THURSDAY, FEBRUARY 23, 1899.

THE NEW MINERALOGY.

A Text-Book of Mineralogy; with an Extended Treatise on Crystallography and Physical Mineralogy. By Edward Salisbury Dana. New edition, entirely rewritten and enlarged, with nearly 1000 Figures and a Coloured Plate. Pp. vii + 592. (New York: John Wiley and Sons. London: Chapman and Hall, Ltd., 1898.)

Manual of Determinative Mineralogy; with an Introduction on Blowpipe Analysis. By George J. Brush. Revised and enlarged, with entirely new Tables for the Identification of Minerals, by Samuel L. Penfield. Fifteenth edition. Pp. x + 312. (New York: John Wiley and Sons. London: Chapman and Hall, Ltd., 1898.)

Elemente der Mineralogie, begründet von Carl Friedrich Naumann (1873†). Dreizehnte Vollständig umgearbeitete Auflage von Dr. Ferdinand Zirkel. II. Hälfte: Specialler Theil. (Leipzig: W. Englemann. London: Williams and Norgate, 1898.)

THIRTY years ago the science of chemistry passed through a great revolution; new points of view were occupied by some investigators, and fresh lines of inquiry opened up by others; a general revision of the nomenclature and notation of the science became necessary, and thus arose what has been called "the New Chemistry." The last few years has witnessed a similar crisis in the history of mineralogy; crystallography has been reconstructed on a revised basis, and new views concerning the optical properties of crystals have rendered much of the old terminology of the science obsolete if not actually misleading.

It is a fortunate circumstance for English-speaking students and teachers of the subject that, in the first two volumes placed at the head of this article, we have a presentation of the science of mineralogy, in its modern aspects, which leaves little to be desired in the way of simplicity, precision and completeness. Prof. E. S. Dana, who is Professor of Physics as well as Curator of Mineralogy in the Yale University, gave the world in the year 1877 his "Text-Book of Mineralogy"—a very admirable introduction to the science. But as time passed on, and new methods of inquiry were invented, or old ones became obsolete, the necessary modifications and interpolations in the text of the book, when successive editions were called for, could not fail to mar the symmetry, and to some extent destroy the value of the work as a scientific treatise. Now the whole book has been rewritten, and, as its author is equally familiar with the methods and literature of physics, as well as with the technicalities and nomenclature of mineralogists—and these are by no means always in harmony with one another—a book has been produced which may be confidently recommended alike to students of the physical and the natural sciences.

Prof. S. L. Penfield, the Professor of Mineralogy in the Sheffield Scientific School of the Yale University, has similarly rewritten the well-known "Manual of Determinative Mineralogy, with an Introduction on Blowpipe Analysis," of Prof. G. J. Brush—a work which first appeared in 1874, and since that date has passed through no less than fourteen editions. It is not too much to say that, wherever determinative mineralogy has been taught to English-speaking students, the work of Brush has been adopted as by far the best and most thorough guide to the subject. Originally based on Von Kobell's "Tafeln zur Bestimmung der Mineralien," successive additions and corrections have given the work a character of its own; and without in any way impairing the efficiency or destroying the familiar features of the work, Prof. Penfield has brought the book up to date, and at the same time added much new matter which will be regarded by all teachers of the subject as being remarkable alike for lucidity and masterly treatment.

It is in the treatment of the difficult subject of crystallography that teachers and students will first appeal to these works for guidance at the present time: and they will not appeal in vain. During the last decade the six systems of crystallography have undergone complete disintegration; and an entirely new nomenclature has become necessary, in order to adequately express the great facts of isomorphism, heteromorphism, and of crystal-symmetry generally. The mathematical researhes of Sohncke, Wulff, Schönfliess, Federow, Barlow and others have shown that there are thirty-two—and only thirty-two—modes of molecular grouping possible in crystals; and, of these, exemplifications of all but three have already been observed, either among artificially crystallised salts or among natural minerals. The great majority of minerals crystallise in one or other of some eight or nine of these groups, however; while only five or six other groups are at all commonly represented among the rarer species of the mineral kingdom. It is to these groups then, and not to the more comprehensive systems of the crystallographer, that the attention of students of practical mineralogy must in future be directed; and we are indebted to Profs. Dana and Penfield for a simplification of the very cumbrous nomenclature hitherto adopted for the crystal groups. It is a distinct gain to speak of the "Pyrite-type" rather than of "pyritohedral-hemihedral forms" of the Isometric system, and of the "Quartz-type" rather than of 'trapezohedral-tetartohedral forms" of the Rhombohedral system.

The complicated mathematical questions involved in the derivation of hemihedral, tetartohedral and hemimorphic forms from holohedral ones, now lose much of their importance to the practical crystallographer. As Prof. Dana says:

"The development of the various possible kinds of hemihedral (and tetartohedral) forms under a given system has played a prominent part in the crystallography of the past, but it leads to much complexity and is distinctly less simple than the direct statement of the symmetry in each case. The latter method is systematically followed in this work; and the subject of hemihedrism is dismissed with the brief (and incomplete) statements of this and the following paragraphs."

Students of the subject familiar with the methods of older treatises on crystallography, will find that Prof. Dana has been able—while giving an admirably clear and complete account of crystallographic methods and results in 144 pages of his book—to dismiss the subjects referred to in less than a single page.

Prof. Penfield's introduction to the study of crystallography, in which the subject is admirably treated in sixty-six pages of large print, will prove of not less interest to teachers, as showing how the great fundamentals of the modern presentation of the science can be dealt with in a very moderate space. Questions like those of the projection of crystals, and the calculation of axial ratios from goniometric measurements, which are well explained in Prof. Dana's text-book, are, of course, omitted in the smaller summary of crystallography by Prof. Penfield.

The subject of the optical characters of minerals is one which in the past has always proved to be of peculiar difficulty to students of mineralogy. The important memoir of Mr. Fletcher on "The Optical Indicatrix," has recently led physicists and mineralogists to reconsider the soundness of the postulates on which Fresnel based his theories of the action of crystals on light; and there can be little doubt that the near future will witness as complete a revolution in the nomenclature and methods of physical optics, as that which we have witnessed in the case of crystallography.

At the present time, however, it seems desirable to adopt the course followed by Prof. Dana, and to lay before the student both of the accepted methods of interpreting observed phenomena in connection with the passage of light through crystals of various kinds. We feel little doubt, however, that a future edition of the "Text-Book of Mineralogy" will break altogether away from the somewhat cumbrous and complicated terminology of Fresnel—hampered as it is by unnecessary assumptions—and that a more simple and rational method of treatment, in harmony with the methods of Mr. Fletcher, will be adopted in its place. The subject of physical optics finds no place in the more elementary work of Prof. Penfield.

The second half of the "Text-Book of Mineralogy" is a very judicious abridgement of the sixth edition of Dana's excellent "System of Mineralogy," the most important features of which were described in this journal at the time the work appeared. It is scarcely necessary to add that the present book has been brought well up to date.

The concluding portion of Prof. Penfield's book is made up of the well-known analytical tables for the determination of minerals. These tables have not only been completely revised, but have now had incorporated in them a great number of new species, including not a few which are of very rare occurrence. This increase in the number of species treated of has necessitated a complete rearrangement of the tables.

Prof. Zirkel, in bringing out a new edition—the thirteenth—of Dr. Naumann's well known "Elemente der Mineralogie," has recognised equally with Profs. Dana and Penfield the necessity for a complete change in the mode of treatment of the crystallographic and optical properties of minerals. As time has not yet permitted him to altogether rewrite the introductory portions of this old standard treatise, he has contented himself with issuing a revised edition of the second or systematic portion of the volume. The excellent features of this familiar text-book are well maintained, and some improvements are introduced into it, especially in the clearer and fuller treatment of the mode of occurrence of the different mineral species. We trust that the indefatigable editor, who has so long kept Naumann's book in the first rank of treatises of the science, may before long be able to supply us with that complete revision of the groundwork of the subject which he contemplates.

JOHN W. JUDD.

THE THEORY OF FUNCTIONS.

Introduction to the Theory of Analytic Functions. By J. Harkness, M.A., and F. Morley, Sc.D. Pp. xv + 336. (London: Macmillan and Co., Ltd., 1898.)

A NOTICE of the "Treatise on the Theory of Functions," by Profs. Harkness and Morley, appeared in NATURE during 1894 (vol. xlix. p. 477). The object of that work, as of Prof. Forsyth's book on the same subject, was to present a complete view of the theory as a whole, and to follow out its various developments as far as space permitted. It would not be correct to regard either of them as written for a student who could be fairly described as a beginner. What Prof. Klein somewhere calls "a certain ripeness of mathematical judgment," which is just what a beginner does not possess, would be necessary in a reader who, without previous knowledge of the subject, could study such volumes with profit.

The new work by Profs. Harkness and Morley, the title of which is given above, is stated in the preface, and quite justly stated, to be in no sense an abridgment of their earlier and larger treatise. The authors say that their aim in writing it has been purely didactic, and that the book is intended to be an introduction to the subject for a student with no previous knowledge of it. The scope of the book will be best described by giving a short account of what it contains. It commences with an introductory chapter on ordinal numbers. The second chapter explains the representation of a complex number by means of an Argand diagram; and the third and fifth chapters deal at some length with the correspondence established between two planes, distinct or the same, by means of a lineo-linear equation between two variables. The fourth chapter discusses the logarithmic function from a special point of view. Chapter vii. deals with rational algebraic functions. In Chapters vi., viii. and ix. the idea of a limit, the conception of continuity, and the definition of convergence in connection with an infinite series are introduced. The conditions under which an infinite series has the properties of an ordinary sum are very completely investigated. Then follow five chapters which treat of power-series, and of some of the properties of an analytic function defined by a power-series and its continuations. Chapter xv. considers the representation of an integral function as a product of primary factors, each of which has a single zero. Next come a chapter on the integration of a function of a complex variable, and three chapters treating very briefly of the elliptic functions. Chapters xx. and xxi. deal with some of the properties of algebraic functions and with the construction and use of Riemann's surfaces in connection with them. The last chapter gives some account of the method of Cauchy and of the theory of the potential.

Opinions will and must differ as to what should be admitted into and what excluded from a book which is

to serve as an introduction to a subject of vast extent. It will be obvious from the preceding account of its contents that the space allotted in this book to algebraic functions is comparatively small. In the present writer's opinion it might with advantage have been considerably increased. Again, it seems a pity that the well-established use of a closed convex surface—a sphere, for instance—as a *locus in quo* for the geometrical representation of a complex variable has been omitted. The possibility of its use is indeed implied in one passage (p. 43), but the sphere is not actually used for the purpose of geometrical representation at all. The apparently exceptional nature of the value $x = \infty$ is undoubtedly at first a stumbling-block to the student, and the use of the sphere as an alternative to the plane would have been a help to him in this respect as well as in others. The excellent and detailed discussion of infinite series should certainly have been supplemented in the proper place by some corresponding discussion of infinite products. This point is referred to again below.

In the main, the authors have carried out the programme they have put before themselves well and thoroughly; their reasoning is in general rigorous and clearly expressed. Here and there however throughout the book there are signs of what appears to be undue haste in putting the matter together. Sentences not unfrequently occur which it is necessary to read more than once before their meaning is grasped; and sometimes, in passing from a sentence to the next, one experiences too great a sensation of transition. Moreover, haste appears occasionally to have led to inaccuracy. Two or three examples of this may be given.

The first chapter is intended to give the reader "a distinct image of a number divorced from measurement." On p. 3 occurs the sentence: "We can think of an infinity of objects as interpolated in the natural row, so that each shall bear a distinct rational number, and so that we can assert which of any two comes first." What is meant here by "an infinity of objects"? No test has been given in the sentences which precede the one quoted by which a finite assemblage of objects can be distinguished from an infinite assemblage; and without such a test the sentence quoted appears to beg the whole question discussed in the first chapter.

As a second instance, the opening sentences of Chapter xv. may be quoted.

"Let $a_1, a_2, \ldots, a_n, \ldots$ be a sequence of positive numbers, less than unity. Then

$$(1 - a_1)(1 - a_2) > 1 - a_1 - a_2,$$
$$(1 - a_1)(1 - a_2)(1 - a_3) > 1 - a_1 - a_2 - a_3,$$

and so on.

"Hence if the series Σa_n has a sum s, the products $\prod_1^n (1 - a_m)$ form a sequence of numbers which (1) do not increase, (2) remain greater than $1 - s$. Hence they have a limit; and the infinite operation $\Pi(1 - a_n)$ is convergent; the limit is called the product, and is itself often denoted by $(\Pi 1 - a_n)$."

This is the first place in which an infinite product has occurred in the book, and what is implied in calling such a product convergent has not been explained. The statement that "the infinite operation $\Pi(1-a_n)$ is convergent" is therefore meaningless as it stands. Moreover, with the usual definition of convergence for an infinite product, the proof as given is inaccurate. For if Σa_n is greater than unity, all that has been proved is that $\Pi(1 - a_n)$ is less than unity and greater than some definite negative quantity.

In an illustrative example on p. 232 the following passage occurs:

"By subtraction we have for $|x| = 1$, $x = -1$ excepted,

$$\text{Log } x = \left(x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} + \ldots\right) - \left(\frac{1}{x} - \frac{1}{2x^2} + \frac{1}{3x^3} - \frac{1}{4x^4} + \ldots\right)$$
$$= \frac{x - \frac{1}{x}}{1} - \frac{x^2 - \frac{1}{x^2}}{2} + \frac{x^3 - \frac{1}{x^3}}{3} - \frac{x^4 - \frac{1}{x^4}}{4} + \ldots"$$

The rearrangement involved in passing from the second to the third line of this quotation is one which cannot be used with conditionally convergent series, as indeed the authors have most clearly shown in an earlier chapter.

It is not implied that a few inaccuracies such as the above really impair the value of the book. The authors have certainly made a most useful addition to the gradually increasing number of English text-books of modern type; and all teachers who have to introduce their pupils to the elements of function-theory will be grateful to them.

One further remark in conclusion. The reader of a mathematical text-book does not in general expect amusement as well as instruction; but surely, in such a work as that under notice, the *definition* of Log x by means of a piece of string and a cone which "should not be polished" (p. 47), has its humorous side.

W. BURNSIDE.

THE "IMPROVEMENT" OF FRUITS.

Sketch of the Evolution of our Native Fruits. By L. H. Bailey. Pp. xiii + 472; illustrated. (New York: The Macmillan Company. London: Macmillan and Co., Ltd.).

THE main purpose of this book is to give illustrations of the progress made in the development of the edible fruits of North America from their wild progenitors. This is what our fathers would have said; nowadays we express the same meaning in different words, and, as Prof. Bailey writes, we "attempt to expound the progress of evolution in objects which are familiar, and which have not yet been greatly modified by man." The United States offer an exceptionally good field for investigations of this kind. The wild plants are still there, relatively speaking unmodified by man. Cultivation and experiment are of recent date as compared with the long ages that have elapsed since "Noah began to be an husbandman" and prehistoric lake-dwellers dropped the seeds of the grape into the mud of Swiss lakes. Throughout Europe and Asia there is but one cultivated species of *Vitis* recognised, the *Vitis vinifera*, and from it have sprung the countless host of named varieties which are cultivated in the vineyards, and the smaller, though still considerable, numbers [that are grown in this country

under glass. The vine as known here is a composite product, representing the sum of the selection that has taken place during the course of the ages. But the selection has always been within the limits of one species, and for one particular purpose. As the vine is grown for its fruit, we might naturally expect the greatest amount of variation to be manifested in the berries. Systematists tell us that in such cases we should for comparative and historical purposes attach more weight to characters afforded by organs which have not been subjected to man's interference, than to those which are the result of intentional selection. This sounds plausibly, but in practice any one who studies the leaves of the vine will probably find in the foliage which has not been intentionally selected, as great, or even a larger, amount of variation than he will in the fruit.

In the case of the American vines the circumstances are different. There are twenty or thirty native species and a large number of varieties which have been classified by the author of this treatise. By the commingling of a few of these there have been produced within the comparatively short time that has been at the disposal of American cultivators, no fewer than eight hundred "domestic" varieties.

Of these varieties some are found specially suitable to one locality, or to one set of circumstances, whilst others adapt themselves to a different environment. It may seem to some mere ingenious trifling to concern oneself with all these morphologically petty variations. The naturalist knows better, the evolutionist finds himself placed in possession of an armoury of facts; whilst, to give only one illustration, the severely practical man is rendered happy by finding himself endowed with varieties which are relatively uninjured by Phylloxera, and on which, therefore, the European varieties may be engrafted. If a great plague has not been entirely stayed, at least its consequences have been evaded by this practical application of a variation in constitutional endowment.

On all grounds then, scientific, taxonomic or economic, the study of these variations assumes such great importance that naturalists have cause to be grateful to Prof. Bailey for the suggestive book that he has put at their disposal.

The principal aim of the book may be divined from our previous remarks. It is only necessary to add that the fruits treated of are the grape, the mulberry, the plums and cherries, the native apples, the raspberry, blackberry, and sundry other fruits. The history and evolution of these are sketched in a very instructtve and interesting fashion. One thing comes out strongly, and that is that the amelioration of fruits in the United States is better secured by experiment with American species, than with those of European origin. The "environment" is more propitious to the native than to the introduced species.

This fact may, however, be set against others; such as the extraordinary vigour which some species are known to manifest when transferred to a new country, enabling them even to oust the aborigines! Again, in the old countries it is generally more immediately advantageous to improve what we have, than to break entirely new ground. In the one case we have everything to work up, in the other we begin with the advantages conferred by long years of inheritance. In this connection we are of course speaking from the point of view of the practical cultivator always clamouring for immediate results. If time is not of the essence of the matter, and only the sure but slow advance of science is concerned, then it would probably eventually be more fruitful to endeavour to turn to account the opportunities offered to us by the tens of thousands of plants which surround us, with only a few scores of which, at present, we avail ourselves.

Whatever be their needs or their predilections, naturalists will find Prof. Bailey's book a most valuable addition to their book-shelves.

