of glass about 160 times greater for the same reduction of intensity.

Comparison of penetrating Rays with Röntgen and Kathode Rays.—The question at once arises as to whether these very penetrating rays are projected particles like kathode rays or a type of Röntgen rays. The fact that the penetrating rays are not deviable by a magnetic field seems, at first sight, to show that they cannot be kathode rays. I have repeated the experiments of Villard, and have been unable to obtain any appreciable deviation of the rays, which had passed through ·6 cm. of lead, even in a very strong magnetic field. The photographic method was used, and four days' exposure of the plate was necessary to get an appreciable impression. In some other respects, however, the rays seem more closely allied to kathode than to Röntgen rays. It is well known that Röntgen rays produce much greater ionisation in gases like sulphuretted hydrogen and hydrochloric acid gas than in air, although the differences in density are not large. For example, sulphuretted hydrogen gives six times and hydrochloric acid gas nine times the conductivity of air. On the other hand, with kathode rays the conductivity observed is only slightly greater than for air.

The experiment was made of filling the testing vessel with sulphuretted hydrogen, when it was found that the current for the penetrating rays from radium was only slightly greater than for air. Both this experiment and the results for the variation of absorption of the rays with the density of matter seem to show that the penetrating rays have a closer resemblance to kathode than to Röntgen rays.

It must, however, be remembered that the observations on the relative conductivity of gases and the relative absorption of

metals for Röntgen rays have only been determined for rays far less penetrating in character than these rays from thorium and radium. Benoist has shown that the relative absorption of Röntgen rays by matter depends to a large extent on the kind of rays employed. "Hard" rays give quite different ratios from "soft" rays. For penetrating Röntgen rays the absorption of the rays by a *given weight* of the elements is a continuous and increasing function of their atomic weights. From the curve of absorption, given in his paper, the variations of absorption with density are much greater for Röntgen rays than for the penetrating rays from radio-active substances.

A very important question arises in discussing the character of these penetrating rays. According to the electromagnetic theory, developed by J. J. Thomson and Heaviside, the apparent mass of an electron increases with the speed, and when the velocity of the electron is equal to the velocity of light its apparent mass is infinite. An electron moving with the velocity of light would be unaffected by a magnetic field.

It does not seem at all improbable that some of the electrons from thorium and radium are travelling with a velocity very nearly equal to that of light, for Kaufmann has recently determined the velocity of the most penetrating deviable rays from radium and found it to be about 95 per cent. of the velocity of light.

The power of these rapidly moving electrons of penetrating through solid matter increases very rapidly with the speed. From general theoretical considerations of the rapid increase of mass with speed, it is to be expected that the penetrating power would increase very rapidly as the speed of light was approached. Now we have already shown that these penetrating rays have very similar properties, as regards absorption and ionisation, to rapidly moving electrons. In addition, they possess the properties of great penetrative power and of non-deviation by a magnetic field, which, according to theory, belong to electrons moving with a velocity very nearly equal to that of light. It is thus possible that these rays are made up of electrons projected with a speed of about 186,000 miles per second.

An interesting speculation arises from the experimental observation that the excited radiations from bodies include these very penetrating rays. Elster and Geitel have recently shown that excited radio-activity can be produced from the atmosphere by exposing a negatively charged wire in the open air. This excited activity is very similar in properties to that produced by thorium and radium. Since the earth is negative with regard to the upper atmosphere, the surface of the earth is itself made radioactive. From the nature of the phenomenon, it necessarily follows that, not only the surface of the earth, but also the whole interior surface of buildings is covered with an invisible deposit of radioactive matter. From the close similarity in the nature of this excited activity from the air with that from radio-active bodies, it is not improbable that the excited radiations from the air include also some of the penetrating rays. If this is the case, our bodies must be continually subject in a small degree to something very like the Röntgen ray treatment, which is now so popular in medical circles. It would also follow that the "spontaneous" ionisation of air, observed in closed vessels by Elster and Geitel and C. T. R. Wilson, may be due, in part at least, to the presence of these rays, which so readily pass through the walls of the containing vessels.

E. RUTHERFORD.

McGill University, Montreal, July 6.

The Future of the Victoria University.

THE interesting contribution on the subject of the Victoria University which Prof. Schuster has made to your columns (July 19, p. 252) invites a few words of reply from one who does not regard the possible disruption of the University with the same complacency.

It may be unknown to many readers of NATURE that the proposals which would disband the University arose in such a way as to preclude that close and careful deliberation on the future of the University and its colleges which would have resulted in a peaceful maintenance of the *status quo* or in a harmonious process of separation. We should otherwise have been saved from the unfortunate situation in which the University is now placed, when one of the colleges and its county is left standing alone for the maintenance of the University.

I refer to this because it might be supposed that the existing state of affairs was the outcome of something like a quarrel. There has been no quarrel; the three colleges of the Victoria University have worked together with a degree of smoothness and good feeling that might seem hardly possible to those who know the strong local sentiment of the two counties and the three towns. There have indeed been many controverted questions in the University history, but the lines of party have, I think, been usually independent of the colleges.

The question of disruption having been raised in such a way that the University itself could not consider it by means of an unpledged tribunal, the Yorkshire College, believing the movement to be detrimental to the interests of education, desired that there should be a Government inquiry by means of a Royal Commission or other body of high authority. This proposal has not been accepted by the majority of the University Court, and as the matter rests now we have the application of Liverpool for a university formally opposed by Yorkshire and formally approved by Owens College, subject to Manchester being also allowed an independent university.

I have no wish to enter here upon the general question of the relative merits of single college and federal universities, but I think there is something to be said on another question of more immediate practical importance, and that is, whether an action so grave as the disestablishment of a university should not be the subject of a strict and impartial public inquiry.

It is true, no doubt, that the Privy Council may be trusted to give a careful and impartial consideration to the question before it, but in the ordinary course of things that would not involve a public inquiry, and the grounds on which any decision was reached would not be made known.

I believe that the future of the Victoria University is a question not affecting that University alone. It raises the much greater issue of the future of university organisation in England, and it seems to me to be of the first importance that the real grounds, if there are any, for the disruption of the federal Victoria University should be clearly set forth in evidence and endorsed by competent authority.

Prof. Schuster says that "the Victoria University is now practically an examining body, which unites all disadvantages." That is just the sort of statement I wish to see sifted by an impartial tribunal. Many of us would say that such a statement cannot be serious; it seems so exaggerated.

It is proposed to dissolve a great educational corporation which after twenty-three years of hard work has acquired real momentum and has come to be recognised as a factor in educational affairs not inconsiderable when compared even with the older universities. I am one of those who believe that a factor of this particular kind has been and is one of the most urgent needs of our time. I believe also that the defects of the Victoria University, which are undoubted, might be largely rectified by a less drastic process than disruption, and that with a revised constitution the University might continue to exist with greater freedom and ease for its constituent colleges and with undiminished effect in their collective action as an enlightened "modern" force on English education.

Surely at least the question is worthy of the most careful consideration and is one that calls for an open inquiry.

In conclusion, I deplore the haste which has been made by advocates of disruption to convince the public of the defects of a University which after all may be obliged to continue its existence.

ARTHUR SMITHELLS.

July 14.

IN writing about the future of the Victoria University in a scientific journal I was anxious to avoid all questions which are immaterial to the main point. Prof. Smithells's letter deals mainly with side issues. The lines of cleavage at our board meetings interest no one but ourselves, and it does not matter now whether Liverpool might or might not have proceeded in a more academic manner.

The position at present is this:—The two senior colleges, representing about three-quarters of the University, believe that independent universities will in future be able to carry out their educational work better than the present federation. Prof. Smithells thinks that we ought to have accepted the proposal of the Yorkshire College to have the whole question referred to a Royal Commission. But surely the only course likely to be followed by men who know their own minds is to ask for what they want; at any rate, it is the only way to get it. It is fortunate, however, that Prof. Smithells's predilection in favour of a federal university may yet be satisfied. Yorkshire is quite large enough to supply the material for a federation, and as an

experimental philosopher he ought to rejoice at the possibility of having two rival systems put to the test in two neighbouring counties. Prof. Smithells's reference to the momentum acquired by the Victoria University is not a happy one, as he ought to know that if a moving body separates under the action of internal forces, momentum is conserved, while kinetic energy is increased.

As regards the concluding sentence of his letter, it seems to me that while advocating public inquiry by Royal Commission he deplores public discussion before the only tribunal which is competent to deal with this question. It is to men who have had practical experience of university teaching, or who by helping to advance knowledge have acquired a right to speak with authority on the organisation of a teaching university, that I addressed myself in writing to you on the subject.

ARTHUR SCHUSTER.

Science and the London Matriculation Examination.

THE late June matriculation examination of the University of London being the last general examination for all candidates under the old regulations, it may be worth while to note one or two things revealed by it.

(1) Out of just under 3000 candidates, fifteen only gained a place in the honours division, but none of these were from what we should recognise (in the accepted parlance) as "public schools," and no female name appears in that division.

(2) The great public schools are represented only by Harrow, Westminster and Shrewsbury (with five names between them); and if we extend the connotation of the term "public school" to include such schools as the great day-schools of the metropolis, such semi-day-schools as Dulwich and Highgate and such public schools of the second rank as Felsted, Repton and Epsom, we can only (with a liberal interpretation of the term) accredit them with somewhat less than sixty names in the whole list. More exactly, the number one counts is fifty-seven, of whom *only four represent an "optional science,"* the remaining fifty-three having offered an "optional language."

These facts seem to represent a poor return for all the *talk* we have heard of late in connection with scientific education. The fair inferences from them seem to be, (1) that the teaching of languages is immensely stronger in this country than the teaching of science; (2) that the University of London as yet scarcely touches the education of the country as represented by the great public schools of England; (3) that, so far as the public schools generally are concerned, science is regarded still as a *πάρεργον* (with the exception of Epsom, and to a less extent the City of London School, St. Paul's School and Clifton College). In some cases, perhaps, it may be inefficiently taught, but in many more it is handicapped by the biassed autocracy of the classical headmaster. Gentlemen of that type even with the best intentions lack real sympathy; and the responsibility for the results (little short of disastrous) must ultimately rest with the governing bodies of the great schools of the country. While this condition of things remains, can we wonder at the dearth of brain-power exhibited by our officers as a body in the late war, or at that development of mere loquacity which so often characterises the utterances of our public men and puts the thinker entirely into the shade? One is inclined to ask the question whether present attempts at educational legislation are likely to prove other than abortive when our legislators for the most part need to be educated to a true appreciation of science, its nature, its aims and its methods.

A. IRVING.

Bishop's Stortford, July 21.

The Recent Fireball.

THE very brilliant meteor which made its appearance at about 10h. 30m. on Sunday night, July 13, is on record, so far as is known at present (July 26), as having been seen from 106 places. A large proportion of these are in the counties of Middlesex, Surrey, Kent and Essex, while isolated accounts come from as far away as Devon, Wales, Lancashire, Lincolnshire and Norfolk. Many reports of the phenomenon give no details whatever; very few give trustworthy data concerning its path in the heavens. The meteor was fortunately seen by Mr. Denning at Bristol, and from descriptions by him and a few other observers who carefully noted the position of the meteor its approximate real path in the air has been computed. At its first appearance the object seems to have been at an elevation of 86½ miles, the place of its final extinction being 52½ miles over the Straits of Dover. The course of 45 miles was over a line 11 miles to the west of one joining St. Omer and Cape Gris Nez. The fireball must have presented a splendid sight to the inhabitants of the district of France over which it passed, and it is greatly to be hoped that some descriptions will be available from there in order that the above result may be confirmed or corrected.

The radiant-point was probably at 316°+30°, which, though a well-known shower-centre in July, does not seem to have provided such a similarly brilliant member during recent years.

The features of the fireball may be gathered from an inspection of some of the descriptions. The brightness was at least as great as that of the moon, this great light being due to the bursting of the meteor, which then gradually faded. A serpentine streak was afterwards visible, fading away in turn. Some portions of this were traced by some observers for a few minutes afterwards. The duration of flight was variously estimated. If an average of two seconds be taken, as seems permissible, the speed would be 22½ miles per second.

WALTER E. BESLEY.

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Sunspots and Wind.

THE Greenwich tables of wind-direction contain much, I think, that is suggestive of sunspot influence. Take, *e.g.*, the days of northerly wind in the first quarter of the year (according to the classification N., E., S., W.).

Curve A shows how their number has varied since 1841. In B, each year-point represents an average of five values (on an enlarged scale). D is a curve for the whole year, similarly obtained. C is the inverted sunspot curve.

(It should be stated that the values prior to 1860 err a little by defect, owing to the manner of dealing with calms, in the earlier table used.)

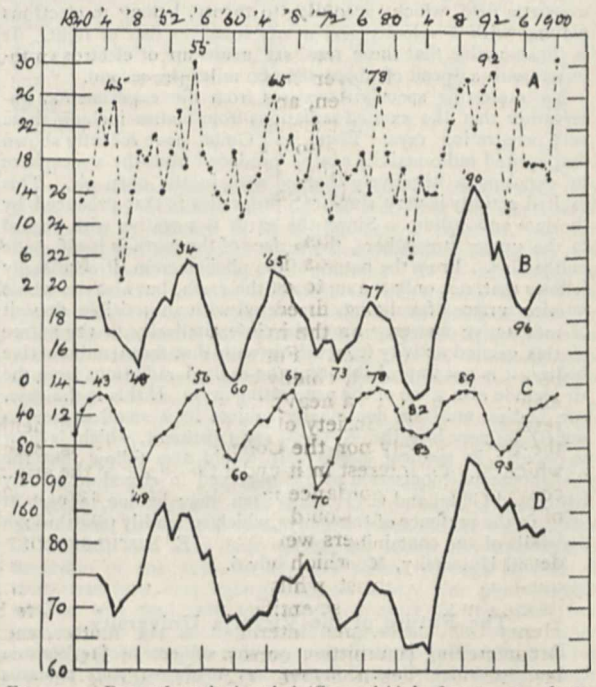

FIG. 1.—A. Days of northerly wind (Greenwich) in first quarter of year (actual variations). B. Result of smoothing A with averages of five. C. Inverted sunspot curve. D. Days of northerly wind (Greenwich) *in year*, smoothed.