LEGENDS OF THE NORTH AMERICAN INDIANS.

Creation Myths of Primitive America in relation to the Religious History and Mental Development of Mankind. By Jeremiah Curtin. Pp. xxxix + 532. (London: Williams and Norgate, 1899.)

THIS book is to a great extent a product of journalistic enterprise. In 1895 Mr. Curtin made an arrangement with the editor of a newspaper, by which he was to travel among some of the Indian tribes of North America and collect myth-tales; the most interesting of those that he might come across he was to send to the paper for publication at regular intervals. Mr. Curtin carried out his agreement. He travelled in California, Mexico and Guatemala, and the twenty-two myth-tales or stories here collected have all previously been published in the newspaper from which he obtained his commission. Science is, perhaps, better served when she is not written to order; but there can be no doubt that Mr. Curtin has collected a number of traditions that will be of great interest to students of the beliefs of savage and undeveloped races.

The myths published in the volume are some of those still current among the Wintus and Yanas, two stocks of Indians whose numbers have suffered considerable diminution during recent years. The Wintus formerly occupied the part of California on the right bank of the Sacramento from Mount Shasta to the northern shore of San Francisco Bay. Half a century ago they may have numbered some 10,000; to-day not more than 500 of them survive. The Yanas have suffered still more severely. Before the year 1864 they probably numbered some 3000; but in that year, in consequence of the murder of some white men in their district, the tribe was practically exterminated by the mining population of northern California; not more than fifty escaped. It is not improbable that before the advance of civilisation these tribes will soon cease to exist. Mr. Curtin has, therefore, done well in rescuing what still remains of their traditional system of belief before it disappears altogether.

The Indians have no very definite theory of creation, and their conceptions on this subject, which really affect their daily life to a considerable extent, can only be gathered from the long rambling stories, passed down with little change through many generations. The stories told by the Wintus and the Yanas resemble many others to be found among the various Indian tribes of North America, and those here published may perhaps, be conveniently, though rather roughly, classified

as "creation-myths." They do not give any systematised account of the origin of the universe, but in the form of tales describe the changes and metamorphoses by which the present world arose from a very similar one already in existence. According to this theory of creation there were people already in existence before the present race of men (that is of Indians) inhabited the earth. These first people were very numerous, and lived happily in a golden age through untold periods of time; they were in a sense divinities. At length disorder was introduced, and from the conflicts that resulted the present world arose. The creation-myths recount the methods by which this older world was changed into the world now existing. The changes were generally effected by struggle between hostile personages, one hero, perhaps, overcoming many opponents, and changing each into some beast, bird, plant or insect, the resultant beast or thing always corresponding in some power or quality with the personage from which it had been changed. Such conceptions are not peculiar to Wintu and Yana belief, but run through the traditions of most Indian tribes. We do not, however, agree with Mr. Curtin in thinking that similar traditions lie at the back of all the mythologies of the ancient world.

There is one slight defect in the general plan of the book that calls for notice, though it is, perhaps, due to the rather unusual circumstances which attended its birth. On opening the volume, a glance at the type and paper would suggest that the book was a novel or a collection of short stories; and, though a writer may make use of what type he likes so long as it is legible, in this instance Mr. Curtin's selection serves to indicate the spirit in which he has approached his work. He has, in fact, attempted to treat these legends from a literary rather than from a scientific standpoint, and it cannot be said that the result is altogether satisfactory. As might be expected, these stories, judged on their own merits as stories, are entirely lacking in interest, and their only value consists in the new material they offer to the student of folk-lore and comparative religion. Mr. Curtin, however, does not seem to be writing for such a reader. It is true that at the end some notes are added, but they omit a great deal of information necessary to any scientific collection of this class. For instance, no details are given as to the sources from which Mr. Curtin obtained the legends that he prints. We should like to know whether they were composed in their present form by Mr. Curtin himself from materials supplied at different times by several members of a tribe; or whether they are translations of actual stories told to him, and taken down by him at the time. We cannot help thinking that if full information on such points had been added, the scientific value of the book would have been considerably increased.

OUR BOOK SHELF.

An Illustrated School Geography. By Andrew J. Herbertson, F.R.S.E., F.R.G.S. Pp. vii + 263. (London: Edward Arnold, 1898.)

IT would be difficult to produce a more elaborately and attractively illustrated volume of geography than that which Mr. Herbertson has constructed upon the basis of Mr. Frye's "Complete Geography," published in the United States three years ago. Every one of the quarto pages contains a pleasing collection of pictures, many of them striking and all of them instructive, and at the end of the volume are sixteen pages of coloured physical and political maps. The volume is thus a text-book, a picture-book, and an atlas combined; and for teachers who consider that books constituted in this way should be used in teaching geography, no better volume is available.

The work might be called a picture-book of geography; for the illustrations take up nearly as much room as the text. The pictures will show the young students who open the book what a large number of interesting people, places and things there are in the world, and will thus create a desire to read the text to learn something about the subjects illustrated. Let a pupil get the idea that geography consists mainly of definitions and statistics, and you will have a difficulty in ever making him believe that there is anything interesting in the study of the earth. But by introducing him to the subject through such an attractive means as Mr. Herbertson's volume affords, attention is at once secured.

The plan of the volume is as follows: After an introduction comes a section dealing with general geography, and including the principles of physical geography; biogeography, or the distribution of plants and animals; and the geography of mankind. In the second part, the special geography of the various countries of the earth is dealt with, beginning with the British Isles. It is intended that after the different aspects of geography referred to have been studied in a general way, the special geography of particular countries shall be considered, so that the principles taught by the first part shall be applied to the parts of the world studied in the second part. Teachers who think that principles should be deduced by pupils from facts will be able to begin at once with the special geography, and will introduce the generalisations where required. Whichever method is adopted, a truly educational course will be obtained; for the knowledge gained will show that many every-day phenomena of nature belong to geography, and carry instruction with them.

Notes on Cage Birds (Second series); *or, Practical Hints on the Management of British and Foreign Cage Birds, Hybrids, and Canaries*. Edited by W. T. Greene. Pp. xii + 340. (London: L. Upcott Gill, 1898.)

IN spite of all that has been and will be said and written against it, the practice of keeping birds in confinement is so popular and so wide-spread, that there is no chance of its coming to an end. This being so, it is all-important that everything possible to alleviate the tedium of their confinement, and to preserve them in the best health, should be done for the captives. And as this is one of the objects of the little book before us, it may be commended to all bird-fanciers. Still, it is rather sad to read that "once a bird has lived in a cage or aviary for a time it is unfitted for a life of freedom, and usually quickly dies if permitted to fly away."

The book consists of a series of extracts from *The Bazaar*, written by various bird-fanciers since 1882, which have been classified and arranged by Dr. Greene; whose known experience affords sufficient guarantee for the selection. To an outsider, it is almost marvellous to note the number of species apparently ill-suited for captivity which have been made to thrive, and frequently even to breed, in this condition. And it is also satisfactory to learn that it is one of the objects of the "fancy" to endeavour to protect our native birds; especially species, like the starling, which are undoubtedly beneficial.

The appearance of the book is sadly marred by the introduction of hideous advertisements on the back of the title-page, &c.; but in other respects it is well and attractively got-up. R. L.

LETTERS TO THE EDITOR.

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

A Stream of Alluvium.

IN a private letter, Captain Roberts, Medical Officer at Gilgit, sends me the following information, which may interest some of your readers. He says that near Owir, which is near Drasan in the Turikho valley of Chitral, there is a curious object which he describes as a "glacier of alluvium." It fills the bed of a *nullah* which comes down from a ridge of Tirich Mir, and is free of snow. It appears to consist entirely of a moving mass of earth, &c. The top of the *nullah* is at about 12,000 feet and the foot of it at about 5000 feet above sea-level, and it is about five miles long. There is neither ice nor snow above or within this moving mass. It has an undulating, broken surface, and looks like a moraine-covered glacier, except that grass grows upon it in places, and even a few cultivation-terraces have been made upon it by the neighbouring villagers. Its breadth is about 200 yards. There is a stream in a depression on each flank of it, between it and the hillside. The villagers state that it is no new phenomenon. They say that it is always on the move. There are some trees upon it, and by the change in their position, as reported by the natives, it is concluded that the rate of movement is about 200 yards a year. The thing, therefore, is not any sort of mud avalanche. As above stated, parts of the surface are cultivated; but the natives have given up attempting to build houses upon it, because they always tumble down. Captain Roberts is attempting to get a photograph taken of this curious locality.

MARTIN CONWAY.

Chemists and Chemical Industries.

I SEE with pleasure that the notice of Dr. Fischer's pamphlet on technological education has been written by Prof. Meldola, one of the few men who by experience has a competent knowledge of the real needs of this country.

Dr. Fischer, of course, confines himself to one side of the question, and leaves out of sight the clever finance, the ingenious and somewhat Bismarckian trading methods which have combined with sound technical knowledge to place Germany in a position of superiority.

These equally demand the serious attention of our commercial men.

On the question of education—its character and extent when required to furnish skilled chemical manufacturers—Dr. Fischer has the support of a distinguished master of chemical manufacturing and trading, as practised by German firms, in the person of Dr. Böttinger; and there can be no doubt that the German Government will listen to their advice, and endeavour to provide the education for which they ask.

But while Germany—thus awake to the necessity of maintaining her position—is preparing to act, what are we in this country doing?

Our so-called technical instructors will perhaps pride themselves that their efforts have fluttered the German dovecots. Nothing can be further from the truth. The real cause is almost entirely a financial alarm, caused by energetic commercial attacks upon the chemical trade now coming from three quarters—England, France, and America. Germany considers that this can best be met by improvement in technical knowledge on the part of the *officers* of the industrial army.

Meanwhile we are establishing technical schools, institutes, polytechnics, and so on, and teaching smatterings of science to workmen.

What is the result? Our well-equipped technical schools confine themselves to producing not technologists, but teachers.

Germany turns out 95 per cent. technologists, 5 per cent. teachers. Here things are reversed. The reason is plain. Here the persons consulted in such matters have been almost without exception academical chemists, chemical pedagogues. What the manufacturers want has not been asked; the professors know what is good for them, and will provide it. The national attitude so often denounced in the reports of our consuls on the failures of British traders in foreign markets. The London County Council appoints a technical instruction committee—all educationists; the committee does inquire as to the needs of chemical manufacturers, but selects as typical the trades of sulphuric acid and alkali making, in which the problems have been reduced to almost purely engineering ones, where magnitude of output and vast financial interests have reduced price until the margin for chemical movement has been contracted to almost nil. On the other hand, no representative of the organic chemical manufactures, in which these conditions are absolutely reversed, was deemed worthy of consultation.

And so we go on, and waste our energies on schoolboy work, and our money on polytechnic smattering, and the daily addition to those who must teach because no factory wants them.

Meantime every word that Fischer and Böttinger, Lunge and Meldola urge is true.

A technological faculty *is* wanted, and could be readily organised. But as long as the teaching of technical chemistry is controlled by those without any factory experience we shall flounder on. Chemical schoolmasters will abound. Our technologists must come from Germany, or go there to be "made," and the advertisement for "a chemist to act under the orders of the engineer of so and so, salary two guineas a week, one month's notice required and given," &c., will be the criterion by which we understand what is the British appreciation of the chemist.

115 Darenth Road, N., February 20. R. J. FRISWELL.

THE perusal of Prof. Meldola's interesting review (NATURE, vol. lix. p. 361) of Fischer's pamphlet on German chemical technology tempts me to recount an experience which befel me a year or so ago, and which in a way accentuates the contrast drawn by Prof. Meldola between chemical trade methods in England and Germany.

Finding that the collection of specimens of raw materials, bye-products and commercial products available for illustrating my lectures on applied chemistry at the institution at which I have the honour to teach was woefully inadequate, I very naturally made attempts to remedy the deficiency.

In the first place, I addressed nearly a hundred letters to various English manufacturing firms, asking for specimens of the kind described. Most of my letters were received with an expressive silence, and some elicited replies in which the writer's indignation at the impudence of my request was expressed with some vigour; in response to about half a dozen of my begging letters, however, I was presented with the desired specimens, and in some of these cases I am bound to say considerable pains had been taken to provide a really instructive series of specimens. For these I am truly grateful, and can respect the spirit in which the specimens were presented; but half a dozen sets of specimens are quite insufficient to illustrate the magnitude and scope of modern chemical technology. It should be re marked that some of the more churlish of my correspondents suggested that if the specimens were needed we should buy hem; the well-known liberality of my governing body in educational matters is sufficient guarantee that the articles required would have been purchased long ago if they were on the market.

In my need I therefore addressed a second and similar series of letters, this time to German manufacturing firms; in almost all cases I received a notification that sets of specimens were being prepared. And very shortly I was inundated with packing-cases bearing the stamp "Made in Germany," and filled with comprehensive and admirably designed collections of specimens and patterns illustrating the particular branch of technology concerned. My lecture table is now daily well-stocked with specimens of German manufacture.

The explanation of the difference appears to be that the foreigner was quick to recognise that the young men who are my students to-day will to-morrow be in charge of works using large quantities of chemical products, and was quick to realise that the presence of his specimens on the lecturer's table is a better advertisement than costly notices of his goods in English trade journals; the English manufacturers, with a few noteworthy exceptions, did not accept this view of the matter.

WILLIAM JACKSON POPE.

Department of Chemistry, Goldsmiths' Institute, New Cross.

A SIMPLE SPECTROSCOPE AND ITS TEACHINGS.[1]

II.

Series.

MESSRS. RUNGE AND PASCHEN[2] first showed in 1890 that the spectra of lithium, sodium, and potassium were the summation of the spectra of various

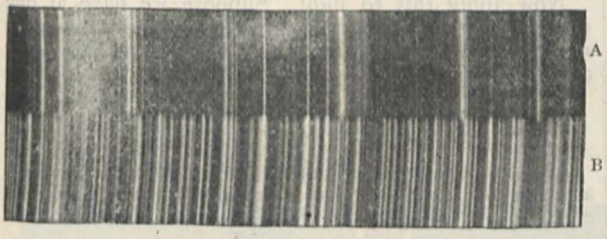

FIG. 7.—Parts of the spectra of (A) barium and (B) iron (from a photograph).

"series." Later they have shown that lead and other metals and the Cleveite gases follow suit.

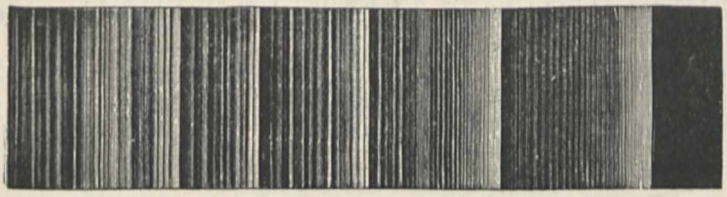

FIG. 8.—Fluting of carbon.

A "series" of spectral lines may be defined as a sequence of lines the intensity of which decreases with

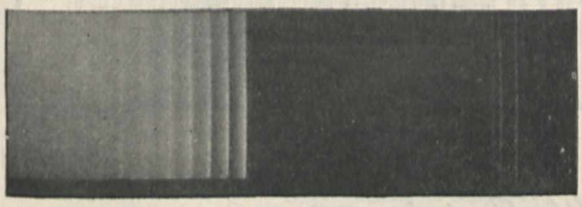

FIG. 9.—Fluting of magnesium.

the wave-length, and the number of vibrations of which may be determined by the formula—

$$A + B/n^2 + C/n^4,$$

where n is given the integers from three upwards, and the constants A, B, and C are determined for each element separately.

The fact that lines must close up to one another, as the violet end of the spectrum is reached, indicates that the character of a "series" is best brought under notice in the ultra-violet end of the spectrum. In the visible part of the spectrum the lines forming "series" are too far apart to be recognised as belonging to series.

As soon as it becomes apparent that a set of lines in the violet seems to form a series, computation will at once give the lines that belong to it in the visible part of the spectrum.

The accompanying diagram (Fig. 10) shows how the apparently irregular lines observed in the spectra of the Cleveite gases can be arranged into the most exquisite order when the six series of lines which build up the spectra are shown separately.

[1] Continued from p. 373. [2] *Abh. k. Akad. Wiss.*, Berlin, 1890.

Some of these series are composed of triplets instead of single lines.

I wrote thus on this subject in 1879:—

"I am at present engaged in investigating this question of rhythm, and I have already found that many of the first order lines of iron may probably arise from the superposition or integration of a number of rhythmical triplets. All this goes to show how long the series of simplifications is that we bring about in the case of the so-called elementary bodies by the application of a temperature that we cannot as yet define.

"Indeed, the more one studies spectra in detail, and especially under varying conditions of temperature which enable us to observe the reversal now of this set of lines, now of that, the more complex becomes the possible origin. Some spectra are full of doublets; others, again, are full of triplets, the wider member being sometimes on the more, sometimes on the less, refrangible side."[1]

Mascart[2] had noted this recurrence of similar features in spectra ten years earlier.

Discontinuous Spectra with Dark Lines.

It is time now to make still another experiment with our needle and prism.

If we study sunlight—taking care again to shield the prism, by allowing a sunbeam to illuminate the needle, we get a spectrum of a kind differing from those we have seen before, inasmuch as the continuous band of colour is broken, it is full of dark lines; that is, some of the coloured rays are lacking; and hence images of the needle are not forthcoming in places. The positions of some of the chief dark lines lettered by Fraunhofer are shown in Fig. 11.

We now know that this result is produced by what is termed the *absorption of light*. To understand it we have only to look at a candle through glasses of different colours: a blue glass absorbs or stops the blue light, and only the red end of the spectrum remains; a red glass absorbs or stops the red, and only the blue end remains.

In these cases large regions of the spectrum are alternately blotted out as differently coloured glasses are used, but the absorption with which we have to do mostly is of a more restricted character; lines, that is single images of the slit, are in question.