Regarding curve B (especially), are we obliged to think that this consistent correspondence through sixty years, showing always less northerly wind about maxima than about the adjoining minima, is a matter of chance? If we are to accept the views given in a recent presidential address (from which, I think, there must be considerable dissent), that is how it is to be interpreted.

A systematic inquiry into the configuration of high-pressure systems in Europe about sunspot maxima and minima, especially in the winter half, would, I believe, be fruitful in results.

ALEX. B. MACDOWALL.

THE CHELSEA PHYSIC GARDEN.

MANY of the readers of NATURE will be aware that the Physic Garden at Chelsea has for some time past been undergoing numerous alterations and improvements in order to enable it once more to take up its old position as a centre of botanical instruction and research. New laboratories and plant-houses have been erected, and on Friday, July 25, these were opened by Earl Cadogan, K.G., who expressed the hope that a long career of usefulness now lay before them. Mr. Hayes-Fisher, M.P., who presided on the occasion of the ceremony and who has throughout the reorganisation taken a most active part in the matter, gave a sketch of the history of the Garden and an outline of the purposes to which it is henceforth to be devoted.

Since its foundation by the Society of Apothecaries some 220 years ago, the Physic Garden has passed through many vicissitudes of fame and fortune, and its history is full of interest to the antiquary and the botanist alike. It has numbered many eminent men amongst its past curators, and as Sir W. Thiselton-Dyer remarked, it gave a curator to that younger physic garden which has since developed into the magnificent institution at Kew. Although it was primarily designed to provide for the proper study of medicinal plants, it soon began to serve as a channel through which new foreign plants became introduced into this country, and it is said (though not without contradiction) that the first cedars of Lebanon to be grown in Britain were the four trees planted in 1683 and formerly thriving in the Garden, of which the last only finally succumbed some two or three years ago.

It seems to have excited some surprise even in those early years to discover how well plants were found to succeed in the Garden, and Evelyn, who visited it in 1685, remarks on the excellent condition of the collections as a whole, and he also incidentally refers to the then novel method of heating the conservatory by heat conveyed subterraneously from a stove situated under the building.

Some fifty years later, Linnæus in 1736 visited the Garden, and he records in his diary that Millar (the gardener) allowed him to collect a number of plants and also gave him some dried specimens. The note is of interest as illustrating the importance which at that time attached to the place. For many years it continued to be more or less used, chiefly by medical students, but its maintenance proved a heavy tax on the somewhat narrow resources of the Society of Apothecaries, and as neither the Royal Society nor the College of Physicians, both of which had an interest in it under the terms of the original conveyance, in accordance with the intentions and wishes of Sir Hans Sloane, would accept the responsibility, the Charity Commissioners were approached with the view of devising a scheme which would provide for the relinquishing of the trust whilst at the same time securing its continuance as a scientific institution. The late Sir Henry Longley became interested in the matter, and a departmental committee, consisting of Sir Henry Longley, Sir W. Thiselton-Dyer and Mr. Spring-Rice, was appointed by the Treasury to inquire into the matter.

The outcome of the various deliberations and negotiations has been the passing of a Scheme in 1899 whereby was ensured the preservation for the practical study of botany in London of a venerable institution and an excellent garden. The Trustees of the London Parochial Charities, subject to certain conditions, provide an annual income of 800*l*., whilst the Treasury, through the Board of Education, subsidises it by a further amount of 150*l*. per annum in consideration of certain rights and privileges thereby attaching to the Royal College of Science. The Garden is administered by the Trustees of the London Parochial Charities, and by a Committee of Management, the seventeen members of which are appointed in accordance with definite regulations laid down in the scheme.

In adapting the Garden to its new purposes various necessary changes have been effected in connection both with the buildings and also with the outdoor department. A strip of land required for the purpose of widening Queen's Road was sold to the Chelsea Borough Council, and this involved the demolition of the old lecture-rooms and curator's house, together with two lean-to greenhouses. Moreover, the main range of plant-houses had fallen into a hopelessly ruinous condition, and their removal was decided upon, the intention being to erect a new range of plant-houses, together with laboratories and a curator's residence, along the revised north-western boundary of the Garden. This has now been done, and it was to witness the opening of these new buildings that the gathering assembled on Friday last.

The laboratories and curator's house have been designed by Mr. G. E. Rivers, of H.M. Office of Works. The laboratories are comprised in a two-storied building which contains on the ground floor a large main class-room, to be fitted up with working tables; out of this open a greenhouse, to be used for physiological purposes, and also two smaller rooms and a convenient dark-room. Upstairs there is a large laboratory which will also be available for lecture purposes, and there are three other smaller rooms, one of which will be appropriated to contain the library and working garden herbarium. The basement of the building has ample convenience for storing and other purposes.

The plant-houses, built by Messrs. Foster and Pearson, are arranged on the corridor system that experience shows to be both economical and easily worked. A single corridor runs along inside the boundary wall, and out of this open three houses designed for stove, intermediate and cool plants respectively. Two excellent pits are connected with the range and are heated by the same boilers. The houses, taken as a whole, are not large, but they will suffice for the practical requirements of the Garden.

Only one of the old glass-houses—a large lean-to on the south-western wall—has been retained. It is an unheated structure, and it was here that Moore, the well-known authority on ferns, grew the greater part of his collection. The rest of the old plant-houses have now, as has already been said, disappeared. The place where they formerly stood is marked by the three small tanks formerly built into them, but which are now situated in the grass in front of the laboratories.

Doubts have often been expressed as to whether it would be possible to grow the plants necessary to enable the Garden to discharge its new functions. A visit to the place would soon dispel any such fears, for it may be at once seen that a very large proportion of the herbaceous species flourish luxuriantly under cultivation there. The fine aspect, with the river frontage, is partly responsible for this, and it is fortunate that for educational uses the greater part of the needed specimens can be provided in the form of herbaceous species. Some of these are of course more difficult to manage than others, but experience shows that by the exercise of discretion in the selection of appropriate material the obstacles imposed by climate and environment in the way of forming a representative collection such as is needed by students can for the most part be easily surmounted.

In the Garden, as in the laboratories, it is intended that provision shall be made for experimental and other investigations, and certain plots of ground will be set aside for these purposes as occasion may arise. And in order that effect may be given to these intentions, general regulations under which the various resources of the Garden may be made as widely available as practicable will be issued early in the ensuing autumn.

A QUARTETTE OF MUSEUM PUBLICATIONS.[1]

BY the issue of the handsome and beautifully illustrated volume standing first on our list, the Trustees of the British Museum have followed the lead set a couple of years ago by the appearance of the "Monograph of Christmas Island," and have thus added a second work describing the fauna of a definite area to the long list of publications bearing their name on the title-page. And there can be little doubt that this new departure will be welcomed by naturalists and by the public at large. In the present instance it has afforded a means of commemorating in a graceful and fitting manner the munificence and generosity of the originator of the *Southern Cross* expedition, and has likewise furnished zoological science with a valuable memoir on the fauna, flora and petrology of the Antarctic. How valuable such a publication is at the present time needs no comment here; and it will accordingly suffice to say that with the "Antarctic Manual" and the present volume the scientific staff of the *Discovery* will, on their return, have an excellent basis for the commencement of their work.

FIG. 1.—Adelia Penguins on their Nests. (*By permission of Sir George Newnes, Bart.*)

The *Southern Cross* expedition, we may remind our readers, was fitted out in 1898 by Sir George Newnes, regardless of expense, the zoological staff consisting of Messrs. N. Hanson and H. Evans. On the return of the vessel, Sir G. Newnes, with characteristic generosity, presented the British Museum with the first "pick" of the natural history collections, desiring that the duplicates should be distributed among other museums, both British and foreign. Unhappily, Mr. Hanson did not survive to superintend the sorting and description of the extensive collections formed during the voyage, and there was consequently considerable difficulty in identifying some of the specimens, more especially in correlating the skulls with the skins of the fine series of Antarctic seals, which formed, perhaps, the gem of the entire collection. Moreover, the loss of an important memoir on the white seal which had been drawn up with great care by Mr. Hanson was an irretrievable misfortune.

The task of describing the different portions of the collection was divided among a large number of specialists, the editorship of the memoirs relating to vertebrates being assigned by the Director of the Natural History Branch of the Museum to Dr. Bowdler Sharpe, while Mr. F. J. Bell prepared for press the invertebrate section of the work. Altogether the work comprises twenty-two separate memoirs, for which the services of as many specialists were secured.

The new forms described in the volume are not very numerous. They include, however, three genera of fishes, each represented by one or more new species, and two specific representatives of a previously named genus. The other new forms are all invertebrates. In this connection it may be observed that there is a want of uniformity between the plans followed by the two editors. In the vertebrate section each new form is indicated as such in the heading, but this is not so in the invertebrate part. It is not a matter of much importance, but still uniformity would have been advisable.

The most generally interesting sections of the book are undoubtedly those treating of the seals and the penguins. The description of the seals was originally undertaken by Captain Barrett-Hamilton, who, we believe, had to leave for South Africa before the volume was finished. Owing to the destruction of the labels, this gentleman was unable to correlate the skins with the skulls, and it was consequently only the latter that could be specifically identified with certainty; his descriptions are, therefore, chiefly limited to the skull and dentition. At a later period it was, however, found possible to assign the skins to their respective species, and their description was undertaken by Mr. E. A. Wilson, now serving on board the *Discovery*. When this identification was made, that eminent artist Mr. H. Grönvold was commissioned to draw the five plates of seals, which were coloured by Mr. Wilson himself and form one of the most striking features of the book. The exclusively Antarctic seals are four in number, namely Weddell's seal (*Leptonychotes weddelli*), the leopard-seal (*Ogmorhinus leptonyx*), the white seal (*Lobodon carcinophagus*) and Ross's seal (*Ommatophoca rossi*), each the sole representative of its genus. Ross's seal, previously known only by the skull, is a most extraordinary-looking creature, recalling, in the curious inflation of the throat, a pouter-pigeon. Captain Barrett-Hamilton comments on the remarkable dissimilarity presented by the dentition of the four species and correlates this with the nature of their food. Specimens of three of the species are exhibited in the Natural History Museum.

The penguins, together with the other birds, are described by Dr. Bowdler Sharpe. They include three species, of which two, the emperor-penguin (*Aptenodytes forsteri*) and the Adelia penguin (*Pygoscelis adeliae*) receive the largest share of attention. Two coloured plates are devoted to the latter, while numerous text-figures (two of which we are enabled to reproduce) illustrate the haunts and habits of both species. The Adelia penguin is a migratory species, which congregates during

[1] (1) "Report on the Collections of Natural History made in the Antarctic Regions during the Voyage of the *Southern Cross*." Edited by R. B. Sharpe and F. J. Bell. Pp. ix + 344; illustrated.
(2) "Catalogue of the Collection of Birds' Eggs in the British Museum (Natural History)," vol. ii. By E. W. Oates. Pp. xx + 400; illustrated.
(3) "Guide to the Galleries of Mammalia in the British Museum (Natural History)." Pp. v + 126; illustrated.
(4) "Guide to the Coral Gallery in the British Museum (Natural History)." By R. Kirkpatrick and F. J. Bell. Pp. v + 73; illustrated. London: Published for the Trustees of the British Museum, 1902.)

the breeding season in enormous rookeries, and special interest attaches to a photograph of the arrival of a party of these birds on the Antarctic land. The curious discovery that these birds as they ascend the cliffs make deep groovings in the solid rocks with their claws was not announced in time to be mentioned in the volume. The eighth and last coloured plate represents the remarkable colour-phases presented by the eggs of MacCormick's skua (*Megalestris maccormicki*).

All concerned in this important contribution to natural history are to be congratulated on the successful completion of a by no means easy task.

Our congratulations must likewise be offered to the author of the second work on our list, the first volume of which has been already noticed in these columns. Since the appearance of the first volume the Museum collection of eggs has received a most important addition by the bequest of the Crowley collection, noted on account of its richness in the eggs of Australian birds. The registration of this vast collection was not completed when the MS. of a large portion of the second volume went to press, so that Mr. Oates has been compelled to add an appendix. The collection will also, we presume, render necessary an appendix to the first volume, if only to include the great auk's egg which forms one of its treasures. Previously the Museum possessed only two bleached eggs of that species, which are entered in the catalogue as valueless.

Even with the addition of the Crowley bequest, the Museum collection is by no means so extensive as is desirable, although it is probably far ahead of any other. To say nothing of many species totally unrepresented, there are many birds—among them such well-known forms as the secretary-bird, the bay vulture and the South African griffon vulture—of which there are not more than two or three eggs in the collection.

Among the special rarities recorded in the volume before us, mention may be made of two eggs of the sanderling (*Calidris arenaria*)—the one from Grinnellland and the other from Iceland—and three assigned to the knot (*Tringa canutus*). Two of these latter (belonging to the Crowley bequest) were taken in Iceland, while the third is one of a clutch of four, said to have been taken with the hen-bird, sent to the late Mr. H. Seebohm from Disco Island. All three specimens are alike; but, according to Mr. Oates, "they bear an exact resemblance in size, shape and colour to some of the eggs of the common snipe. The genuineness of these eggs therefore requires confirmation, but they are probably correctly identified." Here we may call attention to what, in our opinion, is an imperfection in the indexing of the volume. Species of which there is a supplemental notice in the appendix are duly recorded in the index, but this is not the case with genera. It is true that such genera do not receive a separate heading in the appendix, but we nevertheless think they should have been indexed as occurring there; it would have made reference easier.

Other rarities catalogued include eggs of the American noble snipe (*Gallinago nobilis*), two; the Malagasy snipe (*G. macrodactyla*), three; the black jacana (*Jacana nigra*), two; the black-winged courser (*Rhinopterus chalcopterus*), three; the African wattled crane (*Bugeranus carunculatus*), three; the white-winged trumpeter (*Psophia carinata*), two; and the seriema (*Cariama cristata*), three. Of the two species last mentioned, all the eggs in the collection were laid in confinement, those of the trumpeter in Mr. Blaauw's aviary in Holland and those of the seriema in the London Zoological Society's menagerie.

The volume is illustrated by fourteen beautifully coloured plates of eggs, drawn and coloured by Mr. H. Grönvold. Apart from their special interest to oologists, these figures are of great value to the general naturalist as giving him a much better idea of the prevalent type of coloration characterising the eggs of different groups of birds than can be obtained from the figures of exclusively British species. Both author and editor appear to have executed their tasks carefully and conscientiously, and when the remaining volumes are issued the work will not only be invaluable, but absolutely unique.

The works standing third and fourth in our list are of a totally different type from those already noticed, and are intended for the general public rather than for scientific naturalists, although even the latter class of readers may perhaps gain some information from them in regard to those sections of zoology of which they have not made a special study. Before proceeding further we may say a word with regard to the covers and title-pages of these two little works. In the "Mammal Guide" the words "British Museum" are printed in large type and "Department of Zoology" in smaller type, whereas just the reverse of this occurs in the "Coral Guide." Apart from the question of uniformity (which we consider by no means an unimportant one), there seems no doubt that the former style is far the most preferable. It may be added that the address "Cromwell Road, London, S.W.," which appears on the cover of the "Coral Guide" is, in our opinion, quite unnecessary, and not suitable to the dignity and importance of a great public institution.

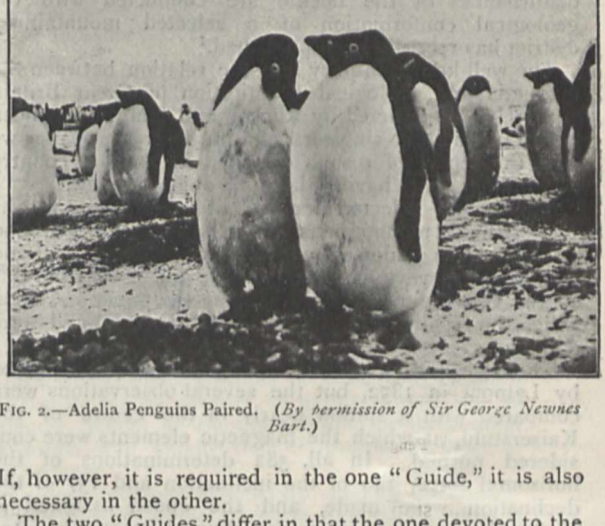

FIG. 2.—Adelia Penguins Paired. (*By permission of Sir George Newnes Bart.*)

If, however, it is required in the one "Guide," it is also necessary in the other.

The two "Guides" differ in that the one devoted to the mammal galleries is the seventh edition, while the other is the first issue; a further difference is to be found in the fact that whereas the names of the authors appear in the second, no such information is afforded in the first. Another point of distinction is the greater prominence given to popular names and the smaller amount of technical detail given in the former than in the latter. In the "Mammal Guide," for instance, the English names of the animals are alone placed under the figures, whereas many of the figures in the "Coral Guide" have only the scientific names, and when English names are given they occupy the second instead of the first place. It is true, as stated in the preface, that it is less easy to avoid the use of technical terms in dealing with the lower invertebrates than when treating of mammals or birds, and popular names are not so readily at hand. We venture to think, however, that more might have been done in this direction than the authors have thought fit to attempt. In any case, the substitution of terms like "hairs" for "cilia," "feathery" for "plumose" and "horny" for "chitinous" could be made without any loss of accuracy

and with advantage to the public. It is extraordinary how limited is the vocabulary of a large portion of even the well-educated section of the public; and it is the too free use of technical terms in the better class of popular natural histories which drives people to those of an altogether inferior description. Another point to which we would draw attention in connection with the "Coral Guide" (which, by the way, includes sponges and various other low invertebrates) is the advisability of omitting the names of describers of particular species or structures. Such names as Wyville Thompson, Hickson, Duerden and Shipley are familiar enough to zoological students, but they are quite unknown to the outside public for whom the book is intended.

A feature of the "Coral Guide" is the wealth and beauty of the illustrations, which render it a most wonderful shillingsworth, altogether apart from its high value as an excellent introduction to the groups of animals of which it treats. A number of new illustrations also characterise the seventh edition of the "Mammal Guide," which, for reasons apparent to those in the "know," the present writer is debarred from either criticising or commending. R. L.

TERRESTRIAL MAGNETISM.

AN interesting paper describing the results of an investigation to determine to what extent magnetic disturbances of the needle are connected with the geological conformation of a selected mountainous district has recently been published.[1]

The well-known inquiry into the relation between the magnetic and geological constitution of Great Britain and Ireland conducted by Rücker and Thorpe has been before us for some six years, and in the present paper we have the report of results obtained in another country and in later years having the same object in view.

The region selected for the observations was the Kaiserstuhl, a mountainous district in the neighbourhood of Freiburg in Baden, of which exact topographical and geological surveys had been made, and it is from this source that the maps accompanying the paper and upon which the results of the observations are exhibited were obtained.

The base station was at Freiburg on the spot occupied by Lamont in 1852, but the several observations were compared with a station nearly in the centre of the Kaiserstuhl, at which the magnetic elements were considered normal. In all, 382 determinations of the horizontal force, 140 of the inclination and 137 of the declination were made, and the epoch assigned is 1898·7, but no corrections for diurnal inequality were made. The resulting disturbances from these observations are shown on a special map of "Isanomalen."

The author arrives at the following conclusions:—(*a*) That wherever the geological conformation is of basalt, there he experiences disturbance of the needle partly due to permanent magnetisation of the basalt; (*b*) that the principal disturbances are caused by compact masses of basalt with a North Pole acting vertically upwards—or nearly so—on the north-seeking end of the needle, and the magnetism of these masses is not due to induction from the earth.

With (*a*) we may concur as to a connection being frequently found between the geological formation of basalt and magnetic disturbance of the needle, but it has been also shown that basalt may be present in large masses and certain forms without causing any such disturbance. The conclusion in (*b*) can hardly be accepted, for it is well known that in the northern hemisphere the north-seeking end of the needle is generally attracted downwards by locally disturbing rocks, pointing rather to induction from the earth as the cause of the magnetisation of basalt.

In order to find an explanation of the causes of the observed disturbances of the needle, pieces of basalt were taken from the surface and from a working quarry, and their several effects upon a compass observed, but no information of importance was obtained from the experiments. The question of the effects of lightning on the magnetism of rocks is also discussed, but dismissed as untenable.

It should, however, be remarked that the author does not look for more than general results from the observations as carried out, but they certainly form the nucleus of a further survey from which more definite results might be obtained as to the connection between geological conformation and magnetic disturbances.

Having considered some of the effects of local magnetic disturbance in Germany, we may now turn to the remarkable effects of such disturbance on the magnetic declination in the United States as shown in the latest chart[1] of lines of equal value of that element for 1902.

This chart is a continuation of the series published by the United States Coast and Geodetic Survey, and gives true isogonals for every degree. An examination of the lines shows that some of the most remarkable disturbances occur in mountainous districts, especially in the State of California. With its lines of equal annual change of the declination this chart is decidedly valuable, both from the practical and scientific points of view.

The values of the magnetic dip and declination given in Father Doyle's pamphlet[2] are the result of eight years' photographic record taken at the Manila Central Observatory during the period January 1, 1890, to December 31, 1897. The position of this observatory has been specially selected with a view to avoiding magnetic disturbances either in the locality or the materials of the building. Curves of the mean hourly variation of the declination for each month of the eight years are given, and also curves of the mean annual and mean semi-annual variation of the dip and declination. The chief interest, however, of the data recorded lies in the values of the secular variation of both elements for the epoch 1887-99. In these we have corroborative evidence of the small secular change of the declination, and the large change which is so marked in the dip, which has taken place during the epoch 1880–1900 at the observatories of Bombay, Batavia, Manila and Hong Kong. A chart of the isogonic and isoclinic lines corresponding to the epoch January 1892 for the region comprised between the Philippine Islands and Southern Japan is appended.

THE "NATURE-STUDY" EXHIBITION.

THROUGH the courtesy of the Royal Botanic Society, the aims of which are by no means so purely social as some of its present interests might suggest, a "Nature-Study" Exhibition is now being held in Regent's Park. Never has there been a better undertaking, nor could one be set on foot, which would do more to bring about a rational system of teaching such as is now looked forward to, whereby the pupils may be keenly interested instead of bored and their work made a labour of love instead of a dreary task.

There have long been in this country those who appre-

1 "Erdmagnetische Untersuchungung im Kaiserstuhl," von G. Meyer. (Published in the *Berichte* der Naturforschenden Gesellschaft zu Freiburg i. Br. Band xii., 1902.)

1 "Chart of Lines of Equal Magnetic Declination and Annual Change for 1902." (Published by the United States Coast and Geodetic Survey, February, 1902.)

2 "Magnetical Dip and Declination in the Philippine Islands." Brief notice of the same by Rev. John Doyle, S.J., of the Manila Central Observatory (1901).

ciate the emotional delights and the intellectual pleasures accruing from a first-hand acquaintance with nature, but the magnitude and success of the present exhibition go to show how widely and how well the value of the study which this demands is becoming recognised as a branch of all general education by those more nearly concerned with it than the naturalist.

THE OPENING CEREMONY.

In the first place, the Duke of Devonshire, who presided at the opening ceremony, which was performed by the Duchess of Devonshire on July 23, said that "the new educational departure," as he termed it, had the "very warmest sympathy" of the Board of Education, of which he is the President. In the case of rural education, he continued, the Board had met with a serious difficulty, for if the agricultural labourer does value education at all, it is only too often merely because it enables him to escape from the drudgery of his existence in the country into the more exciting atmosphere of the towns. In these circumstances it is not surprising that country gentlemen and many farmers have not viewed education and educational progress with any great enthusiasm. The Board of Education was consequently very desirous of finding some means by which education, and more especially elementary education, should be brought into closer relation with rural life and with the occupations connected with the cultivation of the land. It also felt the necessity of making all classes connected with the land feel that education is a thing which is not necessarily antagonistic to, but which ought to be conducive to, their interests.

Within the last three years, the Duke went on to say, the Board received the external assistance which they required by the formation of a very influential committee (the Agricultural Education Committee, of which Mr. Henry Hobhouse, M.P., is the secretary) of members of Parliament and county councils, which drew up certain resolutions which were formally laid before the Board of Education and accepted with much pleasure and satisfaction. The Duke of Devonshire then briefly indicated the changes in the elementary education code and in the directory for scientific education which had been made in accordance with the suggestions thus received. He alluded to the publications impressing upon the managers of schools the importance of making education in the village more consonant with the environment of the scholars, and more especially of encouraging children to gain an intelligent knowledge of the common things which surround them in the country. The lack of teachers is being met by the requirement of the Department that "nature-study" from a practical and experimental point of view shall be taken as one of the subjects for the certificate examination. The Duke also referred to the valuable assistance afforded by county councils, and gave it as the opinion of his Board that "nature-study" may with advantage be introduced into all schools, urban as well as rural. In conclusion, although the value of books as representing accumulated knowledge was ungrudgingly allowed, yet in the opinion of the Duke of Devonshire the study of them may too often be only an exercise of memory and may leave almost untouched the other faculties of the mind, while the intelligent observation and study of the facts of nature is a mental discipline which cannot fail to develop those powers of the mind which it is the object of all true education to discover, to cultivate and to strengthen.

THE EXHIBITION.

The number of the exhibits and the fact that all classes of educational establishments have contributed them is another argument in favour of the contention that the appreciation of "nature-study" as a factor in education is no longer confined to a few enthusiasts. The time has passed when one could only say what might be attempted, now one can point to this training college or to that school and say what has been done. The main object of the Association was to bring the movement to this stage and to collect together as many examples as possible of "nature-study" work or of what goes by this name. Teachers who have taken up such teaching would then be able to improve their methods after an examination of others' endeavours, while those in ignorance of how to proceed or apathetic could obtain the information they required or be spurred on to attack a subject so well worthy of attention.

In order that nothing of value might be excluded, the committee admitted anything connected with natural history teaching, and contented itself with making general suggestions as to how this might be represented at the exhibition. It must be said that the immediate results have far exceeded all anticipation. A more detailed consideration of these may be considered in connection with the chief awards that have been made, and this after a third point showing the importance attached to the "nature-study" movement has been dwelt upon. The judges whose names are given below without hesitation signified their willingness to undertake what has proved an arduous task—Profs. Hall, Miall, Lloyd Morgan, Arthur Thomson and Wallace.

In Group A the Boards of Education and Agriculture are exhibiting their leaflets, and most of the agricultural colleges are represented. Seeing how much work has been done by county councils in the training of teachers, but few of them have sent exhibits; Cheshire, Hampshire and Surrey contribute collective exhibits showing the whole educational scheme of each county, and of these Surrey has received one medal for the general exhibit and another for the individual work exhibited by Tiffin's Boys' School Natural History Society properly coming into Group B (secondary schools). A large number of the latter schools of all grades have sent exhibits. Medals have been awarded to the High School, Arbroath, for drawings illustrating natural history; to St. Paul's School, for the work of the School Field Club; to Streatham High School, of the Church School Company, for a nature-study calendar; to James Allen's Girls' School, Dulwich, for the general exhibit, which contains many interesting water cultures of plants; to Bedale's School, Hants, for its scheme of nature-study; and to the Friends' School at Bootham, York, for its general exhibit, which was chiefly that of the Boys' Natural History Society.

Among the numerous elementary schools, the Chislehurst Road Board School, Orpington, Kent, received a medal for its general exhibit, as did the Arnot Street Board School, Liverpool, for its excursion scheme. The only training college similarly recognised was the House of Education, Ambleside, while among the exhibits of private persons and institutions a medal was given to the Stepney Borough Museum. Two American exhibits, namely, those of the New York Natural History Museum and Philadelphia Training College, also received the highest possible award.

A most important result which will possibly accrue from the exhibition will be the determination of what kind of nature-study teaching is to be recognised as such; for this one must look to the report of the Association after receiving the collective and individual expressions of opinion from the judges. Looking, however, at the exhibits which have received medals, it will be seen that they have in nearly all cases shown evidences of outdoor work or practical dealing with living things upon the part of pupils themselves. The fourth piece of evidence as to the value of the exhibition as promoting nature-study is afforded by the position and standing of

those who have taken part in the conferences or have promised to do so. A short account of some of the addresses and papers is given below.

THE CONFERENCES.