One of the most important things that has been gathered from the study of these absorption effects is that if we look at a light source competent to give us a continuous spectrum, through any of the vapours or

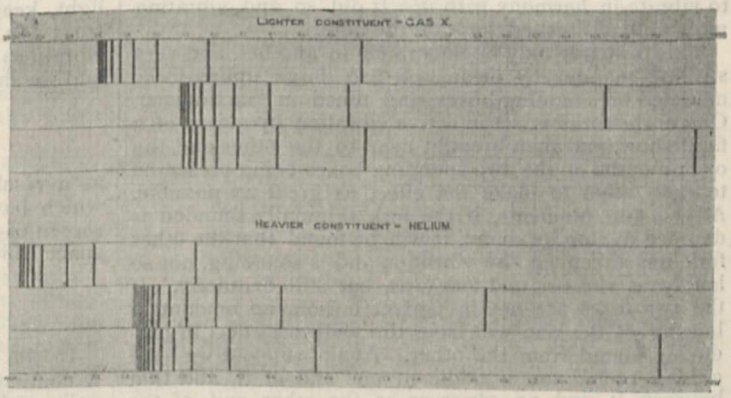

FIG. 10.—The series in the Cleveite gases.

[1] *Proc.* Roy. Soc., vol. xxviii., March 1879.

[2] In 1869, he wrote as follows: "Il semble difficile que la reproduction d'un pareil phénomène soit un effet du hasard: n'est-il pas plus naturel d'admettre que ces groupes de raies semblables sont des harmoniques qui tiennent à la constitution moléculaire du gaz lumineux? Il faudra sans

gases we have so far considered as producing bright lines; provided the light source is hotter than the gases or vapours, the particular rays constituting the bright line or discontinuous spectrum of each of the vapours as gases will be cut out from the light of the continuous spectrum.

Explanation of Absorption.

While in the giving out of light we are dealing with molecular vibration taking place so energetically as to give rise to luminous radiation; absorption phenomena afford us evidence of this motion of the molecules when their vibrations are far less violent. The molecules can only vibrate each in its own period, and they will even take up vibrations from light which is passing among them, provided always that the light thus passing among them contains the proper vibrations.

An illustration from what happens in the case of sound will help to make this clear. If we go into a quiet room where there is a piano, and sing a note and stop suddenly, we find that note echoed back from the piano. If we sing another note, we find that it also is re-echoed from the piano. How is this? When we have sung a particular note, we have thrown the air into a particular state of vibration. One wire in the piano was competent any one of the open strings of the solitary fiddle. Why? The reason is that the air-pulses set up by the open strings of this fiddle, in unison with all the others, would set all the other open strings in vibration; the air pulses set in motion by the vibration of the fiddle cannot set all those strings vibrating and still pass on to one's ear at the other end of the room as if nothing had happened to them.

Now apply this to light. Suppose we have at one end of a room a vivid light-source giving us all possible waves of light from red to violet. This we may represent as before by

V I B G Y O R

Also suppose that we have in the middle of the room a screen of molecules, say a sodium flame, capable of emitting yellow light,

Y

What will happen? Will the light come to our eyes exactly as if the molecules were not there? No; it will not. What, then, will be the difference? The molecules which vibrate at such a rate that they give out orange

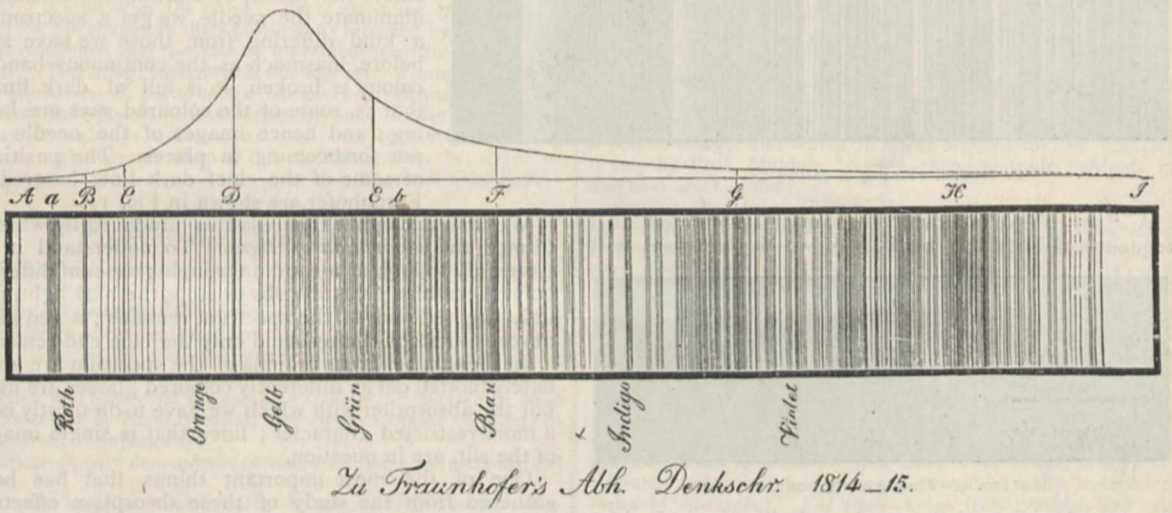

FIG. 11.—Copy of Fraunhofer's map of the solar spectrum.

to vibrate in harmony with it. It did so, and, vibrating after we had finished, kept on the note.

This principle may be illustrated in another and very striking manner by means of two large tuning-forks mounted on sounding-boxes and tuned in exact unison. One of the forks is set in active vibration by means of a fiddle-bow, and then brought near to the other one, the open mouths of the two sounding-boxes being presented to each other to make the effect as great as possible. After a few moments, if the fork originally sounded is damped to stop its sound, it will be found that the other fork has taken up the vibration and is sounding, not so loudly as the original fork was, but still distinctly. If the two forks are not in perfect unison, no amount of bowing of the one will have the slightest effect in producing sound from the other. Again, suppose we have a long room, and a fiddle at one end of it, and that between it and an observer at the other end of the room there is a screen of fiddles, all tuned like the solitary one, we can imagine that in that case the observer would scarcely hear the note produced upon

light, keep for their own purpose—filch, so to speak, from the light passing through them—the particular vibrations which they want to carry on their own motions, and we shall have

V I B G O R

as a result; the light comes to us minus the vibrations which have thus been utilised, as we may put it, by the screen of vapour. We have, in fact, an apparently dark space which may be represented thus;

V I B G **Y** O R

In the spectroscope we see what would otherwise be a continuous spectrum, with a dark band across the yellow absolutely identical in position with the bright band observed when the molecules of the vapour of which the screen is composed radiated light in the first instance. It is not, however, a case of absolute blackness, or absence of that particular ray, for the molecules are set in vibration by the rays which they absorb, and

doute un grand nombre d'observations analogues pour découvrir la loi qui régit ces harmoniques."

therefore give out some light, but it is so feeble as to appear black by contrast with the very much brighter rays coming direct from the original source.

This great law may be summed up as follows: *Gases and vapours, when relatively cool, absorb those rays which they themselves emit when incandescent;* the absorption is continuous or discontinuous (or selective) as the radiation is continuous or discontinuous (or selective).

I have referred to this matter at some length because in our light sources, in the sun, and in many of the stars we have light from a more highly heated centre passing through an envelope of cooler vapours, and on this account absorption phenomena are produced.

Our knowledge of the chemistry of the sun and stars is founded upon the exact coincidence of the bright lines

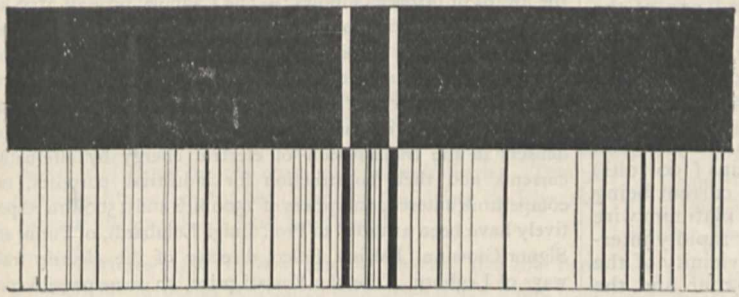

FIG. 12.—The coincidence of the bright double orange lines of sodium vapour with the dark lines, D, of Fraunhofer.

seen in our laboratories with the dark lines noted in the spectra of those celestial bodies. The diagram shows the coincidence in the case of the double orange line of sodium vapour with dark lines in the spectrum of the sun.

Now if my reader has not hesitated to invest his or her sixpence in a prism, and has had the patience (no other quality is needed) to do what I have suggested, the way is open to read with intelligence most books involving spectrum analysis which he or she is likely to come across; terms such as

Spectrum	Discontinuous (or selective) spectrum
Continuous spectrum	Fraunhofer lines
Grating	Wave-length
Prism	Radiation
Spectroscope	Absorption
Slit	Series
Line spectra	
Fluted spectra	

should now have acquired a definite meaning, and I trust the expressiveness of the terms will be acknowledged while they are accepted as part of the future mental stock-in-trade.

NORMAN LOCKYER.

TO CALCULATE A TABLE OF LOGARITHMS.

HAVING been asked to give a short course of lectures to working men, which involved an account of logarithms and the slide-rule, I felt that, although not important, there would be some advantage in being able to show them how they could calculate a table of logarithms and a table of antilogarithms for themselves. Not that they need do so except as an interesting exercise, for I do not think it necessary that a man or boy must be able to make a tool before he is allowed to use it, but it would do them no harm to explain to them a simple method if I could invent one.

Of course on the usual assumption that one must first understand the exponential theorem, it is absurd to think that even average schoolboys who have been six years at mathematics can understand how logarithms are calculated. But if a schoolboy has been told what a logarithm means, and if he can extract a square root by the ordinary arithmetical method, and especially if he has had a sensible teacher and been allowed to use tables of logarithms, I think that he will have no difficulty in understanding the following method, and will rather enjoy working at it a little.

Let him find $10^{1/2}$, $10^{1/4}$, $10^{1/8}$, $10^{1/16}$, $10^{1/32}$, by repeatedly extracting square roots, getting out his answers to five significant figures, say. Let him now by multiplication calculate $10^{3/32}$, $10^{5/32}$, &c., right up to 10^{1}. He thus has a table of which I give the beginning and end.

Number.	Logarithm.
1·0000	0·00000
1·0746	0·03125
1·1548	0·06250
1·2409	0·09375
1·3336	0·12500
.	.
.	.
.	.
8·0584	0·90625
8·6596	0·09750
9·3057	0·96875
10·0000	1·00000

If he plots these values on squared paper he gets a curve which enables him to find the logarithm of any number.

If he wants answers right to four significant figures, it is well to draw only a small part of the curve on one sheet of squared paper. Thus plotting the first three points so that the curve joining them (using a slightly bent straight-edge) passes diagonally through a small sheet of squared paper, one of my students has found answers which are sufficiently correct to impress a student with the value of the method. I give here seven values taken at random from the curves of the early and the late parts of the table. This was the first time that he had tried the method, and the small errors in the fourth significant figures are not likely to occur if a man has more practice.

Number.	Logarithm as measured.	Correct logarithm.
1·035	·0149	·0149
1·110	·0452	·0453
1·151	·0610	·0611
8·950	·9520	·9518
9·175	·9626	·9626
9·345	·9706	·9705
9·825	·9923	·9923

Even with the very cheapest squared paper we can construct tables of logarithms and antilogarithms which will be quite accurate to three significant figures, and by taking twice the trouble and using $10^{1/64}$ we may get a table accurate to four significant figures, even with very cheap paper. Also it is to be noticed that by using $10^{1/128}$ and higher roots, we can find the logarithm of any particular number with any amount of accuracy desired.

JOHN PERRY.

Royal College of Science, February 16.

A NEW CURRENT INTERRUPTER FOR INDUCTION COILS.

MAY I call attention to the most remarkable electrolytic current interrupter due to Dr. A. Wehnelt, of Charlottenburg, which appears to me to be by far the most important improvement that has been made in connection with Ruhmkorff induction coils for many years. From a description in the *Electrical Review* for February 17 we have made in this laboratory one of these appliances, and tried it on a 10-inch Apps coil. The apparatus is of extreme simplicity, consisting merely of a glass vessel filled with dilute sulphuric acid, into which dip two electrodes. One of these is a plate of lead of considerable area. The other is a glass tube, through the end of which protrudes a short piece of platinum wire, sealed into the glass. The glass tube is open at the other end, and is filled with mercury, into which is dipped one of the wires from a source of continuous electric current; in our case the mains of the Westminster Electric Supply Company. The glass tube is immersed in the acid so that the platinum wire is some distance below the surface, and is within half an inch or so of the lead plate. No condenser is employed, the primary terminals of the coil being directly connected to the supply mains (100 volts) through the electrolytic cell, the positive current being arranged to pass through the cell from the platinum wire to the lead. On turning on the current a rapidly intermittent arc is seen to take place in the vicinity of the platinum wire, apparently between the latter and the dilute acid. Judging from the loud hum, the frequency must be some hundreds per second. At the same time, between the terminals of the secondary of the coil placed some five or six inches apart, a perfect torrent of sparks takes place, which follow one another so fast that the stream appears to be almost continuous. The effect is in fact very similar to that produced with a Tesla high frequency coil, but is much more constant and much less diffuse, while the stream of sparks curls about in a curious and distinctive manner, emitting all the time a very loud and continuous note.

The arrangement seems likely to have wide and important applications in connection with Röntgen-rays, wireless telegraphy, and many other purposes. It is a distinct step towards obtaining, from continuous currents, alternating currents of any desired high frequency without the necessity of moving parts. A. A. C. SWINTON.

63 Victoria Street, S.W.

NOTES.

IN view of the advancement of zoological science to be expected from researches in the South Polar Lands and Seas, the Council of the Zoological Society of London have agreed, on the part of the Society, to contribute a sum of 200*l.* to the funds of the National Antarctic Expedition.

THE seventh "James Forrest" lecture of the Institution of Civil Engineers will be delivered by Prof. J. A. Ewing, F.R.S., on Thursday, April 20, at eight o'clock, the subject being "Magnetism." The lecture will be repeated on Friday, April 21, at four o'clock, for the benefit of members and their friends.

WE regret to announce that Dr. William Rutherford, F.R.S., professor of physiology in the University of Edinburgh, died on Tuesday morning, at sixty years of age.

AT the annual meeting of the Russian Geographical Society, on February 2, the following medals were awarded:—The Constantine medal to Dr. Gustav Radde, the director of the Tiflis Museum, for his forty-five years' work in the study of Russia; the Count Lütke medal to I. I. Pomerantseff, for his researches into the forms of the earth's geoid in the province of Fergana; the Semonoff medal to M. Kleiber, for his investigations into the periods of high water in the Volga; the great gold medal of the Section of Ethnography to N. L. Gondatti, for his three years' work of exploration of the Land of the Chuckchis; the Przewalski medal to L. A. Jaczewski, for his physico-geographical researches in Siberia; and three small gold medals to M. Tachaloff, for his instruction of travellers in astronomical observations; A. A. Rostkovsky, for a map of population in the Bitol vilayet of Turkey; and N. A. Zarudnyi, for researches in Persia; a number of silver medals were awarded for minor works.

THE Reale Istituto Lombardo announces in its *Rendiconti* the award of prizes as follows:—The Cagnola prize of 2500 lire and a gold medal of 500 lire has been awarded to Signor Angelo Battelli and Signor Annibale Stefanini for their joint paper containing a critical exposition of electric dissociation considered principally in regard to the experimental proofs of its deductions. For the Kramer prize, on an essay relating to the use of condensers in the transmission of electric energy by alternating currents and their construction for industrial purposes, two competitors entered, and prizes of 2500 lire and 1500 lire respectively have been awarded to Prof. Luigi Lombardi, of Turin, and Signor Giovanni Battista Folco, director of the electric tramways of Leghorn. For the Fossati prize, on some physiological point connected with the human encephalus, two competitors entered, and awards of 400 lire have been made to both—namely Dr. Domenico Mirto, of Palermo, and Dr. Carlo Martinotti, of Turin. For the Brambilla prize, given for the invention or introduction of some new machine or industrial process of real practical value, seven competitors entered. A gold medal and 500 lire has been awarded to Fratelli Boltri, of Milan, for their grain desiccators; a similar award to Premoli and Zanoncelli, of Lodi, for their preparation of Gaertnerised milk. Gold medals and 200 lire have also been given to Rossi, Enrico, and Co., of Milan, for their manufacture of varnishes, &c.; to Piola Alfredo, of Milan, for artists' colours; and to Pizzoni Pietro, of Milan, for the manufacture of baskets.

THE prizes offered by the Reale Istituto Lombardo for future competition include prizes of the Institution for 1899 for a list of unusual meterological events that have been recorded from the earliest times, and for 1900 for an essay on collective property in Italy; two triennial medals for improvements in agricultural or industrial processes in Lombardy; a Cagnola prize and gold medal on the subjects chosen by the Institution, viz. in 1899, for an essay on Hertz's phenomenon, or the effect of active radiation or of products of combustion on the sparking distance in air, and in 1900 for a critical study of toxin and antitoxin; a Cagnola prize and gold medal for 1899 on one of the following subjects chosen by the founder: viz. the cure of "pellagra," the nature of miasma and contagion, the direction of flying balloons, and the methods of preventing forgery of writings; a Brambilla prize for industrial improvements in Lombardy; Fossati prizes for 1899 on the macro- or micro-scopical anatomy of the nervous system, for 1900 on the regeneration of peripheric nervous fibres in vertebrates, and for 1901 on the anatomy of the encephalus of the higher animals; a Kramer prize for an essay on the transmission of heat between the steam and walls of the cylinders of steam-engines; a Secco Comneno prize for 1902 for a description of Italian natural deposits of phosphates; a Pizzamiglio prize for an essay on the influence of socialistic doctrines on private rights; Ciani prizes for popular Italian books, a Tommasoni prize for a history of the life and works of Leonardo da Vinci; and a triennial Zanetti prize for some improvement or discovery in pharmaceutical chemistry.

THE Prince of Wales has accepted the office of President of the National Association for the prevention of consumption and other forms of tuberculosis.

THE annual meeting of the Society for the Protection of Birds will be held next Tuesday, February 28. The chair will be taken by Sir Edward Grey, Bart., M.P.

MR. J. HOOKEY has been appointed to succeed Mr. W. H. Preece, C.B., F.R.S., as engineer-in-chief of the Post Office, and Mr. J. Gavey has been appointed assistant engineer-in-chief and electrician.

PROF. KARL MÜLLER, one of the founders of *Die Natur*, the well-known German scientific weekly, and the editor of it until about three years ago, died on February 9, at the age of eighty-one. His botanical researches and many scientific writings have contributed much to the advancement of science.

THE Governor of Yeniseisk states that the native report regarding the Andrée expedition has been in no way confirmed either in Yeniseisk or in the region under the supervision of the inspector of mines for the northern Yeniseisk district. Though an exhaustive search has been made on the Upper Pit River, no traces of the expedition have been found.

WE learn from the *British Medical Journal* that the Paris Académie de Médecine is about to build itself a new house on a palatial scale. The plans have been drawn by M. Rochet, and all the architects who have seen them are said to have been unanimous in declaring that the building will be one of the finest in Paris. It is expected to be completed in two years.

THE International Congress of Mathematicians at Paris in 1900, of which a brief announcement appears in the *Revue Générale des Sciences* for February 15, promises to be one of the most important of coming events in the mathematical world. The Congress, which will be in conjunction with the Paris Exhibition from the 6th to the 12th August, will probably hold most of its meetings at the Sorbonne. Already upwards of 910 members and others have announced their intention to be present. The price of the tickets of membership has been fixed at thirty francs.

MR. STANLEY FLOWER seems to be making good progress with the reorganisation of the Zoological Garden at Gizeh, near Cairo, of which he has lately been appointed director. An Indian elephant has been received from Calcutta, and a fine specimen of the Gangetic crocodile has been presented by Captain Henderson, of the s.s. *Manora*. Large series of aquatic birds have also been lately obtained from Damietta, and have added much to the lively appearance of the garden, which is now much frequented by visitors from Cairo.

THE last letters received from Mr. John S. Budgett, who has been sent out on a scientific mission to the Gambia by the Zoological Society of London, are dated from Nianimaru, on the Gambia, about thirty miles below McCarthy Island, January 23. They announce that Mr. Budgett, who was in excellent health, was busily engaged in collecting fishes and birds. Of *Polypterus*, one of the objects of his special inquiries, he had obtained some large specimens, one of which was found to contain large ova. The Manatee (*Manatus senegalensis*) had been ascertained to ascend the river thus far.

THE anniversary meeting of the Geological Society was held at Burlington House on Friday last, February 17. The officers were appointed as follows:—President, Mr. William Whitaker, F.R.S.; vice-presidents, Dr. Henry Hicks, F.R.S., Prof. J. W. Judd, C.B., F.R.S., Prof. W. J. Sollas, F.R.S., and Rev. H. H. Winwood; secretaries, Mr. R. S. Herries and Prof. W. W. Watts; foreign secretary, Sir John Evans, K.C.B., F.R.S.; treasurer, Dr. W. T. Blanford, F.R.S. The medals and funds were awarded as announced on January 19 (p. 275). The President delivered his anniversary address, which dealt with various subjects in which geology has practical application.

AT the meeting of the Chemical Society on Thursday last, the President announced that Mr. C. E. Groves, F.R.S., had resigned the editorship of the Society's *Journal*, and that Dr. W. P. Wynne, F.R.S., had been selected to succeed him. The Council had recorded their sense of Mr. Groves' services to the Society in a vote of thanks, a copy of which would be engrossed on vellum and presented to him. It was announced that the following changes in the officers and Council were proposed by the Council: As president—Prof. T. E. Thorpe, F.R.S., *vice* Prof. James Dewar, F.R.S. As vice-presidents—Mr. C. E. Groves, F.R.S., and Prof. Thomas Purdie, F.R.S., *vice* Prof. F. R. Japp, F.R.S., and Prof. W. A. Tilden, F.R.S. As hon. secretary—Dr. Alexander Scott, F.R.S., *vice* Dr. W. P. Wynne, F.R.S. As hon. treasurer—Prof. W. A. Tilden, F.R.S., *vice* Prof. T. E. Thorpe, F.R.S. As ordinary members of Council—Mr. H. Brereton Baker, Prof. F. Clowes, Dr. G. T. Moody, and Prof. James Walker, *vice* Prof. Bedson, Mr. Hehner, Prof. McLeod, F.R.S., and Dr. Scott, F.R.S.

REFERRING to the recent landslip at Airolo, a Reuter telegram from Berne says: "With the weather becoming warmer fresh falls of rock have occurred at Sasso Rosso, near Airolo, one of them being of considerable magnitude. These falls confirm the view taken by geologists that the further slides will not take place all at once, but in sections varying in bulk from 5000 to 10,000 cubic metres. The fresh masses fell on the present accumulation of débris without causing any damage. The St. Gothard Railway is not endangered, and there is no question of the traffic being interrupted."

WE learn from *Science* that the Physical Society of Berlin, established in 1845, has decided to be known as the German Physical Society. The object of the Society is to advance physical science by the following means: (1) the publication of *Proceedings*, especially, for the prompt issue of short communications. (2) The publication of a year-book on the progress of physics. (3) Co-operation in the publication of the *Annalen der Physik und Chemie*. (4) Participation in the meetings of the Section of Physics, of the German Society of Men of Science and Physicians. (5) Regular meetings in Berlin, and (6) a journal club.

IN 1894 the Goldsmiths' Company made a grant of 1000*l.* to the conjoint Board of the Royal Colleges of Physicians and Surgeons for the purpose of further experiments in connection with the anti-toxin treatment of diphtheria, with the stipulation that a supply of the best possible serum should be supplied for the gratuitous treatment of poor patients, especially children, suffering from diphtheria. In a report to the Company, Sir Walter S. Prideaux has expressed the opinion that the Company would take a wise and beneficent step if they were to make a further grant to the conjoint Board, adding, "There can be no question that the grant made in 1894 has proved not only of much importance to science, but has also been of great value to suffering humanity amongst the poorer classes." Upon consideration of the report the Goldsmiths' Company have made a further grant of 500*l.* to the conjoint Board, making the same stipulation as before, that a supply of the best possible serum shall be supplied for the gratuitous treatment of poor patients.

THE Rev. M. Dechevrens, S.J., director of the St. Louis Observatory, Jersey, has sent us a letter with reference to Mr. W. H. Dines's recent paper on the connection between the

winter temperature and the height of the barometer in north-west Europe. Mr. Dines concludes, and M. Lancaster, of Brussels, agrees with him (see p. 377), that in winter it is just as likely to be cold when the barometer is below the average as when it is above the average. This result is opposed to the current theory, but the Rev. M. Dechevrens holds that the phenomena concerned are only an extension of the general theory of variations of temperature in cyclones which he has for some years been bringing before the attention of meteorologists. A brief description of his conclusions as to the variations of air temperature in cyclones, and their cause, will be found in NATURE of July 28, 1898 (vol. lviii. p. 301).

DURING the fine weather of last week Mr. Walter Garstang successfully accomplished the first of his periodic surveys of the physical and biological conditions of the English Channel for the current year, an investigation in which he has been assisted by a grant from the British Association and by the use of apparatus belonging to the Government Grant Committee of the Royal Society and the Marine Biological Association. Mr. Garstang left Plymouth on Friday last in the steam tug *Stormcock*, and returned home late on Sunday. Stations were established in mid-Channel (50 fathoms), off Ushant (60 fathoms), off Parsons Bank, seventy miles west of Ushant (80 fathoms), and off Mounts Bay (50 fathoms). Serial temperature soundings were taken, and collections of plankton were made at the surface and in 40 fathoms at each of these stations. The deep water plankton collections were made by means of a pump and 40 fathoms of armoured suction hose. Surface collections were also made with the same apparatus. The quantity of water pumped on each occasion was determined with all possible accuracy, and the filtered samples were preserved for future examination without accident, thus admitting of a quantitative analysis for a comparative statement of the results obtained. Surface collections were also made at each station by means of tow-nets for comparison with the results obtained by the pump. A heavy ground swell, crossed by a stiff north-westerly breeze, was encountered between Ushant and Parsons Bank, but in other respects the weather was all that could be desired. The temperature results display a remarkable uniformity for all depths at each of the stations. The warmest water was met with to the westward, while the mid-Channel water was found to be warmer than that bathing the English and French coasts, thus confirming Mr. H. N. Dickson's results as to the course of the axis of high temperature in the Channel. It is intended to repeat the investigation at the same stations during May, August and November of the present year, in order to provide material for a complete account of the seasonal changes, as well as the horizontal and vertical distribution of plankton and temperature in this region of the Channel.

FROM a report in the *Adelaide Chronicle*, it seems that the iguana lizard, hitherto supposed to be perfectly harmless, except in poultry yards, has been found to be the slaughterer of lambs. Several sheep-owners have caught the iguana in the act of killing lambs, so there can be no doubt that this reptile must now be classed amongst the enemies of the pastoralists. The scarcity of opossums has probably driven the iguana to attack lambs for food. Pastoralists, who since the discovery have watched their lambs closely, say that even very small iguanas will attack a lamb, and they further state that any lamb so bitten will not recover.

THE presidential addresses delivered before the various sections of the American Association at the forty-seventh meeting and fiftieth anniversary, held at Boston, Massachusetts, last August, and abstracts of the papers communicated, are printed in the volume of *Proceedings* (vol. xlvii.), which has just been published by the permanent secretary, Dr. L. O. Howard. The volume runs into 658 pages, and contains many papers of scientific interest and value. This year's meeting of the Association will be held at Columbus, Ohio, the president for the meeting being Prof. Edward Orton, of Ohio State University.

THOUGH the age of the implements or "palæoliths" from the Trenton gravels has been the subject of much controversy, little attention appears to have been given to the human remains from the same beds. Dr. Frank Russell has, therefore, made a detailed study of these remains in order to determine whether or not they resemble the remains of recent Indians of the region. The Delaware Valley was occupied by the Lenni Lenapé until 1737; and Dr. Russell concludes that the crania found near the surface, at least about Trenton, are the skulls of members of this tribe, or of other modern Indians. The paper in which the remains are discussed appears in the *American Naturalist*.

EXPERIMENTS to determine the density of ice are described, by Prof. Edward L. Nichols, in the January number of the *Physical Review*. From his own investigations, Prof. Nichols concludes that the natural ice he used in the form of air-free icicles, and in the massive form of ice-blocks cut from the surface of a frozen pond, had a density at 0° of 0·9180. Artificial ice produced by the use of carbon dioxide and ether was found to have a density not far from 0·9161. There appears to be no doubt that natural ice obtained from the surface of frozen ponds and rivers and in the slow formation of icicles possesses a density greater than that of artificial ice by about two parts in a thousand.

MR. CHARLES S. TOMES, F.R.S., describes, in the *Quarterly Journal of Microscopical Science*, an investigation on the differences in the histological structure of teeth of fishes of the family Gadidæ. The object of the investigation was to ascertain the extent of the variation in structure of the teeth of various Gadidæ, and to see how far these differences coincide with the lines of classification on general grounds. The conclusion arrived at is that the differences of tooth structure only to a limited extent follow the lines of the general affinities of the genera. Mr. Tomes also remarks: "The teeth of the Gadidæ appear to furnish an argument against the adequacy of the purely mechanical theory of the evolution of tooth forms, so warmly advocated by Cope under the name of kinetogenesis, and adopted in its entirety by a large number of the American school of naturalists."

THE Pilot Chart of the North Atlantic Ocean, issued by the Hydrographic Office of the United States for February, reviews the state of the weather from December 20 to January 20. In many localities the weather in the Atlantic was very severe; gales of hurricane force accompanied with violent squalls were frequently reported. The tracks of fifteen storms are traced upon the chart; the centres of these disturbances were for the most part to the north of the transatlantic routes, moving north-eastward, and following each other in rapid succession. Several of them are shown to have traversed the whole of the North Atlantic. Nearly all of them passed to the northward of our islands, although their influence would be felt on our extreme north-west coasts. The principal exception was the storm which was central over England on December 29, which after reaching longitude 30° W., took a nearly direct westerly course; this disturbance developed off the American coast on December 26. Reports from the Newfoundland coast indicate a rapid southerly movement of the Arctic ice floe. Some immense icebergs were reported 200 miles S.E. of St. John's, Newfoundland, in the latter part of January, directly in the track of shipping.

ABOUT four years ago, Prof. Wilhelm von Bezold pointed out, from theoretical considerations, that both winter and night thunderstorms, compared with summer and afternoon thunderstorms, should be much more frequent on the sea and the coasts than inland, but that this effect could scarcely be expected in the case of sea-coasts where the paths of the cyclones are generally from the land to the sea. The work of Messrs. Mohn and Hildebrandson on Norway and Sweden, and of Dr. Meinardus on the open sea, is in general agreement with this theory, as also are other more or less complete reports for different places. Prof. H. D. Stearns has made a further investigation of the subject, and gives his results in the U.S. *Monthly Weather Review*. His tables and curves, showing monthly percentages of thunderstorms on coasts and inland in various parts of the world (the British Isles included), establish a general law that the percentage of winter thunderstorms decreases in passing from a coast inland in the general direction of the prevailing cyclonic winds.

THE spectroscopic analysis of minerals is in most cases undertaken by using the electric spark as the heat source for volatilising the substance. Considerable difficulty is experienced in the case of those minerals which are non-conductors, such as the felspars. M. A. de Gramont (*Bull. de la Soc. Franc. de Mineralogie*, March, April, and May 1898) has overcome this by first mixing some easily fusible salt with the powdered mineral, and then heating the mixture with a Bunsen burner, when the mineral is generally dissolved in the salt, and the electric spark is passed from the mass while molten. In most cases, he uses one or more Leyden jars in the secondary circuit to raise the temperature sufficiently. The salts he finds best adapted are the carbonates of lithium and sodium, chiefly on account of the simplicity of their spectra, which have, of course, to be eliminated from the results before the spectrum of the mineral itself can be mapped. For this purpose he gives tables of the principal wave-lengths in the spectra of these salts, and also of the more commonly occurring simple bodies. He then describes in detail the characteristics of the spectra observed with the non-conducting minerals, of which he has examined some twenty-five different specimens.

FROM a paper dealing with the mica mines in Bengal, contributed by Mr. A. Mervyn Smith at the meeting of the Institution of Mining and Metallurgy on February 15, it appears that the industry is a very ancient one, the methods of mining the mica and preparing it for market having been in use for centuries. The mica occurs in pegmatite veins running through foliated rocks, and is taken out from open cuts made in the decomposed granite, and abandoned as soon as solid rock is reached. The miners are a local tribe called Bandathis, men, women and children all working at the mines in the dry months when there is no agricultural work in the fields to be done. The books of mica are chiselled out, the work being aided by large fires when the pegmatite is hard, and split into sheets of about one-eighth of an inch in thickness. The rough edges are then trimmed, and the sheets sorted into four qualities and several sizes; the best "ruby" mica, which is unaffected by high temperatures, being worth 20*s*. per pound when in large sheets, while small sheets only fetch 2*d*. per pound. The uses are well known, and the consumption is now increasing, but appears to have been greater in early times. The output was given by Dr. McClelland in 1849 as 100,000 maunds, or about 73,000 cwts., and is estimated by Mr. Mervyn Smith at less than 20,000 cwts. in 1895. He also states that nearly all the mica used in the arts comes from these mines.

IN the *Verhandlungen der k.k. geologischen Reichsanstalt* (Wien) for November 30, 1898, Herr A. Bittner contributes an interesting description of some fish remains collected by him from the Hallstätter Kalk of Mühlthal bei Piesting. Though the fossils here dealt with consist only of isolated teeth, every such addition to our knowledge is welcome, for, as pointed out by the author, these remains are but rarely met with in the Alpine Trias. While Rhætic forms have been recorded by Gümbel, and later by Zugmayer, from the Kössener Schichten, and Stur discovered a *Ceratodus* skull, later described by Teller, at the base of the Lunzer Schichten, no fish remains whatever, as far as the author is aware, have hitherto been chronicled from the Hallstadt limestones. The teeth, illustrated by text figures, are referred to the genera *Sargodon* and *Hybodus*, and are regarded as representing new species. In the same number of the *Verhandlungen* are papers by Dr. W. Salomon, discussing the age of the Asta granite; and Herr F. Kerner, who describes several Culm plants from the Dachschiefer near Johannesbad. Herr F. Schaffer records the occurrence of Miocene strata in the neighbourhood of Siegenfeld, and, on the evidence of fossils obtained from well sinkings, correlates the beds with the Tegel of Baden.

M. PAUL MILLET, writing in the *Revue scientifique* of January 14, discusses the causes of the disappearance of insectivorous birds and the best means of prevention. These causes are twofold in nature, viz. natural causes tending to maintain the balance of nature, and artificial causes due to human agency, to which latter the author chiefly attributes the phenomenon in question. The means of prevention are also of two kinds: methods of a persuasive character, and legislative measures. Among the former may be cited (1) the teaching of ornithophily in schools and colleges; (2) the posting of printed notices; (3) introduction of books on birds into public libraries; (4) recommendation to teachers in primary schools to insist on the utility of preserving birds and nests. These means are all considered quite inadequate to deal with the evil, and M. Millet considers it desirable to enforce existing laws on the subject (1) by the passing of a regulation forbidding the capture or sale of birds smaller than the lark; (2) by suppressing the privileges sometimes granted for snaring birds in snowy weather; (3) by forbidding the sale of instruments for capturing small birds; (4) by enforcing vigilance on the part of gendarmes and police throughout the year; (5) by the seizure of small birds at the octroi, in railway stations or in markets; (6) by taking similar measures against milliners; (7) by the protection of birds of passage when landing, a measure in which Custom-house officers could assist; and (8) by killing birds of prey and animals which attack eggs. It is suggested that the French "Ligue Ornithophile" might materially assist in such measures, the need of which is far more urgent in France than in this country.