Mr. Hanbury, President of the Board of Agriculture, presided at the first of the meetings on July 24 and spoke of the general educational value of nature-study and of the special dependence of agricultural industry upon habits of careful observation. He further pointed out how his Board and that of Education were working in harmony together, and said with regard to those agricultural colleges which have been undertaking the training of teachers that their work ought to be recognised by the bestowal of extra grants by the Board of Agriculture.

Lord Avebury took as the subject of the first address "The Study of Nature." He attributed a most curious ignorance of common things to the fact that great public schools omit the subject altogether, or devote to it only an hour or two in the week snatched from the insatiable demands of Latin and Greek. Oxford and Cambridge have most excellent science schools, but prizes and fellowships are still mainly given to classics and mathematics; degrees are given there, and now, alas! even at the University of London, without requiring any knowledge of the world in which we live. Our universities give excellent teaching, they prepare learned specialists, but are places of instruction rather than of education. Lord Avebury touched also on early specialisation; on the use and abuse of collections; and the various lines along which nature may be studied.

Mr. Henry Hobhouse, M.P., read a paper on "How County Councils may encourage Nature-Study." Their chief work, he said, lies in the direction of training teachers, and this training, though not necessarily a thoroughly scientific one, should impart the elements of certain sciences, and more particularly a knowledge of the best methods of inculcating habits of observation. Mr. Hobhouse summarised what the county councils had already done, and said that much more still remained to be accomplished. As it was not to be expected that every village schoolmistress would be able to teach nature-study, an arrangement would have to be made for peripatetic teachers to visit groups of small schools: school gardens and school museums would also have to be organised. Useful work in the protection of wild birds might be done by holding classes to which gamekeepers might be specially asked to attend, and much economic nature-study could be taken up.

Prof. Geddes was unable to be present, and his paper was taken as read; its vital points are (1) that nature is a moving unity or pageant of the seasons, not an abstract syllabus of "object lessons" or even dissected "types"; (2) that the essential strategic point for the nature teacher is to give the pupil the joy of nature before the intellectual analysis of it; (3) among immediate practical possibilities, and taking excursions for granted, the essential desideratum to be secured for country and suburban schools without delay and for town schools so far as possible is the school garden, always provided this is designed to show to the full, the living seasonal beauty of its chosen plants and be not a cats' graveyard of labels, however orderly. The introduction of a flower border, however small, into the present desert playground is pleaded for on all grounds, moral as well as intellectual and æsthetic.

Prof. J. Arthur Thomson began his most interesting and suggestive paper by quoting the definition of nature-study given by his friend Prof. Geddes, it is "the habit of observing and thinking for oneself and at one's best, without books or helps, in the presence of the facts and in the open air." Prof. Thomson had next a word to say on the danger of doing nature-study teaching badly and distorting the child's outlook on the world. Given a man or woman with the mood of the naturalist, the country schoolmaster who knows and loves the birds, or the country schoolmistress who knows and loves the flowers, then the course of nature-study—now compulsory—is sure to be healthful. Given, however, a teacher who, through overwork, or preoccupation with other disciplines, or lack of early training, is only coercively, not organically, interested in nature-lore, then Prof. Thomson feared that the result would be very bad indeed. The title of the paper was the "Seasonal Study of Natural History," and a sketch of a seasonal course was given, arranged so that the scholars faced appropriate problems at appropriate times. It was argued that the seasonal order and method of study, though not the easiest, was the most natural. It was the most primitive method, yet the exhibits seemed to show that it was capable of being the most evolved. It followed up the pre-school education of the child, and was justified by physiological and psychological facts. Furthermore, the seasonal method worked exceedingly well in practice, being always relevant to what the pupils are seeing and feeling out of school, facilitating the desirable cooperation of the class in securing the specimens for the actual work, and being readily correlated with other school studies.

Mr. H. Coates illustrated the subject of local museums as aids in the teaching of nature with reference to Perth Museum, in connection with which children's essay competitions are most successfully held.

Lord Strathcona, as chairman at the second conference on July 28, gave an account of work in Canada carried out by the generosity of Sir William McDonald, who has given three-quarters of a million of money. Model farms were touched upon, and Lord Strathcona gave a particularly interesting account of his own work in introducing vegetable culture into Labrador, which had previously been unknown.

Prof. Lloyd Morgan had also a definition to give when dealing with nature-study in elementary education. He said that it was "a means by which simple natural objects and processes acquire *meaning*." Like Prof. Thomson's paper, the whole question is so carefully considered that no brief notice could do it justice. The movement which the meeting was to foster and develop, according to the speaker, is part of that reform of educational procedure which has been in progress for many years. One of the points to be regarded is the patchiness of a child's mind, to whom even the beginnings of science are impossible. The teacher, say a scientific botanist, must not, therefore, get tired of fostering the powers of observation and affording facilities for simple investigation, and instead endeavour to inculcate general laws and principles beyond the comprehension of the child. Technical terms where they are simple nouns and not descriptions are allowable, but after reading a long description of the dandelion taken from a nature-study book Prof. Morgan begged his hearers to stop before they got to "anthers syngenesious."

Mr. Franklin dealt with how to bring children into touch with nature, and the work of the Leicester School Board was described by Mr. Major. Miss Mary Simpson, in speaking of the teacher as an observer, suggested that if the teacher had reached that stage most of the difficulties would be gone. Finally, at this meeting, which during the latter half was presided over by Sir Joshua Fitch, Mr. John Evans urged the advantages of using trees as a means of nature-study.

On Tuesday, July 29, the chair was taken by the Lord Balfour of Burleigh, K.T., Secretary for Scotland. He gave an account of the excellent progress of the "nature-study" movement started several years ago across the border. "Nature-study," he said, must be rather looked upon by the children as recreation; their minds must not be filled with facts, but must be taught to make observations and to investigate. If this were done it would redound to the credit of education in all countries.

Mr. Choate, the American Ambassador, in introducing Prof. Albert Bickmore, of the Natural History Museum, New York, added the weight of his testimony to the value of the work in hand. After this Prof. Bickmore briefly explained his methods of visual instruction, at first geographical and now combined with nature-study; and after the conference in the club-room the audience adjourned to the museum in the gardens to see a series of views thrown upon the screen with the lantern to illustrate further Prof. Bickmore's methods, with children, older scholars, university students and teachers. He began his work with a class of 28, and last winter the attendance at his lectures was 26,910.

Mr. Herbert Morrell, M.P., brought forward many trenchant and amusing examples of the value of "Nature-Study in relation to Rural Pursuits."

Prof. Hall, of Wye College, in defining the "Proper Attitude of the Teacher," had some excellent points to lay before his hearers. He appeared, however, to think, contrary to others interested in the subject, that "facts" must be accompanied by "ideas," which brings it near to elementary science teaching. The subject taken from the standpoint of a teacher in an elementary school and considered in a paper by Mr. G. H.

Rose, headmaster of Caterham Board School, has much in it that others less nearly connected with the work might fail to recognise, and will prove well worthy of careful examination when it is printed.

The remainder of the programme is as follows :—

Thursday, July 31, chairman, Sir George Kekewich, K.C.B., Secretary to the Board of Education. Address on "Nature-Study in Colleges and Higher Schools," by Prof. Miall, F.R.S. Selected speakers :—"Nature-Study in Girls' Secondary Schools," Miss Mary Gurney ; "Plant Life as Nature-Study," Mr. Scott Elliott ; "School Gardens," Mr. T. G. Rooper; "Geology as a Branch of Nature-Study," Prof. Grenville Cole.

Friday, August 1, chairman, the Right Hon. Sir W. Hart-Dyke, Bart., M.P. Address on "The Training of Teachers in Nature-Study," by the Rev. Canon Steward. Selected speakers :—"The Relation of Nature-Study to School Work and to the Home," Sir Joshua Fitch ; "Nature-Study as an Element of Culture," Mr. M. E. Sadler ; "School Rambles and the Training of Teachers," Mr. J. H. Cowham ; "The Present Work of the County Councils," Mr. H. Macan.

In conclusion, it must be said that the work of bringing the undertaking to such a successful issue has taken the whole time and energy of Mr. J. C. Medd, the honorary secretary, who has had at his disposal the great experience and the marvellous tact of Sir John Cockburn, the chairman of the Association ; Mr. Cundall, of the Victoria and Albert Museum, Mr. A. T. Simmons and Mr. A. Taylor, H.M. sub-inspector, to whom the task of arranging the exhibits was allotted, must also be given a full measure of praise. WILFRED MARK WEBB.

NOTES.

THE members of the new Order of Merit were entertained at dinner by the Athenæum Club on Friday last. Science was represented by four of the twelve members of the Order—Lord Rayleigh, Lord Kelvin, Lord Lister and Sir William Huggins. Lord Avebury (trustee of the club) presided, and among other members present were many leaders of science, art and literature.

A NEW laboratory for the study of experimental psychology has been instituted at King's College, London. The laboratory will be in charge of Dr. W. G. Smith, under Prof. Halliburton's general supervision.

THE *Times* states that during her passage from Kronstadt to Kiel the Italian cruiser *Carlo Alberto* carried out some important experiments in wireless telegraphy under the personal direction of Mr. Marconi. Signals were exchanged with stations 2000 kilometres distant, 1000 kilometres by sea and 1000 kilometres by land.

PROF. F. A. FOREL writes from Morges to say that he has made inquiries into the report that after a shower of rain at Frauenfeld, Canton Thurgau, Switzerland, the ground was covered with a thin layer of ashes of greyish-blue colour (p. 306). A teacher of natural history at Frauenfeld has informed him that the news was misleading and that the dust was not of volcanic origin.

A TELEGRAM from Kingstown, St. Vincent, states that there have been two slight eruptions of the Soufrière volcano since July 21, and an earthquake in the north-eastern part of the island. The cable steamer *Newington*, which is working eighteen miles to the north, reports that the depth of the sea has increased in that locality to a mile and a quarter.

THE *Daily Mail* correspondent at Madrid reports that two large cliffs near the town of Calataynd, in Aragon, have fallen down, destroying several houses and injuring many people. A crater has opened in the Pico de Europa mountains, which separate the provinces of Santander and Asturias. A great column of vapour is issuing therefrom, and the people are in a state of alarm, fearing a volcanic eruption. A Central News despatch from the Azores states that there has just been a terrific submarine volcanic eruption off Horta. Masses of rock in a state of incandescence were thrown up, and the people became panic-stricken. A Reuter despatch from San José, Costa Rica, states that there has lately been unusual activity among the Costa Rican volcanoes, considerably affecting the land in the neighbourhood of Terraba. From New York another Reuter despatch records that an earthquake shock was felt shortly after midday on Monday, July 28, in parts of Nebraska, Iowa and South Dakota, but no damage was done. Three shocks have also occurred in the Lompoc Valley, California, since Sunday evening, July 27. Cracks appeared in the earth and there was widespread panic among the inhabitants. Vibrations have also been felt at other places in California.

THE *Westminster Gazette* on Saturday last devoted a column and a half to the Armstrong-Orling system of wireless telegraphy. We have referred on two or three occasions to this system, the receiving apparatus of which was described in these columns last December. We now understand that a company is about to be registered to manufacture and supply the transmitters and receivers. It is stated that apparatus has been worked out suitable for wireless signalling up to a distance of twenty miles, the ground being used as a conductor, and that it will be sold, at a very cheap rate, for private installations. Details of a technical nature are, however, entirely wanting, and without these it is impossible to form any opinion of the system. So far as we know no description of the transmitter has been published, although we were told eight months ago that it was proposed to read a paper upon it before one of the scientific societies. We have also consulted the patent files, but there is nothing in Mr. Orling's name as yet printed which is specially novel or remarkable. It is therefore advisable to wait until further particulars are available before deciding whether the "programme of amazing promise" sketched in the *Westminster Gazette* is likely to be realised.

WE regret to see the announcement of the death of the Rev. Charles E. Searle, master of Pembroke College, Cambridge, and formerly college lecturer in mathematics.

IN the House of Commons on Monday, Mr. J. A. Dewar asked whether it could be made a condition of the annual grant of 15,300*l.* to the Meteorological Council that the high-level and low-level observatories at Fort William should be kept in a state of efficiency, or whether an additional contribution towards the expenses of properly maintaining these observatories would be considered. In reply, Mr. Balfour said he had been advised it would not be desirable to impose conditions on the Meteorological Council or to inquire into this or that particular observatory. He was not prepared to give an answer to the last part of the question.

THE decision to close the observatory on Ben Nevis was discussed at the general meeting of the Scottish Meteorological Society, held in Edinburgh last week. Lord Maclaren, who presided, said that the observatory would have to be closed because there were no funds available for carrying on the work. He thought it was a case for inquiry, and if the Government appointed a committee to take evidence, probably the difficulties would be overcome. Sir John Murray, as one of the original directors, said it was not their intention to found a permanent institution, but only to make an experiment of high-level observations. The experiment had been most satisfactory in every respect. But the observatory must now be closed unless one of two things happened ; either the State must take over

the observatory, or the directors must be put in possession of 12,000*l.* worth of consols to enable them to carry it on for another meteorological cycle.

PRINCE AUGUSTE D'ARENBERG, president of the Suez Canal Company, has sent a letter to the president of the Liverpool School of Tropical Medicine asking for the cooperation of the school in a concerted effort to cope with the prevalence of malaria in Ismailia, and making a formal request for the services of Major Ronald Ross, C.B., F.R.S., to start operations there against mosquitoes. The committee of the school has acceded to the request, and is making arrangements to enable Major Ross to proceed to Ismailia in September next, when malaria is especially prevalent. Major Ross will begin by starting an organised campaign against malaria, and will go out again later in the year to carry it through.

THE Prince of Wales has consented to act as president of the fund which has been established for the purpose of conducting research into the nature, causes and cure of cancer. The vice-presidents of the fund are the Lords Lister and Strathcona, the Right Hon. Arthur Balfour, Sir Frederick Bramwell, Sir William Broadbent and Mr. Bischoffsheim. The executive committee is composed of Sir W. Broadbent, Sir W. Church, Sir H. Howse, Drs. Sydney Martin, Pye-Smith and Rose Bradford, Prof. Sims Woodhead, and Messrs. Langton, Henry Morris, Butlin, McFadyean and Watson Cheyne. The money contributions actually paid amount to 32,391*l.*, and promises of 4100*l.* more have been received, making a total of 36,491*l.* towards the full amount of 100,000*l.* originally asked for. Work will be commenced with the sum in hand, but it is hoped that the full capital required will be subscribed.