TO rid beech-trees of that dangerous parasite *Cryptococcus fagi*, which causes much anxiety to foresters, many methods have been tried. Solutions of soft soap, methylated spirit, and so on, applied to the skin of the tree, are of no avail when the bark has become much decayed. External remedies having in such cases proved useless, Mr. John Shortt, the head forester upon the estate of Sir Matthew White Ridley, Bart., has tried internal ones, and the results are mentioned in the recently-published volume of *Transactions* of the English Arboricultural Society. Thirty years ago several trees which were in the last stages of decay were selected, and three holes were bored in the trunk of each, about two feet from the ground, slanting downwards, and converging towards a common centre. Sulphur, saltpetre, and other substances were placed in the holes—sulphur in one tree, saltpetre in another, and something else in a third—and the holes were then securely plugged. All the trees died except the one that had been treated with sulphur. Since these experiments several other beeches have been treated in the same way, and with equally satisfactory results. The

operation, it may be added, is performed in the autumn. These experiments in practical forestry have excited great interest among foresters. It is hoped that the matter will be taken up in a scientific way, and that the chemical action of the impregnated sap will receive elucidation in a form which will be of practical use to the owners of woodlands throughout the country.

Bulletin No. 4 (vol. iv.) of the Laboratories of Natural History of the State University of Iowa is entirely occupied by two papers: On the Cyperacea of Iowa, by Mr. R. J. Cratty; and on American Uredineæ (part 2), by Messrs. J. C. Arthur and E. W. D. Holway. Both papers are well illustrated.

WE have received the *Proceedings* of the Agricultural Research Association for 1898. In its report, the Committee calls especial attention to the experiments carried on by the Association, under the direction of Mr. Thomas Jamieson, on the cross-fertilisation of the oat, resulting in the production of new valuable varieties by natural cross-pollination rather than by any artificial assistance.

AMONG the lectures to be delivered at the Royal Victoria Hall, Waterloo Road, on Tuesday evenings during March, are the following:—March 7, "The Scenery of Alpine Lands," Mr. E. J. Garwood; March 14, "The Atmosphere," Morris W. Travers; March 28, "Mont Blanc, the Great White Mountain," Mr. J. Russell.

AMONG the papers in the winter number of *Brain*, is the presidential address delivered to the Neurological Society by Prof. Victor Horsley, F.R.S., on the determination of the energy developed by a nerve centre, and a contribution on an experimental study of visions, by Dr. Morton Prince.

UNDER the title of "An experiment in commercial expansion," Mr. Leonard Courtney, M.P., delivered in December last a presidential address to the Royal Statistical Society, dealing with the economic lessons taught by a study of the commerce and development of the Congo Free State. The address is now published In the Society's *Journal*.

A BRIEF summary has been published at Philadelphia of a voluminous report drawn up for the Japanese Government by Tentearo Makato on "Japanese notions of European political economy." The report contains, *inter alia*, a summary of the main views of leading political economists as they presented themselves to the mind of the Japanese Commissioner.

A BI-MONTHLY magazine devoted to the study and protection of birds, edited by Mr. Frank M. Chapman, and published by the Macmillan Company, New York, has just appeared under the title of *Bird Lore*. The journal will be the organ of the Audubon Societies, and will provide students of bird-life with interesting articles and notes and pictures. The fact that during the past six years New York and Boston publishers have sold more than seventy thousand text-books on birds, promises success to this popular journal of ornithology.

IN a recent note in these columns attention was drawn to the reported discovery by M. Jaubert of a substance capable of removing from the air of a closed chamber the carbonic acid, water vapour and other irrespirable gases produced by a living animal within the chamber, and at the same time of keeping up the supply of oxygen. In the *Comptes rendus* for February 6, the subject is referred to in two communications. MM. Desgrez and Balthazard describe experiments made with sodium peroxide. This substance is acted upon by water according to the following equation, $Na_2O_2 + H_2O = 2NaOH + O$. The caustic soda produced will, of course, absorb carbon dioxide. A guinea-pig weighing 400 grammes, when enclosed in 10 litres of air, was asphyxiated in from two to two and a half hours; but under similar conditions when sodium peroxide was placed in the enclosure, and water allowed to drop on it, a guinea-pig showed no diminution of vitality at the end of four hours. To see if the moisture of expired air would suffice to act on the peroxide, two guinea-pigs were enclosed in 30 litres of air with 66 grammes of peroxide. They were taken out alive at the end of ten hours, whereas two others of the same weight died at the end of four hours in the absence of peroxide. Finally a dog weighing 6·5 kilogrammes, enclosed with 70 litres of air and 200 grammes of peroxide, gave unequivocal signs of life at the end of six hours. The peroxide was only attacked superficially in the last cases, owing probably to the formation of a protective layer of carbonate.

IN discussing the above experiments, M. d'Arsonval points out that seventeen years since he proposed an effective method of achieving the same end. The animal is enclosed hermetically in a tubulated receiver; the upper part of this contains a receptacle filled with pieces of soda-lime; through the tubulus a solution of hydrogen peroxide, coming from a Mariotte's bottle, is conducted by a tube so as to drop into a strong solution of chromic acid. The apparatus works automatically, for as the animal breathes and the carbon dioxide and water are absorbed by the soda-lime, the pressure falls and the Mariotte's bottle comes into action. The hydrogen peroxide solution then begins to drop into the chromic acid, and disengages oxygen until the pressure is restored. The flow from the Mariotte's bottle then stops, and the cycle begins again.

THE additions to the Zoological Society's Gardens during the past week include a Rhesus Monkey (*Macacus rhesus*, ♀) from India, presented by Mrs. A. J. Pauley; a Mozambique Monkey (*Cercopithecus pygerythrus*, ♂) from East Africa, presented by Mr. E. Tudor Johnson; a Bonnet Monkey (*Macacus sinicus*, ♀) from India, presented by Mr. J. H. Howden; a Coypu (*Myopotamus coypus*) from South America, presented by Mr. Sidney Grey; a Restless Cavy (*Cavia porcellus*) presented by Miss Druce; a Canadian Lynx (*Felis canadensis*); a Prairie Wolf (*Canis latrans*) from North America, presented by Mr. Henry Anger; two Mountain Ka-Kas (*Nestor notabilis*) from New Zealand, presented by the Hon. Walter Rothschild, M.P.; an Alexandrine Parrakeet (*Palaeornis alexandri*, ♀) from India, presented by Mr. A. Pam; a Beccari's Cassowary (*Casuarius beccarii*) from Vokan Island, Aru Islands; a Mauve-necked Cassowary (*Casuarius violicollis*) from Terangan Island, Aru Islands; a Salvadori's Cassowary (*Casuarius salvadori*), a Milne-Edwards Cassowary (*Casuarius edwardsi*) from North-west New Guinea, two Yellow-naped Cassowaries (*Casuarius occipitalis*) from the Island of Geelvink Bay, New Guinea; three Reeves's Terrapins (*Damonia reevesi*); three Black-headed Terrapins (*Damonia reevesi unicolor*) from China, deposited; two Red-breasted Mergansers (*Mergus serrator*, ♂ ♀), European; two Bahama Ducks (*Poecilonetta bahamensis*) from South America, nine Spotted-billed Ducks (*Anas poecilorhyncha*), a Bar-headed Goose (*Anser indicus*) from India, five Brent Geese (*Bernicla brenta*), European, purchased.

OUR ASTRONOMICAL COLUMN.

UNITED STATES NAVAL OBSERVATORY.—Prof. A. N. Skinner, one of the staff of this well-known observatory, contributes to *Science* (vol. ix., No. 210, pp. 1–16, January 6) a detailed history of the institution from its first inception to the present time. He divides the time into four periods, each characterised by some decisive change, both in the scope and administration of the department. In 1823, J. Quincey Adams,

the U.S. President, strongly urged the foundation of a depôt for the charts and instruments necessary for the navy; but it was not until 1830 that consent was given to this, when Lieut. Gouldsboro established one at Washington, the only astronomical equipment being a 30-inch focus transit. Three years later the contents were removed to a room about 14 feet square on Capitol Hill. Here the equipment was increased by a 3¾ in. transit, a Borda's circle, 3 ft. 6 in. focus achromatic, a portable transit, and sidereal clock. Up to this time the work of the institution entirely consisted of such astronomical observations as were necessary for the rating of chronometers. In 1838 a new epoch was entered upon by the instalment of Lieut. Gilliss, who at once improved the equipment and commenced systematic observations of the moon, eclipses and occultations, and also began the determination of right ascensions of standard stars. He soon reported to the Government that the housing of the instruments and charts was unsafe, and asked for better accommodation. It was not until 1842, however, that this request was acceded to, but in that year a Bill was passed voting 25,000 dollars for a new observatory. To prepare for it, Gillis visited all the European observatories and gave orders for the best instruments then available. The site selected was close to the Potomac River, and about 100 feet above the water.

In September 1844, the new observatory was ready for use with a fine equipment of first-class instruments; but, strange enough, the man who had evolved the whole of the arrangements, Lieut. Gillis, was not selected as superintendent, this post being given to Lieut. Maury, who occupied the position until 1861. During his incumbency the chronograph was introduced into the observatory, and it is of interest to read that for the use of a magnetic clock, fillet chronograph and cylinder chronograph, Dr. Locke was in 1849 paid the sum of 10,000 dollars. Maury's scheme of work was so wide that the reductions soon fell behind, and an enormous mass of work remained unpublished when he left in 1861. Gillis succeeded him, and again infused new life into the place. He resumed the meridian work, which had been almost neglected, and started to complete the reductions of previous observations. In June 1866, the observatory was relieved of a great part of its labour by the creation of the Hydrographic Office, which then took charge of all the charts, chronometers, sextants, &c. Later on, however, in 1883, most of this work came back to the institution. Daily time signals were originated in August 1865, by Prof. Harkness, and were transmitted by hand until 1879, when an automatic distributor was installed. The large 26-inch object-glass was received in 1873.

Magnetic observations had been started under Maury in 1845, but no progress was made until 1887, when a complete outfit was provided for obtaining continuous photographic records of all the magnetic elements.

In 1893 the observatory was again removed to its present site on Georgetown heights, 280 feet above the Potomac; it covers a circle having a radius of 1000 feet, and an area of about 70 acres. The principal work of the observatory is to carry forward a continuous series of meridian observations of the sun, moon, planets and ephemeris stars, which form the basis of the requisitions of the navy. Other work, however, has by no means been neglected, as is shown by the lengthy list of published observations and discoveries in the article. It is significant to notice that the magnetic observations have been entirely suspended at the new observatory since the summer of 1898, the results being vitiated by the electric roads in the vicinity.

USE OF TELEPHOTO LENS IN ASTRONOMY.—Dr. Rudolf Steinheil, of the famous German firm of opticians, contributes to the *British Journal of Photography* (vol. xlvi. p. 102) an article discussing, from experimental data, the extent to which the telephoto combination may be useful to astronomers. For stellar work he thinks it will be little used, as for delineating faint objects it is unfitted on account of its relatively low speed, and for successfully defining double stars, &c., it would necessarily have to be of large aperture. For the planets it is scarcely more fitted, the prolonged exposures necessary causing loss of definition owing to inaccuracies of following. The field of its use for astronomical purposes will probably thus only include the sun and moon. In the case of the moon the success will depend on the degree of magnification required, as if this is pushed too far the image becomes feeble, and the difficulties due to the moon's motion in declination, which are not remediable by using a driving-clock, render the result uncertain. With the sun, however, all the difficulties encountered with other objects disappear, as the light available is sufficient to allow of instantaneous exposures with the largest amplifications. This Dr. Steinheil thinks will be the only permanent use of the telephoto lens for astronomical purposes, and he instances cases in which photographs of sun-spots have been obtained measuring 7 mm. without sacrificing detail.

VELOCITY OF METEORS.—Prof. G. F. Fitzgerald writes in the *Astrophysical Journal* (vol. ix. p. 50, January 1899), suggesting the preparation for attempting to determine the velocity of the meteors during the next prominent showers. All that is required is an arrangement whereby a toothed wheel may be rotated in front of the camera lens during the exposure. The motion must be uniform, and we must know the rate of rotation and number of teeth on the wheel, and design these so that there may be two or more eclipses during the passage of the meteor across the field. Other methods of breaking up the image are given, such as an oscillatory motion of the lens or plate, or pointing the camera to a moving mirror; but in all these cases distortion of the star images would follow, and hence the advantage of the simple eclipsing arrangement.

It would probably be possible with some such arrangement as that suggested, to determine the meteor velocity with sufficient accuracy to show whether there is any sensible change due to the resistance of the atmosphere.

It is also evident that if two such cameras were employed at stations a considerable distance apart, and the same meteor caught by each, that the information given by the two would be extremely valuable.

THE FISHES OF THE NILE.

A MEMORANDUM regarding a proposed survey of the Nile, with the object of determining the species of fishes inhabiting its waters, has been drawn up by Dr. John Anderson, F.R.S., and is here printed in full, as it will interest all biologists. We are informed that the scheme, as detailed in the memorandum, has been sanctioned, and that Mr. W. Leonard S. Loat has been appointed superintendent. The only modification which has been made in the scheme, as detailed in the memorandum, affects the permanent use of a steam launch, as there was a practical difficulty in procuring one. The occasional use of a steam launch for trawling purposes will be available. This slight departure will in no way interfere with the efficiency of the survey.

Lord Cromer, whom Dr. Anderson approached on this subject in November last, has taken a most lively interest in the scheme throughout. The subjoined memorandum was drawn up at his request, and he has provided the funds necessary for the accomplishment of the Survey.

Our knowledge of the fishes of the Nile appears as yet to be very imperfect. It may be said to have taken its origin in 1750, when Hasselquist described thirteen species found in the deltaic area or in its immediate proximity. Since his time a number of distinguished men, *e.g.* Forskål, Geoffroy St.-Hilaire, Rüppell and others, have contributed by their observations personally carried out on the banks of the river to make its fishes more and more known.

By far the most important addition to our knowledge of the fishes of the Nile, after Hasselquist's day, was that made by Geoffroy St.-Hilaire in the "Description de l'Egypte," in which twenty-nine species were described and figured. Between 1829 and 1832, Rüppell published two valuable contributions to the subject. De Joannis, who accompanied an expedition to Luxor, somewhere about 1830-34, seems to have undertaken a careful investigation of the fishes of that locality during his brief visit. The value attached to his work rested largely on the fact that his descriptions, which were published in 1835, were illustrated by figures of each species drawn and coloured from life; moreover, he had not depended solely on the fishermen for his material, as not a few of the species were of no economic use and have not been rediscovered since. He described fourteen species in all, nine of which were new to science. His paper was supplemented by a list of all the known species of fishes inhabiting the Nile, including Rüppell's observations up to 1832; hence he enumerated fifty-three species.

In 1837, the third contribution of Rüppell appeared; but he was seemingly unaware of Joannis's researches at Luxor, and consequently he mentioned only fifty-five in his summary of the species then known to inhabit the river. The fishes collected by Russegger in Egypt enabled Heckel, in 1847, to raise the

number to sixty-seven species, excluding certain Barbels described by Rüppell from Lake Tzana and some other species of doubtful origin. This number, however, was considerably in excess of the reality, as many of Heckel's species were afterwards found to be synonyms. Sixty probably represented the number of the known species at that time (1847). Petherick, while in Egypt in 1861–63, made, at Dr. Günther's request, a collection of fishes for the British Museum. The specimens were obtained at Cairo, Khartum, and Gondokoro, and were described by Dr. Günther in an appendix to Petherick's "Travels," published in 1869. The collection contained eighteen new additions to the fauna, and raised the number of known species to eighty-two. It thus materially advanced our knowledge of the piscine fauna of the Nile; and as Dr. Günther not only figured eight species, but at the same time added a description of every form, his contribution has proved most useful.

Since 1869 the fishes of the Nile have been almost completely neglected. Sauvage, however, in 1880, added a new species from Lake Maryut; Pfeffer, in 1888, mentioned the species obtained by Stuhlmann in Egypt; and Mitchell, in 1895, brought to light and figured a new *Chromis* from Lake Menzaleh, and gave an account of the edible fishes of that lake. In 1896, Prof. Vaillant, in revising the Synodonts, pointed out the existence in the White Nile and at Khartum of two hitherto unrecognised forms.

At present, therefore, about ninety species of fishes are known to inhabit the river, but this number, considering the vast extent of its waterway and the very diverse physical conditions which characterise many parts of its course, cannot be considered as at all approaching finality.

The collections hitherto made from the Nile have principally been obtained from below the First Cataract; indeed Rüppel and Petherick are the only two collectors who had opportunities to investigate the river above Assuan. The former distinguished traveller and naturalist largely collected in Lower Egypt, and not a few of Petherick's specimens were from the same region. In Dr. Günther's account of this collection only six species were distinctly recorded as coming from Gondokoro, Khartum, and the White Nile, while thirteen, besides the foregoing six, species were stated to belong properly to the reach of the Nile above the Sixth Cataract.

In dealing with the distribution of fishes in the Nile, the use of the phrase Upper Nile, unless what is meant by the term is clearly defined, leads to endless confusion. Dr. Günther has made it quite evident in what sense he used the terms Lower and Upper Nile; but it is to be feared that the latter term has generally been used in a wider sense, and has included the river from Philæ southwards to the Lakes. While we possess a fragmentary knowledge of the species from Khartum southwards, the immense tract of the Nile from the First to the Sixth Cataract remains practically untouched.

The great mass of the forms known from below the First Cataract is largely made up of edible species, and a careful consideration of the literature bearing on this part of the Nile favours the supposition that the collections of fishes which have been formed in the past have been chiefly obtained by the assistance of the fishermen along the banks of the river and from the fish-markets of the country. However, in a great river like the Nile, unique in its annual inundations and in other characters, a much more thorough course of procedure than the foregoing is absolutely necessary in order to obtain an accurate conception of the true nature of its fauna.