NATURAL science in Ceylon has sustained a severe loss by the untimely death of Mr. Oliver Collett, F.R.M.S., who, while carrying on actively his vocation as a tea planter, found time for excellent original work both in the field and laboratory. He devoted himself especially to the Mollusca; and a genus and several species of land shells bear his name. As a member of the Ceylon branch of the Royal Asiatic Society he contributed various papers on zoological questions. He also brought his scientific knowledge to bear on some economic questions in connection with the cultivation of tea, and was much esteemed by his fellow planters, being at the time of his death chairman of the local Planters' Association. Mr. Collett, who was thirty-five years of age, possessed a very attractive personality, and many, both at home and in Ceylon, who were brought in contact with him by common interests, deplore the loss of a charming friend and an enthusiastic naturalist. He died on June 13 somewhat suddenly at Colombo, from an attack of dysentery.

A MEETING of the Institution of Mechanical Engineers was held at Newcastle on Tuesday and Wednesday, July 29 and 30. Among the papers down to be read were:—"Liquid Fuel for Steamers," by Mr. E. L. Orde; "Some Experiments on Steam-Engine Economy," by Prof. R. L. Weighton; "Pumping Plant for Condensing Water," by Mr. Charles Hopkinson; "Mechanical Appliances in Mines (Drilling and Coal Cutting)," by Mr. R. H. Wainford; "Recent Developments in Pneumatic Tools and Appliances," by Mr. Ewart C. Amos; and "Motor Cars of 1902," by Captain C. C. Longridge.

A FEW weeks ago (July 3, p. 227) we gave a short account of the investigations into the connection between the magnetic currents in the earth and the Aurora Borealis, which Prof. Kr. Birkeland conducted in the winter of 1899-1900 at two stations Talvik and Haldde, on the summits of two mountains to the west of Bossekop, Altenfjord, in Lapland. Prof. Birkeland recently left Christiania for Archangel in order to start from there on July 23 and proceed to Matoschkin Strait, Nova Zembla, to organise and set in working order a similar station and leave it in the hands of four observers before returning to Norway. At Bossekop, where observations will also be made, the observatory is admirably situated on the summit of Haldde Mountain; for at the base a tunnel belonging to a copper-mine runs for 250 metres into the mountain, and registering apparatus can be set up in it. Simultaneous observations can thus be made on the electrical currents in the atmosphere and in the earth. The third station will be on Axel island, Spitsbergen. A fourth station, with two observers, will be at Dyrafjord, Iceland, and researches will be carried on for about a year at all of them. In order to supplement his own observations and compare them with others, Prof. Birkeland has invited more than a hundred magnetic and meteorological observatories to make simultaneous observations, and has received promises of co-operation from many of them.

WRITING from St. Petersburg on July 22, Mr. J. F. Baddeley gives in the *Times* a few details of a serious glacier disaster in the Caucasus, news of which has been received from Vladikavkaz. Between Mont Kazbek and Ghimarai Khokh a glacier descends into the narrow wedge-shaped valley of the Ghenal Don, which, after a course of about thirteen miles, nearly due north, joins the Ghizel Don, a tributary of the Terek. Like most of the glaciers in the Caucasus, that of the Ghenal Don has of late years receded considerably, and some thirty years ago copious springs of hot sulphur water were uncovered, which had formerly made their presence known by the steam that forced its way through the ice. About the middle of July the end of the glacier suddenly broke off and slid down the valley, causing the loss of thirty-two lives. On July 19 another huge block of ice broke off and followed the first with terrible rapidity for eight miles down the Ghenal Don. Similar catastrophes have frequently occurred on the Georgian Road, in the valley of the Terek, owing to icefalls from the Devdoraki Glacier, north and slightly east of Kazbek; but Mr. Baddeley says he has not met with any mention of previous cases in connection with the Ghenal Don.

EVIDENCE that the competition of the electrical tramway is making itself seriously felt is afforded by the fact that the North-Eastern Railway Company has decided to start working some of its local lines near Newcastle-on-Tyne electrically, and has already invited tenders for the electrical equipment of the sub-stations, permanent way and coaches. It is also reported that the Lancashire and Yorkshire Railway Company is about to make a practical test of electrical running on one of its branch lines near Manchester.

A RECTIFIER for alternating currents devised by Messrs. G. H. Morse and C. R. Cushman is described by the former in the New York *Electrical World and Engineer* for July 19. An electric arc is burnt between three carbon points which are placed in a strong magnetic field; the arc burns between the upper carbon and one or other of the lower carbons, according to the direction of the current. The alternating current is thus divided into two pulsating direct currents, and experiments have shown that, with a proper adjustment of the strength of the magnetic field, the length of arc, &c., the rectification can be made practically complete; that is to say, two direct currents can be obtained each equal to half the alternating current.

ELECTROCHEMISTRY has made enormous strides on the continent and in America. But chemists and electricians in this country have, for some reason best known to themselves, shown a want of interest which is absolutely astonishing. Almost every university and technical institute in Germany has

an electrochemical laboratory, or if there is no special laboratory at least the subject is taught, and the same may be said of America. France also is making considerable headway in the teaching of electrochemistry. Here in this country the whole subject has been practically ignored. In order to try to bring the claims of this very important science before the scientific world and to interest manufacturers in electrochemistry, a small committee of electricians and chemists has been sitting since March in order to see whether it would not be possible to form a British Electrochemical Society. A fair amount of support has been promised, and the committee is now sending out circulars inviting cooperation in the formation of the proposed society. It is to be hoped that there will be a ready response to the invitation, so that all who are interested in electrochemistry may combine their efforts to promote its advancement in this country.

INTERNATIONAL balloon ascents were made on the morning of March 6 in France, Germany, Austria and Russia, and kites were also sent up by Mr. Rotch at Blue Hill, Boston, U.S.A., on the previous evening. The following are some of the preliminary results of the highest unmanned ascents:—Itteville (near Paris), temperature at starting, 2°·8 C.; greatest height reached, 14,000 metres; lowest temperature recorded, − 67°·0. Strasburg, temperature on ground, −0°·4; at 9300 metres, − 54°·0. At Blue Hill the kites ascended through a thick snowcloud; the lowest temperature, − 7°·0, was recorded at a height of 1658 metres; above this the temperature rose, and at a height of 2000 metres it reached − 2°·4. Over Europe an area of high barometric pressure prevailed, while at Blue Hill the kite rose on the north-west side of a deep depression, the centre of which lay over the Atlantic.

THE results of the meteorological observations made at the Rousdon Observatory, Devon, during the year 1901 have been published by the Hon. Lady Peek. The observations have been regularly made, as hitherto, by Mr. C. Grover, and the tables have been prepared for publication under the supervision of Mr. W. Marriott, assistant secretary of the Royal Meteorological Society. The volume also contains an account of damage done by lightning to a room occupied by two persons on the night of June 29–30. The results of this valuable series of observations for the years 1884–1900 are discussed by Dr. J. Hann in the current number of the *Meteorologische Zeitschrift*, chiefly from tables given in the previous volume (1900). In this discussion Dr. Hann lays stress on the advantage of calculating the mean monthly and yearly extremes of temperature and pressure instead of merely quoting the absolute extreme readings, because the latter may only refer to any one of the years under discussion, and are not comparable with the results of a series of years.

AN interesting instance of that adaptability to changing tastes and conditions which is the mainspring of progress in industry as well as in science is afforded by a note in the *Journal* of the Society of Arts (July 18). For some years the demand for claret has greatly diminished in favour of the wines of Champagne, and has seriously affected the wine industry in the Bordeaux district. Several proprietors in the Médoc have, however, now commenced the production of sparkling wines by the same process as champagne is made, and their action has been the means of developing practically a new industry. It may at first seem strange that white wine should be able to be made in the Médoc, where only black grapes are grown, but as a matter of fact champagne is almost entirely made from black grapes, and the most celebrated vineyards in the Champagne district are all planted with them. The colour of the wine depends only on the way in which the wine is made. All the colouring matter is in the skin, while the fruit itself is colourless, or nearly so. If the whole of the grape, skin and all, be allowed to ferment together, the colouring matter in the skin will be dissolved in the juice of the grape, and the wine produced will be red. If, on the contrary, the skin be removed before the fermentation begins, the wine will be white. Sparkling wines require much more working and preparation than still wines, and a second fermentation has to take place when the wine is in bottle, and it is this which gives the gas. The wine has to pass through a long series of operations, which have to be carried out, from first to last, under a perfectly even temperature. For this reason, the cellars in the Champagne district are dug out often to a great depth in the chalk. It would have been impossible to find such cellars in the Médoc, where the soil is of a gravelly nature, but at Bourg, on the right bank of the Gironde, opposite the Médoc vineyards, there are cliffs of Oolitic limestone, whence the stone has for centuries been quarried. The stone has been quarried out in long galleries, which are now adapted for cool cellars, with a perfectly even temperature all the year round, and in these the sparkling médoc is made in identically similar circumstances to the wines of Rheims or Epernay. It is stated that to the ordinary taster there is nothing but the label to distinguish the sparkling médoc from the best brands of champagne. Another white sparkling wine is made at St. Emilion, and the cellars are in the caves below the ruins of an old monastery, from which the wine takes its name.

IN a note contributed to the *Atti dei Lincei*, xi. (1) 10, by Signor E. Daniele, dealing with certain particular cases of motion of a point in a plane, we notice the following interesting conclusion:—"In the motion of a point under a central force, the trajectories can be divided into an infinity of isothermal orthogonal systems, when the force is proportional to any power of the distance."

THE theory according to which the properties of colloidal substances are attributed to particles in a fine state of suspension is advanced by Dr. J. Billitzer in a recent communication to the Vienna Academy (*Sitzungsberichte*, No. 9). The author starts with the assumptions that we have to deal with a fine suspension and that the particles of this are oppositely electrified to the fluid. From these hypotheses numerous important conclusions are derived, and an attempt has been made to answer the principal objections to the theory.

A MATHEMATICAL investigation of the principles of the seismograph is given by Dr. M. Contarini in the *Atti dei Lincei*, xi. (1) 10. In this paper the author passes from the problem of the motion of a chain of rigid bodies, the first of which is fixed to the ground by at least one point, to the special case of two bodies only. It is shown how with such a system it is possible to determine four out of the six components of the seismic disturbance. For the other two components an instrument resembling the Vicentini microseismograph may be used.

THE question as to whether bats are capable of transmitting bubonic plague is discussed by Dr. B. Gosio in the *Atti dei Lincei*, xi. (1) 10. During a recent small epidemic at Naples it was suspected that the disease emanated from a building completely isolated by walls from the town, and with separate drainage, and the idea suggested itself that the infection must have been carried by the numerous bats that were constantly flying around the building. Dr. Gosio accordingly made experiments by inoculating specimens of *Vespertilio noctula* with doses of the virus varying from 0·5 c.c. to 0·05 c.c. of cultures developed for twenty-four hours. The result was that in every case the bats contracted the disease and died in a comparatively short interval, and on examination all the organs of the dead animals were seen to be rich in germs. It is suggested that the

numerous parasites with which the bat is commonly affected may be the means of propagating the germs, and this view is confirmed by experiments previously made in the author's laboratory on the common flea. A further confirmation is afforded by the observation that subcutaneous injections of infected matter, even in small quantities, are sufficient to transmit the disease to bats.

THE *Zoologist* for July contains but two papers, the one, by Dr. A. G. Butler, on birds in captivity, the other, by the Messrs. Ticehurst, on birds met with in Finmark.

THE "corallines," or calcareous algas, of Japan form the subject of a memoir by Mr. K. Yendo in the second part of vol. xvi. of the *Journal* of the College of Science of Tokyo, the other two articles in the same issue being also devoted to botanical subjects.

IN the first part of vol. lxxii. of the *Zeitschrift für wissenschaftliche Zoologie*, Herr E. Schultz continues his studies in "regeneration," taking as his text the turbellarian worms. The superficial nerve-cells in the spinal chord of birds and reptiles form the subject of an article in the same journal by Herr A. Kölliker.

TO the *Aarbog* of the Bergen Museum for 1902, Mr. J. A. Grieg contributes a review of the echinoderms of northern Norway; while Mr. H. Friele describes the molluscs obtained during the cruise of the fishery steamer *Michael Sars* in the North Sea during the summer and autumn of 1900. In the latter paper several new forms are named. A third article, by Mr. H. H. Gran, forms the continuation of a memoir on marine bacteria.

IN a memoir on a new generic type (Gephyrocrinus) of crinoid dredged by the Prince of Monaco at a great depth in the Atlantic, the authors, Messrs. Koehler and Bather, state that it is allied to Hyocrinus, represented by a single species obtained by the *Challenger*. Only one specimen, and that imperfect, of the new form was obtained. The paper is published in vol. xv. of the *Mémoires* of the French Zoological Society.

FROM an article in the *Egyptian Gazette* we learn that the additions to the Zoological Gardens at Ghizeh during May and June were seventy-six in number, and include many very valuable and rare animals. Nearly all are natives of the Nile Valley except four Capuchin monkeys from South America, received in exchange, and a specimen of the two-humped Bactrian camel, which has been purchased and delivered in Egypt through the assistance of Dr. Büttikofer, the well-known Swiss naturalist, now Director of the Rotterdam Zoological Gardens, where this species of camel is bred with success. In Egypt, where the one-humped camel is so well known, it is specially interesting to be able to see a specimen of the two-humped camel, and to the native visitor it is perhaps the most astonishing animal in the menagerie.

AT a special memorial meeting held on April 25 of this year under the joint auspices of the Natural History Society, the Teachers' School of Science and the University of Boston (of which an account appears in vol. xxx. No. 4 of the *Proceedings* of the first-named society), addresses were delivered in commemoration of the work of the late Prof. A. Hyatt. According to the inaugural address, Hyatt was born at Washington in 1838 and died suddenly at Cambridge, Mass., in January of the present year on his way to attend a meeting of the Boston Natural History Society, of the museum of which he was so long curator. Hyatt "was professor of zoology and palæontology at the Massachusetts Institute of Technology from 1870 to 1888, and professor of biology at Boston University from 1877. He was the founder of the seaside laboratory at Annisquam, and took the leading part in the foundation of the Teachers' School of Science and of the American Society of Naturalists."

ONE evening in the autumn of last year, while strolling on the beach of a small watering-place near Christchurch, New Zealand, Dr. A. Dendy picked up a small gelatinous object thrown up by the tide. On examination this object turned out to be a relatively large pelagic hydroid polyp. When found it was in a moribund condition, and the body was seen to be covered with a number of medusæ in various stages of development. A full account of this remarkable organism is given by its discoverer in the July issue of the *Quarterly Journal of Microscopical Science*. The organism, which is endowed with free-swimming power, indicates an entirely new type of hydroid, for which the name *Pelagohydra mirabilis* is proposed. Structurally it comes nearest to the aberrant Corymorpha. "It is a very curious fact," remarks the describer, "that two distinct genera of tubularian hydroids agreeing in such striking anatomical peculiarities should have become adapted to two such different modes of life, the one (Pelagohydra) swimming freely in the open ocean, and the other (Corymorpha) rooting itself in the sand at the bottom. . . . So far as I am aware, there is no other hydroid yet known which has become specially adapted to a pelagic mode of life."

A NEW popular edition of Mr. Oliver G. Pike's pleasantly written book entitled "In Bird-Land with Field-Glass and Camera" has been published by Mr. T. Fisher Unwin. The book is illustrated by eighty-three reproductions of photographs of birds and nests taken direct from nature by the author. A notice of the original edition, with one of the illustrations, appeared in NATURE two years ago (vol. lxii. p. 418).

MR. HENRY FROWDE will publish shortly the first instalment of the "Tebtunis Papyri" found by Dr. B. P. Grenfell and Dr. A. S. Hunt at Ûmm el Baragât in the south of the Fayûm and edited by them, with the assistance of Mr. J. Gilbart Smyly. This volume deals with the papyri in which the mummies of crocodiles were wrapped, and they date from the end of the second or the early part of the first century B.C. Mrs. Hearst supplied the funds for the excavations on behalf of the University of California, and this volume inaugurates a series of publications by the University dealing with Egyptian archæology. The book is being issued conjointly by the Egypt Exploration Fund to subscribers to the Græco-Roman branch.

IN the July number of the *Moniteur Scientifique*, Prof. Zinno describes a synthesis of tartaric acid suitable for the production of this substance on the large scale. The method consists in passing a current of carbonic acid gas under a pressure of about three atmospheres over potassium glycerate, the reaction being very similar to that of Kolbe by which sodium salicylate is produced. Potassium glycerate is easily obtained by oxidising glycerin by means of lead dioxide or minium and nitric acid, and then adding to the boiling solution of the lead salt potassium carbonate. Numbers are given in the paper which show that cream of tartar can be produced by this method at a cost which should justify the commercial development of the process.

THOSE who are interested in the sulphuric acid industry will find a noteworthy series of articles bearing upon the subject in the July number of the *Moniteur Scientifique* under the title "Grande Industrie Chimique." The first of these, by Messrs. Niedenführ and Luty, is entitled "A comparative economic study of the manufacture of sulphuric acid by the anhydride and the modern lead chamber processes." Much interesting matter is contained in the paper, and the authors arrive at the conclusion that at the present time the lead chamber processes, when conducted properly, are considerably more economical than the

contact processes, so far as the production of acids which are not very concentrated is concerned. For the manufacture of the strongest acids, however, numbers are given which indicate that the contact process is considerably superior to the older process from the commercial point of view. The other articles on the subject deal with more recent alterations which have been made in the lead chamber process, the theory and practice of sulphuric acid manufacture and the treatment of platinum residues.

THE additions to the Zoological Society's Gardens during the past week include a Side-striped Jackal (*Canis lateralis*), a Young Leopard (*Felis pardus*), a Spotted Hyæna (*Hyaena crocuta*), a Harnessed Antelope (*Tragelaphus scriptus*), a Nagor Antelope (*Cervicapra redunca*), a Marabou Stork (*Leptoptilus crumeniferus*), a White-necked Crow (*Corvus scapulatus*), a Spur-winged Goose (*Plectropterus gambensis*), two Red-backed Pelicans (*Pelecanus rufescens*) from Gambia, West Africa, presented by Captian Sir George C. Denton, K.C.M.G.; a Striped Hyæna (*Hyaena striata*) from Gambia, West Africa, presented by Captain MacCarthy Morrogh; a Black-eared Marmoset (*Hapale penicillata*) from South-east Brazil, presented by Mrs. Armyn Thornton; a Yellow-fronted Amazon (*Chrysotis ochrocephala*) from Guiana, presented by Miss Ellen Cull; a Red-winged Parrakeet (*Ptistes erythropterus*) from Australia, presented by Miss E. P. France; a Pale-headed Parrakeet (*Platycercus pallidiceps*) from Australia, presented by Mr. Thomas Morson; a West African Python (*Python sebae*) from West Africa, presented by the Rev. H. Ross Phillips; two European Tree Frogs (*Hyla arborea*), European, presented by Mrs. Sidney Wolton; a Thar (*Hemitragus jemlaica*), a Yak (*Poephagus grunniens*) born in the Gardens.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN AUGUST:—

August 1. 15h. 25m. to 19h. 8m. Transit of Jupiter's Sat. III.
4. 11h. 34m. to 16h. 29m. Transit of Jupiter's Sat. IV.
5. 5h. Jupiter in opposition to the sun.
8. 12h. 38m. Minimum of Algol (β Persei).
10. 8h. 29m. to 9h. 32m. Moon occults 8 Libræ (mag. 5·3).
10. 8h. 41m. to 9h. 35m. Moon occults α Libræ (mag. 3·0).
11. 9h. 27m. Minimum of Algol (β Persei).
11–12. Maximum of the Perseid meteoric shower.
15. Venus. Illuminated portion of disc = 0·886. Mars = 0·965.
18. 17h. 1m. to 17h. 22m. Moon occults c^1 Capricorni (mag. 5·2).
28. Saturn. Outer minor axis of outer ring = 16″·48.
30. 4h. 37m. to 8h. 20m. Transit of Jupiter's Sat. III.
31. 11h. 10m. Minimum of Algol (β Persei).

A NEW ALGOL VARIABLE.—Prof. Pickering announces the discovery of a new Algol variable (+43°·4101) by Mrs. Fleming, at the Harvard College Observatory.

Two plates, taken with the 8-inch Draper telescope on March 7, 1900, and April 3, 1902, respectively, were being examined in order to discover, if possible, a trace of the image of Comet 1902 *a* on the latter plate. This search was unsuccessful in its immediate object, but Mrs. Fleming noticed that the image of a faint star, the position of which for 1900 was R.A. = 21h. 55·2m., Dec. = +43° 52′, showed a variation in magnitude during the interval between the taking of these two plates, and on examining more plates it was found that generally the light was bright and constant, thus showing the star to be of the Algol type.

The period is about 31·4 days, and the star retains its maximum brightness (photographic magnitude = 8·9) for twenty-eight days and then decreases to minimum by the following steps:—9·0 m. at 1·05 d. before minimum, 9·5 at 0·94 d., 10·0 at 0·84 d., 10·5 at 0·71 d., 11·0 at 0·58 d., and 11·5 at 0·43 d. The light then remains constant at 11·6 m. for more than half a day. The times of increase are apparently the same as those of decrease, but this is not conclusively indicated. (*Astrophysical Journal*, No. 5, vol. xv.)

SPECTROSCOPY OF THE SOLAR ECLIPSE OF MAY 18, 1901.—In No. 5, vol. xv. of the *Astrophysical Journal*, Mr. W. J. Humphreys gives an account of the United States Naval Observatory Eclipse Expedition to Sumatra last year, and a reduction of the spectrograms obtained.

Excellent photographs of the corona were obtained, the cœlostat used having a mirror at either end of its heavy polar axis, one supplying the light to the coronagraph, the other to the spectroscope.

The concave grating used was of 30 feet focal length and had a diffracting surface 8 inches long and 5 inches wide; the whole of this area was not used, however. To obtain good uniform focus heavy celluloid films were used, and these were 2½ inches wide and 36 inches long.

Six films were exposed, and the reductions of the spectra are set out in tabular form, 330 lines between λ 3118 and λ 5204 having been measured. Neglecting those due to hydrogen and helium, the lines are chiefly those belonging to the Mendeléeff series which terminates with the Fe, Ni, and Co groups.

Incidentally observing the shadow bands, Mr. Humphreys found that they were stationary at first, but another observer noted that afterwards they widened out and then attained an increasing velocity.

Mr. Humphreys concludes his report with some useful suggestions which might be profitably considered by future eclipse observers.

REPORT OF THE CAPE OBSERVATORY FOR 1901.—Sir David Gill, in this report, announces the completion and official inauguration of the 24-inch "Victoria" telescope presented to the observatory by Dr. Frank McClean.

The transit circle has been completed and effectively mounted, the house being of a semi-cylindrical form, of which the two halves may be drawn aside at right angles to the axis when observations are to be taken. Owing to the loose nature of the upper rocks, the standard azimuth marks have had to be placed on the surface of the solid rock at the bottom of shafts some 30 feet deep, from which the marks are reflected to the instrument. The heliometer has been cleaned and repaired, and observations of the oppositions of Mars, Jupiter and Saturn have been made. Some thirty observations of the distances and position angles of Jupiter's satellites have also been completed.

The equatorials have been used for observing the phenomena attending ninety-seven separate occultations, to observe Giacobini's comet and the great comet of 1901, and to seek, without success however, for Encke's comet. Thirteen previously unrecorded double stars have been detected by Mr. Innes, the most interesting of them being τ_2 Lupi, h 4625 (chief star) and C.G.A. 2861. The 7-inch equatorial has been used for the revision of the C.P.D., and incidentally the unsuspected variability of the following stars has been detected:—C.P.D. −51°·2275, anonymous, Cor. D.M. −22°·14789, the ranges of variability being from 8·6 m., 9·8 m. and 9·4 m. to invisibility respectively. The character of the second star is not completely known yet, but it is suggested that it may be a Nova, R.A. = 11h. 14m. 14s., Dec. = 61° 10′ S. (1875).

The geodetic work has been actively prosecuted throughout the year, the geodetic arc of meridian having now been carried to the Zambesi, and an effective service of time signals has been distributed throughout the Colony.

WORK AT THE ATHENS OBSERVATORY.[1]

YEARS ago, under the vigorous direction of the late Prof. Schmidt, the Athens Observatory acquired a distinction that was denied to some kindred institutions more favoured with instrumental equipment and substantial endowment. Since that time evil days have fallen on the National Observatory of Greece and its record of useful work has been broken; but it is now a pleasant task to record that a period of renewed activity appears likely to make itself felt in the future conduct of this ancient centre of scientific work. The third volume of the

[1] "Annales de l'Observatoire National d'Athènes." Publiées par Démétrius Eginitis, Directeur de l'Observatoire. Tome iii. Pp. 376. (Athènes: Imprimerie Royale Raftanis-Papageorgiou, 1901.)

"Annales," which has just appeared, devoted mainly to meteorological and climatic inquiries, is perhaps of a modest character viewed from a scientific standpoint; but it shows that the present director, M. Eginitis, is alive to the importance of creating a broader scientific interest throughout the country, which may be productive of greater energy and lead to the establishment of a well-supported institution. If this be the intention of the director, the means he has employed are excellent. For M. Eginitis has endeavoured to interest a number of the better instructed class, such as civil engineers, professors of mathematics in the colleges and schoolmasters, in meteorological and seismological inquiries, and has induced the Government to provide a simple instrumental equipment at stations where it could be properly employed. The result is that he has distributed throughout Greece and the Ionian Isles a number of centres whence climatic observations are regularly forwarded to the central observatory at Athens and there reduced.

The results for the years 1894–9 are printed in this volume, and we regard the fact that the dormant energies of a large number of people are interested, and the habit of continuous observation encouraged, as of greater importance than the actual observations collected. The public is being trained to expect a certain amount of scientific work from the Government officials, and demands for a further advance will be made and will be granted, when urged by competent observers backed by a growing scientific opinion. We would urge M. Eginitis steadily to pursue the methods which he has introduced, and which cannot but be productive of a lasting and beneficial result.

Two memoirs from the director accompany the volume, one a discussion of the observations of meteors made at the observatory, the other on the distribution of earthquakes throughout the day and year as recorded at the Grecian stations. In 1899, M. Eginitis reports 567 earthquake shocks, of which 271 occurred in the spring against 62 in the summer months, and this peculiarity is in general agreement with a more extended inquiry embracing the period 1893–8. With regard to the relative position of the earth and moon, in which the latter might be presumed to have some slight effect in displacing the arrangement of internal rocks as the consequence of a tidal flow, M. Eginitis finds that there is no noticeable connection between the frequency of seismic disturbance and the position of the moon in its orbit. A description of the effects experienced on the occasion of the earthquake at Triphylie on January 22, 1899, concludes this section.

VIBRATIONS OF BRIDGES.

THE last volume issued by the Earthquake Investigation Committee of Japan published in a foreign language is "On the Deflection and Vibration of Railway Bridges"—a subject which, although not seismological, is an excellent illustration of investigations which seismologists have been tempted to pursue.

The author, Dr. F. Ōmori, experimented on twelve railway bridge girders, the spans of which varied between 20 and 200 feet. The instruments used to record the bridge vibrations were a pair of seismographs such as are used for recording horizontal motion, and a horizontal lever seismograph for vertical motion. This latter instrument is here called a *deflectometer*. The quantities measured were the *deflection* of girders, or the total amount of bending caused by the passage of rolling stock, and the vertical transverse and longitudinal *vibrations*, which latter are almost *nil* when the speed of a passing train is either very slow or at a maximum, when the speed has a certain value. The incentive to this work was a question respecting the stability of the Rokugo-*gawa* Bridge, which was the first large bridge built in Japan. It was put up in 1875, a time when the rolling stock was somewhat lighter than that now in use. Oddly enough, the vibrations and deflections of this same bridge, and also others, were investigated in 1895 with apparatus similar to that now employed, and had Dr. Ōmori known this, it is possible that he would have compared the apparent state of the bridge at that date with what it was found to be five years later.