Apart from the mere knowledge of how many species of fishes exist in the river, great economic questions come to the front when their life-history is studied. These, however, can never be usefully worked out until there exists on record a basis on which to work, in the form of a detailed description of each species accompanied, as far as practicable, by a figure.

The inundations of the Nile exercise a powerful influence on the distribution of the fishes contained in its waters, while, on the other hand, the cataracts retard their range. A multitude of questions of great interest bearing on the life-history of the species thus at once suggest themselves in view of the physical features encountered in this marvellous river.

Moreover, as within the next few years a change will be effected in the distribution of the Nile waters by the construction of the controlling-powers now in course of erection at Philæ and Assiut, and as other similar structures or dams are likely to follow toward the south, all of which are certain ultimately to limit more or less the range of certain species of fishes, it is much to be desired that, before any of these triumphs of the Department of Irrigation have been completed, we should be placed in possession of the main features and present condition of the piscine fauna of the great reaches of the river.

The present time seems also extremely opportune for the commencement of such an investigation, as the authorities of the Congo Free State have satisfactorily inaugurated a Survey of the Congo, and have already published some of the results. Were a corresponding Survey for the Nile entered upon by the Egyptian Government, and were the description of the species entrusted to Mr. G. A. Boulenger, F.R.S., who is describing the fishes of the Congo for the Congo Free State, and who is prepared to place his services at the disposal of the Egyptian Government free of all charge, the two surveys would mutually benefit each other, as the materials afforded by the one would throw light upon those of the other, many of the species of the two great rivers being closely allied. The results would doubtless be unique, and would form a lasting contribution to human knowledge, and, moreover, would be of great practical utility to both States.

The foregoing are a few of the grounds on which the proposed Survey is advocated.

Scope of the Survey.

It is recommended that some one who has had a zoological training should be appointed to superintend and carry out all the arrangements that it would be necessary to make for the formation of a representative collection of the fishes of the Nile, and who would be able likewise to discharge efficiently the other duties detailed in this memorandum. As it is very important that the form and life-colours of the different species should be accurately recorded by outline sketches, the Superintendent should be qualified to carry out such a work, because the information which such drawings would afford, if made by one who had a correct eye for colour, would be of great use to Mr. Boulenger when he came to describe the individual species. The highly-finished drawings for the illustration of the volume of "The Fishes of the Nile" would be made in London under Mr. Boulenger's personal supervision. A colloquial knowledge of Arabic would be of great advantage to the Superintendent, as it would enable him to obtain direct, from the fisher-folk on the banks of the river, much useful information on the subject of his investigations. Moreover, to properly discharge his various duties, the Superintendent should be a strong and healthy man.

An investigation of the entire river from the sea to Lado, and if possible through the *sudd* and rapids between Lado and Dufilé to its origin in the Albert Nyanza, should be kept in view as the ultimate aim of the Survey, which might be followed, later on, by similar researches into the fauna of the Nilotic lakes as a whole. Such a work is now proceeding on Lake Tanganyika, an intermittent effluent of the Congo, inaugurated by Mr. J. E. S. Moore, under the auspices of the Royal Society. Possibly when Mr. Moore has completed his work on that lake he may be able to direct his attention to Lake Kivu, and afterwards he might be in a position to cross the watershed to the Nile lakes and determine the character of their fauna as well, returning to civilisation by the Nile.

Although these are the lines on which a Survey of the Nile should be conducted to render it scientifically complete, it is suggested that the Survey should for the present be of a more limited character.

In the first instance, a series of stations should be selected along the river extending at intervals from the Delta, to Lado in the territory leased by the Egyptian Government to the Congo Free State, and as far to the south of this as possible. And it may be mentioned that were the Egyptian Government to inform the Secretary of State for the Congo Free State that an investigation into the fishes of the Nile was to be undertaken under its auspices, there is every reason to believe that the Secretary of State would issue orders for a collection of fishes to be formed by the Belgian officers at Lado and transmitted down the Nile to Cairo.

The following is a provisional list of the places recommended at which collections should be brought together, viz. Damietta, Lake Menzaleh, Rosetta, Lakes Burlus, Edku, and Maryut, Mahallet el Kebír, below the Barrage, above the Barrage, Cairo, Benisuef, Birket el Kurun (and two or three stations throughout the Fayum), Assiut, Luxor, Edfu, Assuan, Philæ, Korosko, Wádí Halfa, Akasheh, Dongola, Ambukol, Abu Hamed,

Berber, Kassala, Khartum, Sennaar, Fashoda, Sobat and Lado, and possibly Dufilé and Wadelai.

It is suggested that all necessary instructions for collecting fishes should be issued in the form of a circular in English and Arabic, and should be sent to some responsible official in each of the foregoing localities accompanied by a collecting-box and alcohol, to be supplied by the Trustees of the British Museum, with the name of the locality burned into the wooden case containing the metal box holding the alcohol, on which the name of the station also should be indelibly scratched or engraved. The selection of the officials to whom the collecting should be entrusted would be a matter for the Government to decide; but it is suggested that Commandants of Stations, officers of the Royal Army Medical Corps, and officials connected with the Irrigation Department would be the most likely to take the greatest interest in the work. I speak from experience, because not a few of these officials gave me invaluable aid in the formation of the collections on which the first volume of the "Zoology of Egypt" is based. In military stations, the black troops, when at leisure, are generally well pleased to assist in searching for living things, and were their successes rewarded by small pecuniary payments the results achieved by their agency might be considerable.

The services also of the fishermen along the river should be enlisted in the work, and were fair prices paid to them for the fishes they collected, and were they encouraged to procure as many kinds of fishes as possible, large and small, collections of considerable value would doubtless be forthcoming, and were they further instructed to net the very smallest fishes, in localities where there are backwaters, doubtless interesting and obscure species would be discovered.

The fishermen should also be utilised for obtaining the native names of the fishes throughout the different parts of the river, and it is suggested that each station should furnish a set of numbered specimens accompanied by a list giving the native name opposite to each number.

Should the Egyptian Government see its way to sanction this Survey, it is suggested that the officer in charge of the Museum of Natural History of the Medical School of Cairo should be entrusted with the reception of the collecting materials from the British Museum, with their distribution to the different collecting stations, with their reception when returned filled with fishes, and with the duty of forwarding them to London.

It is recommended that the distribution of the circulars and collecting-boxes should take place as soon as they are ready, and that they should be sent out to all the stations aforementioned, even to the most remote. In this way, many boxes would soon be returned filled, and, as they would at once be forwarded to London, the work of identifying the fishes might be proceeded with at once. By this plan, Mr. Boulenger would be placed in a position to offer valuable suggestions and to make known whenever the collections from a locality might require supplementing.

In not a few instances only the young of certain species might possibly be represented in a collection, or some of the specimens might be single examples of new or rare species which could only be satisfactorily made out by the aid of additional material. Mr. Boulenger having gone over the collection from one locality would thus be able, in returning the box for further material, to indicate clearly to the collector wherein his collection had been deficient. This could be done by the aid of an occasional figure of a fish when it was wanted, or even by the return of a specimen when more than one existed and more were required. It would also enable Mr. Boulenger to supply each station with a list of the species of fishes contained in each box, and by so doing contribute to stimulate the collectors to further exertions. Moreover, were preliminary lists of native and scientific names from a number of stations published at intervals and distributed among the stations, each collector would be in a position to judge of his relative success, especially in those cases in which the stations were situated on the same reach of the river. The native names of the fishes of the reach below the First Cataract are the same throughout the whole of its extent, whereas in many instances they differ materially from those in vogue between Berber and Lado. The reach from Philæ to Berber is so little known, in so far as its fishes are concerned, that preliminary lists from it would be invaluable, either in demonstrating uniformity or diversity of names in its own area, or as regards the reaches to the south and north of it.

Whilst the immediate distribution to the above-mentioned stations of instructions for collecting fishes, along with the necessary materials for so doing, is strongly advocated, it is equally desirable that in the beginning of the actual survey the attention of the officer in charge should be confined exclusively, in the first instance, to the river between Assuan and the sea. He should be constantly on the river at all seasons, and on his way down should visit the different stations, inspect the collections formed, satisfy himself that the specimens are properly preserved and that they are fairly representative. He should also particularly note the physical characters of the river at each station, find out as much as possible about the habits of the fishes, the depth at which they are found, the general character of the river-bed, the seasons in which the fishes breed, and the nature of their food. He should also satisfy himself that the native names have been correctly recorded in Arabic and rightly applied.

After the completion of the Survey from Assuan to the sea, the attention of the Superintendent should then be devoted to the reach of the river between Philæ and Berber, and after that has been attained he should proceed to investigate the interesting tract between the latter town and Lado.

To carry out his operations efficiently the Superintendent should be provided with a steam-launch, by means of which he would be placed in a position to use methods of fishing which it would be impossible to undertake by a sailing-boat. It would enable him to move freely up and down the reaches of the river which might require detailed investigation, and thus provide a means by which the Survey could be carried out in a thoroughly practical manner and with the least loss of time, as the nets at the disposal of the Superintendent might be constantly at work.

Other advantages of great importance would attend the use of a steam-launch in the way here advocated, as a cool airy room could be set apart for the storage of the specimens in alcohol, either in the course of preservation or finally preserved, and for the drying of the skins of fishes too large for conservation in alcohol. Moreover, the temperature of the contents of the boxes when the heat is great could, in such circumstances, be artificially reduced by simple means. The smooth joltless character of transit by water of boxes full of fishes recommends its adoption in preference to all other means; and, in connection with this, it may be mentioned that should it ever be necessary to send such boxes by railway train they should invariably be slung in complete shade. Transport by camels is out of the question.

The Superintendent should have the assistance of a native taxidermist to assist him in selecting the fishes as they are caught, in preparing and labelling them, and in changing the alcohol from time to time. His services would also be required in skinning the larger specimens.

On entering on the investigation of each new reach of the river from Assuan northwards, the Superintendent should secure the services, for a few days only, of three or four fishermen living on its banks and familiar with its fishing-grounds. Each party should be accompanied by its own boat and nets, so that when their services were no longer wanted the fishermen could easily return to their villages.

The Superintendent should be furnished with appropriate nets, among which should be an eight-foot beam trawl; and it is recommended that his equipment in fishing-gear should be much the same as that supplied to the officer entrusted with the survey of the Congo River.

This memorandum is accompanied by some instructions, drawn up by Mr. Boulenger, for the preservation of fishes.[1]

[1] As it is extremely desirable that any opportunity which may lend itself to the enlargement of our knowledge of the fauna of Egypt should be taken advantage of, it is therefore suggested that this Survey might, without much additional labour, do something towards making known the character of the Mammals found along the banks of the river, even as far as the margin of the desert. This might be accomplished were the Superintendent to have various kinds and sizes of appropriately baited traps set every evening when the launch was moored for the night along the river's bank, but not immediately in front of villages. They should be placed at wide intervals in zigzag lines reaching from the river to the desert; and likely situations for the presence of animal life, alternately on the two banks of the Nile, should be selected in determining where the launch is to remain for the night. Hares and animals of larger size should be prepared as skins, the skull and leg-bones of each specimen being left attached to the skin, the inside of which should be well smeared with arsenical soap. Specimens smaller than hares can be preserved in alcohol, but, as a rule, no mammal larger than an ordinary rat should be so treated, as the hair is apt to come off unless the spirit has been very frequently changed, which adds to the expense. As many skins, therefore, as possible should be prepared, even of

Cost of the Survey.

It is difficult to say what the annual cost of such a Survey as has been sketched would amount to. Were the Egyptian Government in a position to place a steam-launch at the disposal of the Survey, the cost of the working expenses, crew, and fuel, including the salary of the Superintendent and the pay of the taxidermist, should not exceed, under judicious management, more than 450*l.* to 500*l.* per annum for a period of three years.

The expenses would have been much greater had not the Director of the Natural History Departments of the British Museum undertaken to supply the necessary collecting-boxes, sixty in number, with alcohol to fill them. But apart from this there would be the initial cost of nets and other necessary apparatus, which may be put down at 20*l.*; but if the Superintendent were selected in England, his passage to and from Egypt would have to be met.

The cost of the transmission of the collecting-boxes from London to Cairo, as well as the cost of their return-carriage to London, would have to be borne by the Egyptian Government.

The cost of publication would be about 1500*l.* This calculation is based on the probably correct supposition that one hundred plates would suffice for the illustration in a satisfactory manner of the fishes of the Nile. The cost of each plate would be 12*l.*, so that 1200*l.* would be required for the illustration of the work, provided all the figures are uncoloured. The same number of plates in chromolithography would amount to nearly 2000*l.*

The printing of the text should not cost more than 300*l.*, so that were 1500*l.* set apart for the bringing out of a volume uniform with the "Reptiles and Batrachians of Egypt," but with uncoloured plates, the total cost of the undertaking would be met by a grant of 3000*l.* spread over a period of three years.

JOHN ANDERSON.

71 Harrington Gardens, London, January 12.

We, the undersigned, desire to express our general approval of the scheme detailed above for a Survey of the Nile, with the object of making known the species of fishes inhabiting its waters, and we beg to recommend it strongly to the favourable consideration of the Egyptian Government.

LISTER, President of the Royal Society of London.
A. GÜNTHER, President of the Linnean Society of London.
E. RAY LANKESTER, Director of the Natural History Departments, British Museum.
P. L. SCLATER, Secretary of the Zoological Society of London.

HUNTER AND THE SCIENCE OF SURGERY.[1]

IN accordance with the terms of a deed establishing the Hunterian Oration, we celebrate to-day John Hunter's name and fame. Born on February 14 in the year 1728 at Long Calderwood, a small estate his father farmed, some eight miles from Glasgow, he died on October 16, 1793, in his sixty-fifth year, celebrated alike as a great surgeon, a profound biologist, and a man of genius.

Here, in view of this noble presentment of Hunter by the foremost painter of his time, the orator is called upon to praise its foremost surgeon.

The picture was painted by Reynolds in 1785, when Hunter was fifty-seven years old, and as we look at it we perceive him in deep reverie, in one of those waking dreams to which he refers in his lectures. He has paused from writing in order to think out some problem, and, as he often said, it was a delight to him to think. As we dwell upon the features we cannot doubt that a sudden inspiration has flashed upon and gradually pervaded his mind, some great scientific truth or generalisation which he has grasped, and is pondering with intense satisfaction.

Buckle, in his "History of Civilisation," writes: "It sometimes seems as if Hunter's understanding were troubled by the grandeur of its own conceptions, and doubted the path it ought to take. Still, his powers were so extraordinary, that among the great masters of Organic Science he belongs to the same rank as Aristotle, Harvey, and Bichat, and is somewhat superior to Haller and Cuvier."

To appreciate, or even fully to comprehend, the labours of Hunter, one must strive to judge them from the standpoint of his time, for in this way only can we form a just conception of their splendid superiority.

On Hunter's early life and the many moot points it involves —his preliminary education, whether he was for a time a carpenter by trade, why he was not sent to Glasgow College like his brothers, or why in later life he spent some time at Oxford University without being in the least appreciative of the training he might there take advantage of—I do not purpose to dwell. William Hunter desired his brother John should be trained as a physician, and sent him to Oxford to obtain the necessary classical education, but during the short period he spent there he found himself quite unable to study Latin and Greek, and spoke afterwards rather contemptuously of the ancient learning.

Hunter's scientific career dates from his arrival in London in 1748, where, when twenty years of age, he joined his brother William's school as an ill-educated youth, new to all the amenities of life, brusque in manner and negligent in appearance, yet with a keen sense of physical enjoyment. As a pupil he showed a marvellous aptitude for anatomy, and soon became a successful teacher of it, but he always remained a learner in that book of nature which was ever open before him, and whose pages, until he died forty-five years later, he never ceased to turn, interpreting aright many of its obscurest passages.

In 1759, undermined in health by ten years of incessant toil, he obtained an appointment in the army and sailed with Keppel for Belleisle, and afterwards accompanied the expedition into Portugal. It was there that he studied the phases of inflammation and the treatment of gunshot wounds.

When he returned to London, with nothing but his half-pay to provide the wherewithal to live upon, and nothing but his genius to trust to for advancement, Hunter's life became one of untiring labour. He was elected a Fellow of the Royal Society when thirty-nine, a year later became surgeon to St. George's Hospital, and in 1776 was appointed Surgeon Extraordinary to the King.

In 1786 he was appointed Deputy Surgeon-General in the army, and three years later became Surgeon-General. He also published his work on Venereal Diseases in 1786, and the following year received the Copley Medal from the Royal Society on account of many valuable papers. His great work on the "Blood and Inflammation," however, still remained unfinished after thirty years of labour bestowed upon it, and was only published after his death.

At fifty years of age he had reached the zenith of his surgical career, having done more to improve the science of surgery than all the other surgeons of Europe had done before him.

On the death of Pott, Hunter became the chief surgical authority in London; his opinion was highly valued in difficult cases, and he acquired a lucrative practice. There is no doubt he was an admirable clinical teacher and a courageous operator, and although his systematic lectures on surgery were marred by a faulty delivery and occasional obscurity of style, they attracted all those who afterwards attained distinction amongst their contemporaries.

The evidence of Cline, Abernethy, Astley Cooper, Royer Collard, Billroth—surgeons indeed of every school—emphasise the excellence of these lectures on the Principles of Surgery, and it is still evident to the reader of to-day in the somewhat fragmentary record which has been preserved by Hunter's pupils.

Hunter was deficient in what we are pleased to call general culture, and doubtless he suffered in consequence. He read but little, and many of his discoveries had been anticipated by others, but when this was brought to his knowledge he abandoned any claim he might have advanced. It appeared to him of small consequence by whom a discovery was made if it only proved the stepping-stone to a higher and more complete knowledge. He was no mere collector of facts in order simply to augment their number. He thought too much attention could not be paid to facts so long as they helped to establish principles, and in the capacity for generalisation Hunter was pre-eminent. He had a great power of estimating what was worth doing, and how best to do it, his descriptions are graphic, and as an expositor of what he had to tell he is often unsurpassed.

the smaller mammals. Before specimens are placed in alcohol they should have the abdomen slit open to admit of the spirit having free access to the viscera. The date of capture, the character of the ground on which the animal has been found, the exact locality, and the sex of each individual should be entered in the day-book opposite to a number corresponding to the number attached to the specimen.