An account of this earlier work, with reference to that of others, as, for example, the seismometric measurements made by Prof. J. A. Ewing on the new Tay Bridge, will be found in *Engineering*, January 24, 1896.

The mechanical time marker used to determine the speed at which the record-receiving surface was moved, which is a determination of great importance when estimating vibrational periodicities, is apparently very similar to a contrivance largely used in seismometry in 1882 (see *Trans.* Seis. Soc., vol. iv. p. 97, Fig. 8).

A point not touched upon is a comparison between values given to displacements as measured by seismographs and as determined by the direct methods employed by engineers. Previous investigators have done a little in this direction, but before the confidence of the practical man can be obtained it is clearly necessary that this work should be extended. The results which, however, have been arrived at respecting the strength and rigidity of various types of iron girders by this neglected method of investigation appear to be worthy of consideration by the builders of bridges. In the *Erdbebenwarte* of last year there are three notices of Dr. Ōmori's important and carefully conducted investigations, which are now followed by the advertisement of an instrument maker who is prepared to supply engineers with apparatus designed for this particular class of work.

J. M.

REPORT ON UNIVERSITY COLLEGES.

A REPORT upon the work of university colleges has been issued as a Blue-book and contains much information as to the provision for higher education in various parts of the country. An annual grant of 25,000*l.* is made by the Government in aid of certain university colleges, and the character and quality of the work done, with special reference to the difference between work of an elementary character and that of a more advanced nature, is tested by occasional inspection.

A visit of inspection was held in 1896 by Mr. T. H. Warren and Prof. G. D. Liveing, and another was made last year by Dr. H. G. Woods and Dr. Alex. Hill. The colleges visited were:—University College, London, King's College, London, Bedford College for Women (University of London), the Owens College, Manchester, University College, Liverpool, Yorkshire College, Leeds, the University of Birmingham, University College, Bristol, Durham College of Science, Newcastle-on-Tyne, University College, Nottingham, Firth College, Sheffield, University College, Dundee, Reading College, the Royal Albert Memorial College, Exeter, and Hartley College, Southampton. As has already been announced, the Reading College and the Hartley College, Southampton, have only recently been added to the list of university colleges, of which there are now fifteen which participate in the Government grant.

The present report is almost entirely made up of descriptions of the buildings and laboratories of each of the colleges, main lists of work, organisation, and position of various departments of arts and sciences. Preceding this is a general statement by Drs. Wood and Hill, and following it a report by Mr. H. Higgs upon the financial position of the colleges. A few of the points touched upon by Drs. Wood and Hill are mentioned below.

Plan of Buildings.—Anyone who makes the round of the university colleges is certain to develop in his own mind an ideal scheme of college buildings. Our own observations have led us to the conclusion that it is a mistake for a college to invest a large portion of its capital in buildings which cannot readily be adapted and extended to meet changing needs. We could cite cases in which much money has been spent upon the material fabric of a laboratory, whereas the want of funds to provide an adequate modern equipment seriously reduces the effectiveness of its work. The demands of science are constantly changing. It is therefore desirable that funds should be so husbanded as to allow of the provision of new apparatus and appliances of all kinds as they are called for. In this connection we feel that it is not too much to say that we have seen no single college in which adequate funds were available for departmental expenditure. A few departments of particular colleges which have been housed and equipped by private munificence are notable exceptions, but in the large majority of cases the funds assigned to departmental libraries, apparatus, lecture illustrations, &c., are altogether insufficient.

Statistics of Progress.—The general result of our observations and inquiries is to show that very remarkable progress has been made by the university colleges during the last five years. The great, we might almost say immense, growth is proved by the following statistics:—(1) The total amount of the benefactions

received during the last five years by the twelve colleges which participate in the grant amounts to close upon one million sterling. (2) The total number of day students attending the colleges during the session ending in July, 1901, was 7825, as against 7186 attending during the session ending July, 1896. (3) The advance in the standard of work is more striking than the advance in numbers. This advance is best shown by the larger number of university degrees obtained by students. The aggregate figures for the two periods are as follows:—1891–6, 1437 degrees; 1896–1901, 2186 degrees.

Position of Teachers.—Nothing has impressed us more than the enormous amount of routine work which the majority of university colleges exact from their teachers. There are, it is true, several exceptions. In certain colleges and in particular departments in which the number of students is small, the professors and their assistants have a good deal of leisure, and are able to undertake literary and scientific work with the support, in some cases, of fairly satisfactory libraries and laboratory appliances. In the larger and more successful colleges and departments the pressure upon the time and thought of the teachers is unduly great. If the head of a department is to maintain a high standard of teaching and to ensure a creditable list of examination successes he has little leisure for private work, and especially is he obliged to be assiduous in his duties because the students of the university colleges belong, for the most part, to a social class which exacts the maximum return in results for the fees paid. As to the effect of too much work upon the teacher there is no room for doubt. It tends to sap his intellectual vitality by leaving him neither time nor energy to draw fresh inspiration from the study of the work of others or from his own investigations. A fresh and unharassed mind is, above all things, necessary for research.

There is another respect in which, as it appears to us, the colleges are not serving their own best interests by overworking their teachers. The stipends which they offer are, for the most part, distinctly moderate. The opportunities for continued study and research are, except in London, inferior to those which Oxford and Cambridge afford. It can hardly be expected, nor is it to be desired, that a man of real capacity should look upon an appointment at a provincial college as a settlement for life. Rather should he regard it as a stepping-stone to preferment. If the colleges were to realise that the smallness of the stipend which they offer would be more than compensated in the eyes of an ambitious man by larger opportunities of qualifying for preferment, they would attract to their service young men of the greatest promise. If the probability of the advancement of its professors and lecturers to more lucrative and important posts is kept in view and their duties so arranged as to allow them leisure to display their capacity for original work, the colleges may count upon a supply of young men of the greatest ability who will occupy their chairs for a certain number of years while waiting to be called to a wider sphere.

Research.—We have found it difficult to give any adequate idea of the amount of original research in science which has been carried out by the teachers and students of the several colleges during the quinquennium under review. The greater part of the research work carried out at provincial colleges is done by heads of departments, and we recognise that a summary of each professor's own work would have greatly increased the value of our report. For several reasons, however, we have not felt ourselves at liberty to attempt this. In the first place, the leisure and, therefore, the opportunities for research, which the professors enjoy vary immensely. In the majority of cases we should say that the professor's duties are far too arduous and incessant to allow him to do much work of this kind. In the second place, we find that certain professors hold that it is the duty of the head of a department to work through his students. To them he conveys his ideas and affords constant assistance in carrying them out. A teacher who adopts this point of view may publish nothing under his own name, although all the work which emanates from his laboratory is really inspired by him.

Students and Original Research.—With regard to the question of the desirability of encouraging students to undertake original investigations, we find that teachers hold diametrically opposed views. Some consider that to set a student to such work is to rob him of the opportunity which his student days afford of acquiring information. Others look upon experience in research as the best training which any student can receive. The amount of research work done by students depends, therefore, to a certain extent upon the position which professors take with regard to this question. It may also be noted that the effort and originality required to produce "a paper" in some subjects is very different from that required in others. Probably the scope for original work in science is greatest in chemistry and least in physiology. In chemistry, too, the making of new substances and the investigation of interactions is a training in the science to a much greater extent than is similar work in any biological subject.

University Colleges and Secondary Schools.—We find that the relations of the more important provincial colleges to the secondary schools of their districts have become distinctly closer in the last five years. Not merely do more pupils pass from the secondary schools to the colleges, but reciprocity of representation on the governing bodies of schools and colleges is becoming more frequent, and there has been a certain amount of inspection of secondary schools carried out by members of the staff of several of the colleges. Another significant fact is that there have been of late several instances of denominational colleges, especially training colleges for the Nonconformist ministry, settling near university colleges in order that their students may attend university courses in arts and science. These facts point to the increasing importance of university colleges as educational centres.

University Colleges and Technical Education.—In an ever-increasing degree the university colleges are serving to co-ordinate the various agencies for higher education into an effective whole. They serve to focus educational forces. Particularly is their integrating action noticeable on the technological side, and although their results in this direction are not the phases of their activity which we were commissioned to investigate, they are, in our opinion, so desirable that we venture to call attention to them. Technical institutes are growing up in all large towns. When they are not in direct connection with the university colleges, where such exist, there is inevitably a certain amount of rivalry, with consequent friction, overlapping and waste of energy. The scientific direction of technological studies is a matter of national importance. In the technical departments of a university college, technical education is lifted to a higher plane. The head of a technical department, who is also a member of a college staff, and in close touch with the heads of departments of pure science, takes a higher and wider view of his own work, and inspires a more scientific spirit in his pupils. Further than this, the more capable of his pupils have the opportunity of prosecuting the study of the pure sciences as far as their inclination or financial resources allow. Not infrequently they discover in themselves an aptitude for science which would never have been suspected had they not joined a technical department for the purpose of acquiring instruction which would enable them to earn a living. In departments which would at first sight appear to be the most distinctly technical, we found that researches were being prosecuted which were helping to solve questions of general interest to men of science, the results reaching far beyond the interest of the particular industry to which the department belonged. Every year the boundaries which separate pure science from applied science become more indistinct. The physicist, the chemist and biologist make discoveries which prove to be unexpectedly useful in their application, while the technologist, going farther and farther afield, undertakes researches, the applications of which he cannot foresee, in the hope that he may light upon results which commerce can turn to account.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE pass list of the D.Sc. examination of the University of London contains the following names:—Mixed mathematics, Louis N. G. Filon (Granville scholarship); experimental physics, G. J. Parks, W. Watson; chemistry, R. H. Aders, R. M. Caven, C. H. Desch, E. J. Russell, J. Wade, Martha Annie Whiteley; botany, F. E. Weiss; zoology, H. S. Harrison (Sherbrooke scholarship), H. H. Swinnerton; physiology, Florence Buchanan, F. G. Hopkins; geology, C. A. Matley, E. W. Skeats.

THE Annual Calendar of the McGill College and University, Montreal, for the session 1902–1903 is a volume of more than four hundred pages filled with details of the buildings and equipment of the various departments, and the courses of work

carried on in them. The three buildings endowed and equipped by Sir William C. Macdonald for engineering, chemistry and mining, and physics, afford excellent facilities for study and research. There are special laboratories and workshops in which machinery of full size has been erected, so that all investigations can be carried on in all respects under working conditions.

THE tenth report of the Technical Instruction Committee of the County Borough of Plymouth has been received. The concluding words of the report show that the committee realises that fundamental principles rather than technical details should be the object of the work in such municipal science, art and technical schools as that at Plymouth. The committee remarks :—"It must not be assumed that the work of the schools is intended to embrace what are commonly called technical subjects only. Their object is to give such higher education and training, combined with manual and technical skill, as may enable their students to perform their work in life with greater intelligence, ability and success."

SINCE Prof. Perry brought forward the subject of "The Teaching of Mathematics" at the meeting of the British Association last September, several associations of teachers have discussed the reforms suggested or appointed committees to report upon the matter. A committee of the Assistant Masters' Association has had the subject under consideration, and a preliminary report has been drawn up, from which it appears that masters in secondary schools are in favour of most of the reforms advocated by speakers at the British Association meeting. The report is as follows :—I. *Arithmetic.* (1) The method of teaching in the early stages should be inductive and concrete. Actual measuring and weighing should be introduced as early as possible. (2) Decimals should be treated as an extension of the ordinary notation, their nature being illustrated by actual metric weights and measures. Multiplication and division of a decimal by a decimal would, we think, have to follow vulgar fractions. (3) The decimalisation of English money and English weights and measures should be practised frequently. (4) Approximate methods should be gradually introduced after the treatment of finite decimals. They should be taught with due regard to rigidity of proof. Appreciation of the degree of approximation should be continually insisted upon. (5) If "commercial arithmetic" is to be taught at all, the subject-matter should receive more adequate and correct treatment, and the examples should be drawn from transactions as they actually occur.—II. *Algebra.* (1) The foundation of algebra should be "literal arithmetic," *i.e.* algebra should at first be arithmetic generalised. (2) The minus sign should receive its extended meaning from copious illustrations ; and illustrations, not rigid proof, should also be resorted to for the purpose of the "rule of signs." (3) Algebra should often be applied to geometry. (4) Logarithms should form an important section of the subject. We believe that the graphic method could be very usefully employed in this connection. (5) We desire to deprecate the waste of time so commonly practised in mere manipulation of symbols.—III. *Geometry.* (1) We are strongly of opinion that the ordinary deductive geometry should be preceded and continually supplemented by concrete and inductive work. (2) Whilst "mensuration" might possibly be taught in connection with physics and arithmetic, we believe that the value of geometry would be enhanced by practical applications of the propositions as they occur. (3) We feel very strongly that Euclid's text is very unsuitable for teaching geometry. But we are impressed with the difficulty of abolishing its use in the face of external examinations. In the circumstances, we can only hope that examining bodies, even if they insist on Euclid's sequence, will allow greater latitude in methods of proof, and give greater prominence to easy "riders" and applications of geometry.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 12.—"The Dissipation of Energy by Electric Currents induced in an Iron Cylinder when rotated in a Magnetic Field." By Ernest Wilson, Professor of Electrical Engineering, King's College, London.

The effect which induced currents have upon the distribution of magnetism in an iron cylinder, when rotated about its longitudinal axis with uniform angular velocity in a magnetic field, has already formed the subject of a communication (Wilson, Roy. Soc. *Proc.*, vol. lxix. p. 435, also NATURE, vol. lxv. p. 502). The present paper deals with the energy dissipated by these electric currents, and a comparison is made between the results of experiment and theory. In connection with the theory of the subject a contribution by Mr. J. B. Dale is made use of. The cylinder experimented upon has diameter and length each 10 inches (25·4 cm.), and is rotated between the poles of a magnet weighing some tons. It is supplied with exploring coils, threaded through holes drilled in a plane containing its longitudinal axis, by the aid of which the electromotive forces due to rotation in a magnetic field have been observed. The results of experiment have been obtained graphically by a process of double integration. The distribution which has to be assumed in connection with the experiments is that the induced currents distribute themselves on the surfaces of cylinders similar to and concentric with the cylinder experimented upon. Two other distributions are also discussed, namely, the distribution assumed by Baily (*Phil. Trans.* Roy. Soc., A, vol. clxxxvii., 1896, pp. 715–746), that in any section the electric currents flow in rectangular paths similar to the boundary of the section, and the distribution in which the current density in any path is constant throughout the path.