[1] Abstract of the Hunterian Oration delivered by Sir William MacCormac, Bart., K.C.V.O., President of the Royal College of Surgeons of England, at the College, on February 14.

He was attacked in 1789 by severe illness, and until his death four years later his life proved a very suffering one. Constant work and insufficient sleep doubtless shortened his days.

His death, sudden and tragic in its circumstances, happened in St. George's Hospital whilst he was demanding from somewhat hostile colleagues what he regarded as a just concession to his pupils.

In the first instance Hunter's work was biological, his range including both the animal and vegetable kingdoms, and the mineral kingdom as well, and to illustrate his investigations he became a collector. But he was chiefly and finally a surgeon, and to the development of surgery he brought all the knowledge and all the training which he had acquired in other branches of science.

He carries us beyond mere handicraft and detail into the region of general principles and law. The surgery of the Middle Ages was a trade, Ambroise Paré and Jean Louis Petit converted it into an art, John Hunter elevated it to the rank of a science.

Hunter's life and work inspired his successors with the spirit of observation, investigation and experiment. We see this exemplified in his great followers, Cline, Abernethy, Astley Cooper, Travers, Green, Brodie, Lawrence, and others since their time. They have been makers of English surgery, and each in turn has done much to raise it to that high standard which it has always maintained.

And now I may refer in detail, yet of necessity very shortly, to some part of Hunter's work in illustration of what I have just said, and show that his views, immensely ahead of his time, fall little short of the principles guiding the most modern surgeon.

I shall first allude to his observations on Animal Heat, which are of the greatest interest, especially when we remember the imperfect quality of the instrumental aid at his disposal; then say some words as to his opinions upon Injuries of the Head, and his never-to-be-forgotten work on Aneurism; I shall briefly review his study of Venereal Diseases; and, lastly, notice his great work on Inflammation and Gunshot Wounds—the last a subject which has always interested me. Nor could the account be in any sense considered complete without a reference to the past and present state of our great museum, itself an imperishable monument to John Hunter's memory.

In 1799, six years after Hunter's death, Parliament purchased his collection and subsequently handed it over in trust to the Royal College of Surgeons for the public advantage. Further grants of money were voted to the College to erect a proper building for preserving and extending "Master" Hunter's collection, and to build a theatre for the delivery of public lectures on anatomy and surgery.

The Hunterian Museum is a monument sufficient alone for the fame of any man. Hunter's aim was no less than to illustrate the whole question of life both in health and in disease. Nature's handiwork in all its manifold perfections is there clearly shown forth by the never-ceasing labour of this great intellect, and he did in the main compass his splendid aspirations.

Hunter rendered to his art and science greater service than any man had done before him, and his claim to our admiration rests not merely on what he did, but on what he suggested might be done.

One cannot but feel amazed at the multitude of the subjects which engaged his interest and attention, the greatness of his achievements, or the far-reaching influence of so many of his inquiries. His spirit survives in the energy of others who follow in his footsteps, and serves to stimulate every student of biological science.

His supreme endeavour was to study life in all its many-sided manifestations. This is the noblest form of study, and the most inexhaustible, yet the problem of life will remain a mystery transcending the power of human investigation or human imagination.

Billroth regarded Hunter as one of the greatest men the English nation has produced, and his work on Inflammation and Gunshot Wounds as the corner-stone of modern English and German surgery. "From Hunter's time to the present day," he says, "English surgery has had about it something noble, and nowhere, either in ancient or modern times, can the pattern be found of a grander scientific career."

Masters of our craft at epochs in surgical history have from time to time declared their art to be then so near perfection that further improvement was impossible.

May we not, nevertheless, hope and expect that surgery will still accomplish new triumphs and yet greater completeness? I am not of those who think there can be any finality in human progress; to believe so would, I consider, render life no longer worth living in its higher sense and greater aspirations. Rather let us consider ourselves as having but just crossed the threshold of the great temple of science, knowing only a small part of that which yet remains to be known.

Anæsthesia has rendered surgical procedures capable of a realisation which not even in dreams could we have supposed possible. It has permitted many new departures in surgery, made many operations feasible which had previously been condemned, and has proved a help of extreme value in the diagnosis of disease. As Oliver Wendell Holmes has said: "The fierce extremity of suffering has been steeped in the waters of forgetfulness, and the deepest furrow in the knotted brow of agony has been smoothed for ever."

Furthermore, one of the scientific descendants of Hunter, deeply imbued with his spirit, transcendently patient and painstaking in detail as was his master, as minute an observer of nature's ways, and as careful an experimenter, after much trying and much thinking, has realised, in the discovery of the methods of antiseptic surgery, a benefit to mankind which only surgeons can to the full appreciate. What was hazardous before is now rendered safe, what was accomplished with pain and suffering is now free from both. There is scarcely a limit to what might be said in praise of this great work. The name of Lister, like that of John Hunter, will stand forth in the records of scientific progress as one who has immeasurably benefited humanity, and as the author of the means whereby surgery has been mainly enabled to make that marvellous progress of which we are all so proud. This is recognised throughout the world, and were I not convinced that our science has fresh achievements in store, I should say that Lister had finally crowned the edifice whose corner-stone Hunter laid.

John Hunter's career has been presented to audiences in this theatre from almost every aspect, and his life and work have been reviewed by the greatest of his successors, some of whom have compelled our admiration by their eloquence and the beauty of the language in which they have expressed their thoughts. I do not expect to equal these, yet I would hope that my story, although "a twice told tale," has aroused in you some measure of sympathetic response. The study of Hunter's works is in itself a liberal education. They show his almost superhuman energy, the versatility of his genius, his extraordinary powers of observation, and beyond all these the absolute mastery of his will over bodily suffering. Of all the great minds which have illuminated the scientific world and guided its destinies, John Hunter's is the one which first directed surgery into the pathways of science, and dying left to surgeons a future in the memory of his past.

He is the one great man without whose aid it is impossible to imagine surgery all that it now is; we cannot take his influence away and yet retain all that we now possess. Our science might have spared some other workers, but it could not have become the science we know without John Hunter.

This great surgeon, one of the greatest men who ever practised surgery, has now long gone to his rest. Cut off in the midst of his glory, he died in harness. Yet, though he be gone, we may well apply to John Hunter what has been said of a pre-eminent statesman lately passed away: "The nation lives that has produced him, may yet produce others like him, and in the meantime it is rich in his memory, rich in his life, and rich above all in his animating and inspiring example."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The 197th meeting of the University Junior Scientific Club was held in the large lecture-room of the museum on Wednesday, February 15, the President in the chair. There were present ninety members and twenty visitors. Prof. Odling delivered a lecture on chemical views in controversy about the year 1850. The following is an abstract of the lecture: To put back the clock is always a very difficult task, and to understand exactly the views of chemists of fifty years ago is extremely hard, as one must forget for the time being all that has been discovered since. In chemistry, as in most other

sciences, the tendency is to look forward and not backward; but it must not be forgotten that the future will be but a development of the present, as the present has been a development of the past. The evolution of chemistry has taken place along one continuous line, broken here and there by great fundamental discoveries, which have been rather apt at first to warp the line of development, and to make it a little one-sided. Thus the striking aptness of Dalton's atomic theory to explain the laws of chemical combination, which he had formulated, and the tables of proportional numbers deduced from them, attracted the attention of chemists to the determination of atomic weights. The importance of molecular weights, or as Prof. Odling preferred to call them unit weights, of compounds was not fully recognised till some half-century later, although Avogadro had pointed the way in his hypothesis put forward in 1811. In the forties Laurent and Gerhardt began to investigate unit weights, and laid the foundation of our present system. In this country Williamson and Brodie were the chief workers at the subject, and Prof. Odling described himself as their junior colleague to whose share much of the fighting fell. They had before them the problem of determining correct atomic weights for the elements, a problem which could only be solved after correct determinations of the unit weights of their compounds; and they considered that physical evidence as to unit weights must be confirmed by the chemical behaviour of substances. Hence the importance of Williamson's theory of etherification; for by showing that ether was not merely the oxide of a hydrocarbon radical, but that it was a combination of two hydrocarbon radicals with oxygen, he was able to deduce the unit weights of alcohol, ether, and other compounds compared with that of water, and to show that the carbon always combines in multiples of twelve, and oxygen in multiples of sixteen, and so these numbers must represent the real atomic weights. It was some years, however, before these new atomic weights, based on a true conception of unit weights, were generally accepted. The first text-book in which sixteen was used throughout as the atomic weight of oxygen being Prof. Odling's "Manual of Chemistry," published in 1861. Subsequently Newlands, from the revised atomic weights, suggested the periodic system of the elements, which was developed by Prof. Odling and Lothar Meyer, and completed by Mendeléeff. The chief work of chemists during the last quarter of a century might be briefly described as the investigation of the internal structure of the chemical molecule, and this, being dependent on an accurate knowledge of unit and atomic weights, is but the natural development of the most important work of the fifties—the correct determination of unit weights.

Mr. A. E. H. Love, F.R.S., Fellow of St. John's College, Cambridge, and University Lecturer in Mathematics, has been elected Sedleian Professor of Natural Philosophy in succession to the late Prof. Bartholomew Price.

CAMBRIDGE.—A Frank Smart Studentship in Botany, value 100*l.* a year for two or three years, will be vacant in June. Candidates must be B.A.s who have taken honours in Natural Science, and are of less than fourteen terms' standing. Names are to be sent to the Master of Gonville and Caius College by June 10.

Mr. A. W. Hill, of King's College, has been appointed Demonstrator of Botany.

Graces for the acceptance of the benefactions offered towards the establishment of a department of Agriculture will be submitted to the Senate on March 2.

A Salomons Scholarship of 70*l.* a year for three years will be vacant in 1900 at Caius College. Candidates will be examined in November 1899; they must be under nineteen, and must declare their intention of entering the engineering profession.

THE first of a series of occasional lectures at Bedford College will be given by Dr. W. J. Russell, F.R.S., on "How pictures can be taken on a photographic plate in the dark," to-morrow, February 24.

IN response to Mr. Balfour's recent appeal for the endowment of medical education and research, Sir Frederick Wills has forwarded to the treasurer of Guy's Hospital a donation of 5000*l.* to be used for the benefit of the medical school.

IT is remarked in *Science* that Harvard University some time ago established a class somewhat similar to the docents of the German University, though the lectureships are limited to a period not exceeding four months, and the University does not even collect such fees as may be charged. The first lectures under this system are now announced.

THE Glasgow University General Council have decided that the memorial to Principal Caird shall take the form of a window on the east side of the Bute Hall. The total cost is estimated at 900*l.*, of which 834*l.* have been subscribed. Mr. Archibald Craig, 156 St. Vincent Street, Glasgow, will be glad to receive contributions to make up the sum required to complete the memorial.

THE trustees of the Reid Trust for the education of women have decided to offer a scholarship at the London School of Medicine for Women, in memory of their co-trustee, the late Miss Bostock, of Penmaen, Glamorganshire. The value of the scholarship will be 60*l.* a year, tenable for two or four years, and awarded on the result of the preliminary scientific examination of the University of London. The Bostock scholar must read for the London medical degree. Further particulars may be obtained from the hon. secretary of the Reid Trust, Bedford College, York-place, W.

IN the House of Lords on Monday, Lord Norton asked the Lord President of the Council when the Education Bill would be introduced. In reply the Duke of Devonshire said that there appeared to be some misapprehension as to the character of his Bill. The Bills which he introduced last year were for the creation of a Board of Education and for the registration of teachers. Neither of those Bills could be described as an Education Bill. The measure which he should introduce would not, as far as he was aware, go beyond the scope of the Bill which he introduced last year. He hoped that next week or the following week he might be able to present the Bill again, and be able perhaps to name the day when the second reading would be taken.

THE sub-committee on Commercial Education, appointed by the London County Council in May 1897, have presented their report to the Technical Education Board. The committee have considered in detail the improvements desirable in elementary and secondary schools for pupils who propose to enter on a commercial career. Among the recommendations are the following:—

(1) That it is desirable that there should be in many of the public secondary day schools in London of the second grade departments devoting themselves primarily and avowedly to the preparation for commercial life of boys who will leave school at sixteen; that in such departments, while a good general education should be given, special attention should be devoted to modern languages in such a way as to turn out pupils able to speak and correspond fluently in at least two modern languages, to the teaching of arithmetic so as to secure perfect facility in the use of the metric system, and to ensuring a good general acquaintance with the commercial geography of foreign countries

(2) That it is desirable that there should be provided in London in at least one public secondary day school of the first grade a department devoting itself primarily and avowedly to the preparation for business life of boys leaving school at eighteen or nineteen; that the curriculum of such department should not lead up to a classical or mathematical career at the Universities, but should qualify its pupils either to enter the higher ranks of commercial life, or to pursue an advanced course of study in the economic and commercial faculty of the new London University, or in other institutions of higher commercial education.

(3) That it is desirable that full and express recognition should be given to higher commercial education in the reorganisation of London University, and that it be referred to the special committee of the Board, dealing with the University, to consider whether it would not be wise to urge upon the Commissioners the establishment, from the first, of a separate faculty of economic and commercial science, the provision of endowed professorships in the various subjects of higher commercial education, and such arrangements as will facilitate and encourage those designed for or engaged in the higher ranks of business to take advantage of University teaching.

SCIENTIFIC SERIALS.

Bulletin of the American Mathematical Society (January).—Report on the theory of projective invariants: the chief contributions of a decade (by Prof. H. S. White), was read before Section A of the American Association for the Advancement of Science in August 1898. The starting-point is from th

publication of the second part of Gordan's "Vorlesungen über Invariantentheorie" in 1887. Gordan's famous theorem is on the finiteness of the form-system of one or more binary forms. After a slight introduction, the subject is discussed under six heads, viz. Mertens' demonstration and Hilbert's first proof of the theorem; Hilbert's general proof for forms in n variables; Deruyts' researches in enumeration of covariants of given characteristics; Hilbert's theorem upon syzygies of higher orders; miscellaneous topics; and the writer winds up with desiderata and remarks upon courses of instruction. It will be gathered from the above selection of headings that the report is likely to be useful to students. There are numerous references, which we hope are more accurate than the following footnote on the first page, which cites Sylvester's proof of the theorem; thus "Proc. Lond. Math. Soc., vol. 27 (1878), p. 11-13." There is a remarkable muddle here. Vol. xxvii. gives *Proceedings* of Session 1895-6, the *Proceedings* of 1878 appear partly in vol. ix. and partly in vol. x., and no reference to such communication occurs in the index to the first twenty volumes of the *Proceedings*.—Miss C. A. Scott discusses Holgate's translation of Reye's "Geometrie der Lage."—Prof. M. Bôcher gives an account of Burkhardt's "Funktionentheoretische Vorlesungen," vol. i., einführung in die Theorie der analytischen Functionen einer complexen Veränderlichen. The little work is said to be a useful introduction not merely to those parts of the theory which have been long classical, but also to the many other important developments of the last thirty years.—An extensive review of Darboux's "Leçons sur les Systèmes orthogonaux et les coordonnées Curvilignes," by Prof. E. O. Lovett, which follows, bristles with references to original memoirs.—Prof. J. Pierpont warmly commends the new Mathematical Encyclopædia, the success of which he regards as being mainly due to the genius, energy and courage of a single man, Felix Klein.—Errata, Notes (which are fuller than ever under Prof. Lovett's care), and new publications close the number.

Bollettino della Società Sismologica Italiana, vol. iv., 1898, No. 6.—Vesuvian notices (January-June 1898), by G. Mercalli. Describes the state of the volcano during each month, adding notes on the changes in the depth of the crater and the excentric eruptive apparatus.—Correction [of an error in copying] in the report of the geodynamic observatory of Casamicciola (Ischia) on the Indian earthquake of June 12, 1897, by G. Grablovitz.—Reply to the same, by G. Agamennone.—Mode of utilising already exhausted *Dalle-Moile* dry piles: new "Guzzanti" pile, by C. Guzzanti.—Notices of earthquakes recorded in Italy (October 2-November 26, 1897), by G. Agamennone, the most important being the earthquakes of Porto Maurizio (October 12), the Marches (October 28), Tuscany (November 1-2), and Latium (November 6 and 13), and distant earthquakes of October 18-19, 20, 23, and November 11.

IN the *Journal of Botany* for January, Mr. Herbert Goss gives an account of the finding of *Orchis cruenta* in Cumberland, already alluded to in these columns.—In the number for February, Mr. G. S. West commences a list of the Alga flora of Cambridgeshire, a comparatively unworked ground. The list will comprise 409 species, 35 of them new to the British Isles, and 9 new to science, including a new *Bulbochaete* and a new *Oedogonium*.—Mr. H. C. Hart commences an account of a botanical excursion through the little-known West of Donegal.—Messrs. Britten and Boulger complete their first supplement (1893-1897) of their Biographical Index of British and Irish Botanists.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 9.—"On the Reflection of Kathode Rays." By A. A. Campbell Swinton. Communicated by Lord Kelvin, F.R.S.

The author has investigated the para-kathodic rays, so called by Prof. S. P. Thompson, which in a focus tube proceed from the front surface of the anti-kathode, and cause the green fluorescence of the glass. By means of a tube in which these rays cast the shadow of a wire upon the opposite end of a tubular annex he has studied their magnetic deflection, and finds it to be in a similar direction to that of kathode rays. By means of another tube containing a small Faraday cylinder, into which some of the para-kathodic rays were caused to pass, he has determined that the para-kathodic rays carry negative charges. The author has previously shown that para-kathodic rays produced Röntgen rays, where they strike the glass; they also produce green fluorescence, hence he concludes that para-kathodic rays are simply reflected kathode rays.