Dealing with the distribution assumed in connection with the experiments, both graphical treatment and theory agree in giving the formula $3{\cdot}95B^2f^2l^2/10^{16}\rho$ for the watts dissipated per cubic centimetre, where B is the intensity of magnetic induction assumed constant, f is the frequency, l is the length of the cylinder assumed equal to its diameter, and ρ is its specific resistance. In the experiments the frequency was varied from 1/45 to 1/360, and for each the average intensity of induction was varied from 1000 to 20,000. In each case the watts per cubic centimetre are less than would be dictated by the above formula. The ratio of the results is 1·3 at frequency 1/360, and is substantially constant for all values of the induction density. At frequency 1/45 this ratio varies from 1·4 to 1·7 for high and low values of the induction density, but it is 3·1 for an intermediate value. A similar, though less marked, effect is observed at frequency 1/90. The explanation given is that with these intermediate forces at these frequencies very great crowding of the induction to the surface occurs ; and, moreover, since the wave-form of the electromotive force near the surface of the cylinder in all the experiments is more rectangular, the dissipation of energy per cubic centimetre is less than the formula above would give, since *there* the wave-form is assumed to be a sine-curve. On the assumption that the electromotive force at the surface is truly rectangular, the formula obtained by graphical treatment is $2{\cdot}08B^2f^2l^2/10^{16}\rho$.

Having reconciled the results of experiment with those of theory, the author compares the dissipation of energy in rotating and alternating magnetic fields. It is pointed out that in the case of circular plates in which the diameter is very great as compared with the thickness, and in which the lines of force are uniformly distributed in the plane of the plate, the rotating field would dissipate about 1·7 times as much energy as an alternating magnetic field in the same time. The results are, however, greatly influenced by variation in wave-form, and even when the lines of force are confined to the plane of the plate, a condition not always met with in practice, the rate of dissipation of energy for a given average induction density may be considerably reduced if the distribution of magnetic induction is such as to give a more rectangular wave-form to the induced electromotive force.

"Note on a Magnetic Detector of Electric Waves, which can be Employed as a Receiver for Space Telegraphy." By G. Marconi, M.I.E.E. Communicated by Dr. J. A. Fleming, F.R.S.

The detector is based, in the author's opinion, on the decrease of magnetic hysteresis which takes place in iron when, under certain conditions, it is exposed to the effects of Hertzian waves. On a core of thin iron wires is wound a coil consisting of one or two layers of insulated copper wire, and over this and separated from it by insulating material is wound a second longer coil. The ends of the inner coil are connected to earth and the aërial conductor, and the ends of the outer coil to a telephone. The iron core is magnetised by a permanent magnet at one end, which is rotated by clockwork so as to cause a continual slow change in the magnetisation. The magnetisation, however, lags behind the magnetic force owing to the hysteresis of the iron, but when a high-frequency current passes through the inner winding there is a decrease in the hysteresis, due

apparently to the iron molecules being momentarily released from constraint. A sudden variation in the magnetisation of the iron results, and this induces a current in the outer copper winding connected to the telephone. The author finds that the telephone reproduces very accurately the transmitted signals, and that the receiver is more sensitive than the coherer and more suitable for use with a syntonic system of wireless telegraphy. Experiments with the receiver have been carried out between St. Catherine's Point and North Haven, the distance between these points being 152 miles; the length of the electric waves used was 200 metres.

"A Note on the Effect of Daylight upon the Propagation of Electromagnetic Impulses over Long distances." By G. Marconi, M.I.E.E. Communicated by Dr. J. A. Fleming, F.R.S.

During the experiments carried on between Poldhu, Cornwall, and the U.S. s.s. *Philadelphia* it was observed that the signals transmitted at night had a greater carrying power than those transmitted by day. The transmitting conductor consisted of fifty bare copper wires suspended from a wire stretching between two poles 48 metres high. On board ship the receiving conductor was suspended from the mast and was composed of four wires the tops of which were 60 metres above the sea level. Signals were sent from Poldhu at stated intervals from 12 to 1 a.m., from 6 to 7 a.m., from 12 to 1 p.m. and from 6 to 7 p.m. Until the *Philadelphia* was 500 miles from Poldhu no differences were observed; at distances of more than 700 miles signals transmitted during the day failed entirely, whereas those sent at night remained quite strong up to 1551 miles and were decipherable up to 2099 miles. Daylight at Poldhu was rapidly increasing from 6 to 7 a.m., and it was observed that on the *Philadelphia* the signals which were quite clear at 6 a.m. had almost disappeared by 7 a.m. Confirmatory tests were carried out between Poldhu and North Haven, and it was found that receiving wires 12·1 metres high could be used at night, but that, other things being equal, the height had to be increased to 18·5 metres for the daylight signals to be equally clear. The author suggests that the effect may be due to the diselectrification of the transmitting elevated conductor by daylight, the electrical oscillations being thereby prevented from acquiring so great an amplitude as they attain during darkness. That the effect has not been previously noticed may be due to the extra high potential to which the aërial wires at Poldhu were charged for this long-distance work. This potential was sufficient to cause sparking between the tops of the wires and an earthed conductor 30 cm. distant.

EDINBURGH.

Royal Society, June 16.—The Hon. Lord M'Laren in the chair.—Prof. C. G. Knott read a paper on the change of resistance of nickel due to magnetisation at various temperatures. The apparatus used had been constructed twelve years ago in Japan, but other work had prevented anything like a thorough investigation being made with it. Two exactly equal pieces of nickel wire were coiled so as to form anchor-ring cores to magnetising coils of copper wire coiled round them. Round each nickel wire were coiled two distinct coils with exactly the same number of turns. Thus by joining up the coils in different ways the experimenter was able to subject the enclosed nickel to a strong magnetic field or to no field, without in any way altering the strength of current circulating in the coils. The nickel coils were balanced on a Wheatstone bridge. The magnetising current was passed round the pairs of coils on the nickel cores, so as to magnetise the one nickel but not the other. In this way the heating effect was practically the same in both coils and the change of resistance due to heating very nearly compensated. The coils were heated up to various temperatures in an air bath and the resistance change was measured by deflection after a balance was nearly adjusted. The galvanometer was gauged by means of the deflection produced when a definite change of resistance was made in one arm of the bridge. The first series of experiments indicated that there was a decrease in the proportional change at higher temperatures; but this showed that the total amount of change estimated in ohms for any given wire was very nearly the same at all temperatures between the limits of 10° and 170° C. The bearing of this result upon Prof. J. J. Thomson's theory of corpuscles was pointed out; but further results were held over for another communication.—Prof. Knott also gave an account of the last piece of quaternion work which Prof. Tait had jotted down on July 2, 1901, just two days before his death. The notes bore upon the properties of the linear vector function and were a following up of previous work published in the *Proceedings*.—Dr. Hugh Marshall described the results obtained by him in the first part of an investigation of the thallic sulphates and double sulphates. From these it would appear that it is largely a matter of solubility whether normal or basic salts are obtained, rather than a matter of sulphuric acid concentration. Thus, potassium thallic sulphate, $KTl(SO_4)_2.4H_2O$, when treated with dilute sulphuric acid gives a sparingly soluble basic salt, $K_2TlOH(SO_4)_2$; the latter dissolves easily in dilute nitric acid and this solution gives crystals of the first-mentioned normal salt. No thallic alums could be obtained.

July 7.—Sir William Turner in the chair.—An obituary notice of Lieut.-Colonel J. H. B. Hallen, C.I.E., F.R.C.S.E., was communicated by Principal W. Owen Williams.—Mr. J. G. Goodchild contributed a paper on Scottish mineralogy, based upon a study of the specimens under his charge in the Edinburgh Museum of Science and Art. It dealt chiefly with the developmental history of albite studied in relation to crystal genesis in general. The paper also dealt with the crystallography of Scottish cerussite, analcine, forsterite and some others. Drawings of a large number of crystals were exhibited.—Mr. James N. Miller demonstrated the mode of applying his mechanical trisector to the quinquesection of an angle. It was an ingenious extension of the properties of the trisector.—In a paper on experimental observations on leucolysis, by Drs. A. Goodal and E. Ewart, the following conclusions were arrived at:—(1) Necrobiotic changes occur in the circulatory leucocytes in health; (2) these changes are much more evident in conditions of impaired nutrition and toxæmia, notably in cancerous cachexia; (3) in toxic conditions usually associated with leucocytosis the extent of the necrobiotic changes in the white cells varies in inverse ratio to the number of leucocytes in the circulating blood; (4) these necrobiotic changes can be rapidly induced "in vitro" by the action of certain organisms or other products; (5) the rapidity and extent of the changes depend on the kind of organisms, the virulence of the culture and the number of organisms employed.—In a paper on cross-magnetisation in iron, Mr. James Russell described a large number of experiments showing how the induction, either longitudinal or circular, was affected by cross fields and how the effects of these cross fields were themselves reacted upon. As one among many results, consider the case of a steady longitudinal field with a cyclically changing circular field superposed. The induction due to the longitudinal field went through a corresponding cycle with its maximum points occurring at the instants of greatest change in the cyclic circular field. The cyclic change in the longitudinal field was very similar in form to the change accompanying twisting.—In a note on a suggested improved method of measuring deep-sea temperatures, Prof. Knott called attention to the unsatisfactory character of the methods at present in use, and advocated the use of the platinum thermometer, with which the temperature must be taken *in situ*. Various obvious difficulties in the way of applying the platinum thermometer to deep-sea work were considered, also the manner of measuring the depth at the instant of taking the reading. For experiments down to moderate depths there was no special difficulty in using these electric resistance thermometers, and by such rapidly acting apparatus important problems connected with the penetration of solar radiation through surface waters could be readily solved.

PARIS.

Academy of Sciences, July 24.—M. Bouquet de la Grye in the chair.—On electrolytic actions developed by batteries consisting of two liquids, one being an acid, the other an alkali, by M. Berthelot.—On the existence in the albumin of birds' eggs of a fibrogen substance capable of being transformed, *in vitro*, into pseudo-organised membranes, by M. Armand Gautier. Fresh white of egg, after filtration through paper, was diluted with water and treated with a current of an indifferent gas, such as nitrogen or carbon dioxide. A substance is precipitated in the form of white transparent membranes, possessing a rudimentary organisation, and approximating in composition to the fibrin of human blood and to myosin, but differing considerably from egg-albumin.—On the glycuronic acid in the blood of the dog, by MM. Lépine and Boulud.—Report on a memoir of M. Torres concerning a scheme for a steerable balloon presented to the Academy on May 26. The committee regards the work of M. Torres as constituting a very interesting contribution to the theory of steerable balloons, and considers it desirable that

experiments on the subject should be made.—The mission to Martinique; extract from a letter of M. Lacroix to M. Michel Lévy. A short account of the experiences of the exploring party. Stress is laid on the fact that no heavy masses appear to have fallen upon St. Pierre; the destruction must have therefore been due to the effects of masses of incandescent gases. The torrential rains have caused great ravages, and in some cases have changed the hydrography of the coast. Soundings show that the sea bottom near the coast line has not undergone any appreciable alteration.—On the generalisation of the analytical prolongation, by M. Émile Borel.—Observations on the preceding communication, by M. P. Painlevé.—Anomalies presented by the charge of isolated conductors on solid dielectrics. Particular magnetic phenomena proved in the neighbourhood of the nodes of electric oscillations, by M. V. Crémieu.—On the mechanical phenomena of the electric discharge, by M. Jules Semenov. It has been generally supposed that when a spark passes between two conductors material particles are torn off each pole and carried to the opposite pole. The author describes experiments which show that no particles are removed from the positive pole and that the material carried by the spark towards the negative pole arises exclusively from the gas or vapour in the immediate neighbourhood of the positive pole.—Photograph of a multiple lightning flash, by M. Piltschnikoff.—On magnetic double refraction, by M. Quirino Majorana. The study of magnetic double refraction in solutions of ferrous chloride and of dialysed ferric oxide has led to the deduction of the following laws: the double refraction is proportional to the thickness of the liquid normal to the lines of force, to the concentration of the liquid, to the square of the field strength and to the reciprocal of the square of the wavelength.—On the atomic weight of radium, by Mme. Curie. By concentrating by fractional crystallisation a large quantity of radiferous barium chloride, about 0·1 gram of radium chloride has been obtained, the atomic weight of which, on the assumption that radium is a divalent metal, is 225. According to its chemical properties radium belongs to the series of the alkaline earths. The anhydrous chloride is spontaneously luminous.—The action of hydrochloric acid upon the sulphates of aluminium, chromium and iron, by M. A. Recoura. By the action of hydrochloric acid upon chromium sulphate a chromium chlorosulphate is obtained, $CrSO_4Cl,6H_2O$, the chlorine of which is not precipitated from its aqueous solution by silver nitrate. Freezing-point determinations showed that this compound is not dissociated in aqueous solution.—On the mixtures formed by sulphur and phosphorus at temperatures below 100° C., by M. R. Boulouch. No definite chemical combination of sulphur and phosphorus appears to be formed below 100° C. A eutectic mixture which melts sharply at 9°·8 simulates a definite compound.—On the precipitation of copper bromide and chloride by sulphuric acid, by M. Georges Viard.—Study of cerium silicide, by M. Sterba. A well-defined crystallised silicide of cerium is obtained by heating together cerium oxide and silicon in the electric furnace. Its composition is $CeSi_2$, and it possesses great stability. Its properties are different from those of calcium silicide and approximate rather to those of the silicides of the heavy metals.—The action of alcohols upon the sodium derivatives of other alcohols, by M. Marcel Guerbet. A mixture of œnanthyl alcohol, ethyl alcohol and sodium heated in sealed tubes to 230° C. gives some normal nonyl alcohol. The method appears to be a general one for obtaining higher homologues of the higher alcohols.—Study of the simultaneous distillation of two non-miscible substances, by MM. Eug. Charabot and J. Rocherolles. 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