The mechanical force exerted by these reflected kathode rays appears to be exceedingly small, and is insufficient to account for the inverse rotation of radiometer wheels, which, as described by the author in the *Phil. Mag.* for October 1898, occurs when the wheels are placed just outside the kathode stream. Indeed, all experiments designed to produce rotation by the impact of reflected kathode rays failed, and in some cases the wheels were found to rotate most persistently in a contrary direction, showing that whatever be the cause of such inverse rotation, it is more potent than the force of impact of the reflected rays.

The reflection of kathode rays is largely diffuse, but not altogether so; experiments with a polished concave platinum reflector, capable of rotation, gave under certain conditions distinct visual evidence of true specular reflection, with equal angles of incidence and reflection. In addition to the specularly reflected rays the anti-kathode reflector was also found under certain conditions to give off a well-defined beam of other rays normal to its surface, which caused fluorescence of the glass. The exact nature of these normal anti-kathode rays calls for further investigation.

The author has studied and quantitatively measured the electric charges carried by reflected kathode rays for different angles of incidence and reflection by means of special apparatus. A tube was constructed for this purpose, in which a polished flat platinum reflector could be set at different angles to the incident kathode rays. This tube was fitted with a movable Faraday cylinder which was capable of rotation round the reflector, so that throughout a single plane the whole field traversed by the reflected kathode rays could be explored. The amount of negative charge imparted to the movable Faraday cylinder at different positions, and with different angles for the reflector, were measured both by a reflecting galvanometer and also by a quadrant electrometer. Many complete series of observations for different positions both of reflector and cylinder were made and all agree in showing that the field of reflected kathode rays is not uniform, but increases more or less gradually on both sides up to a maximum, which always occurs almost exactly at the point that makes the angle of reflection equal to that of incidence.

Further experiments show that the amount of charge carried by the reflected rays increases as the incidence is made more slanting, and that the electrification of the reflector itself, which is strongly negative when the incidence of the primary kathode rays is normal, gradually falls to zero as the incidence is made more slanting, until with very slanting incidence the electrification becomes slightly positive.

The author compares this result with that described by him in the *Roy. Soc. Proc.*, vol. lxiii. pp. 434-435, viz. that kathode rays which strike the anti-kathode normally, are more efficient in producing Röntgen rays than those which impinge upon it very much on the slant.

The author points out that these results support the view that the Röntgen rays are actually due to the electric charges carried by the kathode ray particles being imparted to the anti-kathode.

Entomological Society, February 1.—Mr. George H. Verrall, President, in the chair.—Mr. Champion exhibited specimens of an interesting species of Fulgoridæ, *Atalanta auricoma*, Burm., recently received from British Honduras, and stated that he had found Lepidopterous larvæ in the white waxy matter attached to the body of an allied species, *Enchophora stellifer*, Burm., of which he exhibited a specimen, together with a larva taken from it. He also showed numerous specimens, and pointed out certain peculiarities, of both sexes of an undescribed species of *Apiomerus* (Family Reduviidæ), found by himself in Chiriqui.—Mr. Tutt exhibited on behalf of the Rev. G. H. Raynor a large series of *Spilosoma lubricipeda*, Linn., to show that the extreme aberrations of this species could be produced by inbreeding from comparatively normal forms. He then exhibited a number of closely allied forms of *Anthrocera*, received from M. Oberthür of Rennes, and comprising, among others, *A. medicaginis*, Dup., *A. medicaginis*, Bdv., *A. charon*, Dup., and *A. charon*, Bdv. The first two of these, as probably also the fourth, he referred to *medicaginis*, Bdv., considering them to be possibly forms of *Anthrocera lonicerea*; while the specimens of *A. charon*, Dup., were, he

stated, almost indistinguishable from typical *lonicerae*. Mr. Tutt next exhibited some remarkable colour-aberrations of *Anthrocera filipendulae*, captured by Mr. W. H. Harwood near Colchester.—Mr. A. H. Jones exhibited a fine specimen of *Sphaeria robertsi* attached to the larva of *Charagia virescens*.—Mr. Percy T. Lathy communicated "A monograph of the genus *Calisto*"; and the Rev. F. D. Morice, papers entitled "Illustrations of specific characters in the armature and ultimate ventral segments of *Andrena* ♂," and "Notes on *Andrena taraxaci*, Giraud."

Geological Society, February 1.—W. Whitaker, F.R.S., President, in the chair.—On radiolaria in chert from Chypon's Farm, Mullion District (Cornwall), by Dr. G. J. Hinde, F.R.S. This paper describes the discovery of a bed of chert on the mainland, similar to that already described from Mullion Island. The chert is interbedded with clay-slates, and it is a dark massive rock much traversed by quartz-veins; in some parts of it the radiolaria are preserved in an unusually perfect condition, showing their latticed structure and spines very distinctly. The radiolaria for the most part are casts only, without any definite bounding-walls, their outlines being indicated by the dark material of the groundmass, while the interior of the test has been infilled with clear silica, sometimes the cryptocrystalline variety, at others fibrous chalcedony. In the forms showing the structural details, these alone have been replaced by the opaque substance, and are thus clearly defined against the clear silica infilling the test. Eleven species are described, of which ten are new, while one has been previously recognised in the cherts of New South Wales. [At this point, Prof. Bonney took the chair.]—Gravel at Moreton-in-the-Marsh (Gloucestershire), by S. S. Buckman. The author describes certain gravels of Triassic débris and flints at Moreton-in-the-Marsh, with special reference to an upper bed wherein the fragments are mostly in a vertical position, some of them having their heavier ends uppermost. He theorises that the vertical materials were the droppings from melting ice floating down a large river.—On the occurrence of pebbles of schorl-rock from the south-west of England in the drift-deposits of southern and eastern England, by A. E. Salter. A set of twelve representative specimens, consisting essentially of quartz and tourmaline, have been looked over by Prof. Bonney, who informs the author that they consist mainly of felspathic grits, schorl-rock, &c., similar rocks to which occur in the south-west of England. The most westerly point at which the pebbles have been detected is on Great and Little Haldon Hills, 800 feet above Ordnance datum, where they are of larger size, more abundant, and coarser-grained than elsewhere. Thence they are traced to the north and south sides of the Thames Basin, and into East Anglia at Walton-on-the-Naze, Aldeburgh, &c. There is a general decrease in height in the deposit in which the pebbles occur, in passing from west to east, and the pebbles appear to have taken two main courses—one along a peneplain west to east from Dartmoor, the other from south-west to north-east across England. The pebbles are absent from the Weald and from the district around Bagshot, from the Hampshire Basin and its bounding hills (with the exception of the extreme south), and from the highest and presumably oldest gravels north of the Thames.

Linnean Society, February 2.—Dr. A. Günther, F.R.S., President, in the chair.—Mr. E. M. Holmes exhibited specimens of *Schimmelia oleifera*, a native of Venezuela, the wood of which yields an essential oil known in commerce as "West Indian Oil of Sandal-wood." The plant, hitherto undescribed, was found to belong to a new genus of *Rutaceae*, and has been named *Schimmelia*, after the German expert who distilled the oil, and, with considerable difficulty, procured flowering and fruiting specimens of the plant to enable its proper determination.—Prof. Howes exhibited three living specimens of the Lizard *Hatteria*, hatched from eggs which had been received from Prof. Dendy, of Canterbury College, Christchurch, New Zealand, with a view of working out the development of the skeleton. Prof. Howes described the circumstances under which they had been reared, for the first time in Europe, and made some observations on the rupture of the egg-shell. Further remarks were made by the President.—On behalf of Mr. J. Hamilton Leigh, there was exhibited an unskinned example of the Wild Cat, *Felis catus*, which had been trapped on January 31 in Argyllshire, and forwarded to London for preservation. It had all the characteristic features of *Felis catus*, and was of great size, weighing nearly eleven pounds. The President, in commenting upon the occurrence, expressed regret that the rarer Mammalia of Great Britain were daily becoming still more rare for want of that protection which might be accorded to them as well as to birds.—Mr. E. S. Salmon read a paper entitled "Notes on the genus *Nanomitrium*, Lindb." This genus had hitherto been regarded as cleistocarpous. Examination of fresh specimens of *N. tenerum* showed, however, that the capsules possessed a distinct zone of specialised cells—delicate, narrow, and transversely elongated—clearly marking off the upper part of the capsule as a lid. The author pointed out that the characters by which *Nanomitrium* had been separated from *Ephemerum* were insufficient, and considered that the former genus should be limited to *N. tenerum*, *N. Austini*, and *N. synoicum*, referring *N. megalosporum* (and perhaps also *N. aequinoctiale*) to *Ephemerum*. The essential character of the genus *Nanomitrium* was the presence of a zone of differentiated cells, by which a regular dehiscence is effected.—Mr. F. W. Stansfield read a paper "On the Production of Apospory by Environment in *Athyrium Filix-foemina*, var. *unconglomeratum*, an apparently barren Fern." This had been effected by cutting off parts of the immature fronds and allowing them to expand during eighteen months in an uniformly humid atmosphere. The result was the production in the ultimate divisions of a meristematic tissue which gave rise to (1) *gemmae* or bulbils, (2) *prothalli*, producing both apogamous buds and ordinary sexual axes of growth. One of the prothalli had been examined, and found to bear both archegonia and antheridia. On layering the primary fronds produced by apospory, it was found that these readily gave rise to fresh aposporous growths. The ease with which apospory was induced in the primary fronds, as compared with the extreme difficulty in the case of fronds from an older plant, was said to be characteristic of aposporous ferns in general, Mr. Stansfield having observed it in every case (eight in all) in which he had raised ferns by apospory. Assuming the truth of the "recapitulation" theory, he suggested that this fact indicated that apospory was an atavic trait in ferns.—Mr. H. M. Bernard gave an abstract of a paper entitled "Recent *Poritidae* and the position of the Family in the Madreporarian System." In attempting to solve the question as to the affinities of the *Poritidae*, the author adduced reasons for believing that the skeletal formation of *Porites* might be accounted for on the assumption that some early *Madreporaria* acquired the habit of budding before the skeleton was mature. The paper further dealt with all the recent genera which had from time to time been classed with *Porites*, and a revision of the Family was suggested.

Mathematical Society, February 9.—Lieut.-Colonel Cunningham, R.E., Vice-President, in the chair.—Mr. A. Berry communicated a note on a case of divisibility of a function of two variables by another function.—Mr. Love, F.R.S., read a paper on the scattering of electric waves by an insulating sphere. A complete solution is given of the problem of determining the disturbance of a train of plane polarised waves of electric force by a dielectric sphere of any size, and with any difference between the dielectric constants of the material of the sphere and the medium outside it. This solution verifies the first approximation for a very small sphere otherwise obtained by Lord Rayleigh, according to which the direction in which the disturbance in the scattered wave vanishes is at right angles to the direction of propagation of the incident waves. It also shows that in a second approximation, whatever the difference of dielectric constants may be, the direction in which the disturbance in the scattered wave vanishes is inclined at a slightly obtuse angle to the direction of propagation of the incident waves. Prof. Lamb, F.R.S., and Dr. J. Larmor, F.R.S., spoke on the subject.—Mr. A. E. Western gave an account of his paper on groups of order p^3q, and also communicated a paper, by Dr. L. E. Dickson, entitled "The group of linear homogeneous substitutions on mq variables which is defined by a certain invariant."—Mr. A. Young read a paper on the irreducible concomitants of any number of binary quartics.—The following were communicated in abstract: On a certain minimal surface and on a solution of $\nabla^2 V = 0$, by Mr. T. J. Bromwich. In the first part, the author investigates the condition that the plane $lx + my + nz = p$ should envelope a minimal surface. This is found to be $\frac{\partial^2 p}{\partial l^2} + \frac{\partial^2 q}{\partial m^2} + \frac{\partial^2 r}{\partial n^2} = 0$, a result previously given by Prof. Genese (*Quarterly Journal of Mathematics*, 1875). The known surfaces of the helicoid and catenoid are proved to be deducible from this result. Comparing this with an expression for p in terms of l, m, n given

by Darboux ("Théorie des Surfaces"), we are led to a type of solution of $\nabla^2 V = 0$, which seems to be related to the forms given by Prof. Forsyth in the *Messenger of Mathematics*, 1897. In the second part of the paper, Mr. Bromwich investigates this solution and allied forms.—On the complete system of differential covariants of a single Pfaffian expression, and of a set of Pfaffian expressions, by Mr. J. Brill; and the figure of Jacobi with respect to a linear system of hyperquadrics, by Prof. P. H. Schoute.

Royal Meteorological Society, February 15.—Mr. F. C. Bayard, President, in the chair.—Mr. E. Mawley read his annual report on the phenological observations, and stated that the weather of the past year, taken as a whole, had been throughout the British Isles very warm and dry. Wild plants blossomed much in advance of their average dates until about the end of March, but after that time until the close of the flowering season they were mostly late in coming into bloom. Favoured by the rains in May, the crop of hay was everywhere a remarkably heavy one, but the long drought which followed dried up the pastures and caused a scanty yield of roots. The dry season suited the cereals admirably, and especially the wheat, of which there was a very abundant crop. The yield of barley was nearly as exceptional, while that of oats, except in the north-east of England, and in Scotland, was also unusually good. There was a splendid crop of potatoes in Ireland and in parts of Scotland, but elsewhere the yield was on the whole moderate. Apples, pears and plums flowered abundantly, but adverse weather conditions, and the dry subsoil in the spring, caused an irregular "set" of fruit; so that in all parts of the kingdom these crops were, as a rule, below average. On the other hand, there were good crops of all the smaller fruits.—A paper by Prof. W. M. Davis, of Harvard University, U. S., on the circulation of the atmosphere, was read by the Secretary. The author said that although the circulation of the atmosphere is one of the earliest and one of the latest problems of meteorology, its treatment is ordinarily inadequate, inasmuch as the serious student seldom gains from the text-books in current use a comprehensive view of the great problem. After giving a brief historical development of the subject, the author went more particularly into the question of the outflowing polar winds, especially in the Antarctic regions. He called attention to the remarks made by Dr. Buchan at the conference on the "Scientific advantages of an Antarctic expedition," held at the Royal Society last year, and maintained that Prof. W. Ferrel's views on the circulation of the atmosphere, so far as they touch Antarctic winds and pressure, had been misunderstood by Dr. Buchan. Prof. Davis said that it must certainly be clear to every physical meteorologist, that the conventional circulation of the atmosphere, as ordinarily stated, was seriously incompetent, for the most striking features in the distribution of atmospheric pressure are not accounted for by it. As long as the effect of the winds in modifying the distribution of pressure is left out of consideration, no broad understanding of atmospheric processes can be reached.

CAMBRIDGE.

Philosophical Society, January 23. — Mr. J. Larmor, President, in the chair.—On the formation of clouds with ozone, by J. S. Townsend. The clouds which are formed when oxygen containing ozone is passed through a solution of potassium iodide, or sodium metabisulphite, are treated of in this paper. Experiments were described which showed that the formation of these clouds is due to the escape of iodine, or sulphur dioxide, from the solution. When oxygen containing small quantities of iodine vapour or sulphur dioxide is passed into a flask containing ozone a cloud is immediately formed. The cloud disappears when the gas in which it is suspended is dried, and reappears again in the presence of moisture.—(*a*) On detectors of radiant heat. (*b*) On the symbolic integration of certain differential equations in quaternions, by H. C. Pocklington.—On the motion of a charged ion in a magnetic field, by Prof. J. J. Thomson. In this paper the motion of an ion moving through a gas dense enough for viscosity to make the velocity of the ion proportional to the force acting upon it is discussed. If H is the magnetic force, F the electric force, θ the angle between H and F, v_0 the velocity acquired by the ion under unit potential gradient, it is shown that the velocity of the ion at any point will have a component proportional to F along the line of electric force, a component proportional to $Hv_0F \sin\theta$ along the line at right angles to H and F, and a component proportional to $H^2v_0^2F \cos\theta$ along the line of magnetic force. The relative importance of the three components depends upon the value of Hv_0; if this is large, the ions follow the lines of magnetic force; if it is small, they follow the lines of electric force, while in intermediate cases they pursue a spiral path. Thus if we suppose the magnetic force to be constant, and consider two different kinds of ions moving with different speeds under unit potential gradient, the more quickly moving ions may travel along the lines of magnetic force, while the more slowly moving ones may travel along spirals. In the discharge of electricity through gases it has been found whenever the velocity of the ions has been measured that the velocity of the negative ion exceeds that of the positive. The author has shown in a paper recently communicated to the *Philosophical Magazine* that this difference between the velocities of the positive and negative ions will account for many of the remarkable differences between the appearances at the kathode and anode of a discharge tube. The results given in this paper show that it will also account for the difference between the behaviour of the negative glow and positive column in a magnetic field. Plücker showed that in strong magnetic fields the negative glow follows the lines of magnetic force; the positive column, on the other hand, does not do so, but pursues a more or less spiral path. This is what we should expect if the negative glow marks the path of rapidily moving negative ions, for which Hv_0 is large; in the positive column, on the other hand, we have to do with more slowly moving positive ions for which Hv_0 is not large enough to allow us to neglect the components of the velocity along F and at right angles to F and H in comparison with the velocity along H; when this is the case, the path of the ion is a spiral.

PARIS.

Academy of Sciences, February 13.—M. van Tieghem in the chair.—Notice on the life and work of the late Sir George Henry Richards, correspondent in the Section of Geography and Navigation, by M. Hatt.—On the heat of formation of anhydrous lime, starting from its elements, by M. Henri Moissan. The author has taken advantage of the purity of the calcium obtained by his methods to re-determine the heat of solution in water. The heat of formation of lime thus obtained, 145 calories, is greater than that of the oxides of sodium, potassium, and lithium; and direct experiment showed that this last metal could be obtained by heating together lithia and calcium in a vacuum.—On the mechanism of the thermal phenomena connected with the elasticity of solid bodies, animate or inanimate, by M. A. Chauveau.—On experimental typhoid infection in the dog, by MM. R. Lépine and B. Lyonnet. After injection of a virulent typhoid culture into the dog, the number of white corpuscles in the blood was modified, some bacilli were excreted by urine and bile, and the remaining bacilli appeared to be localised in the liver and spleen. After some days the blood serum acquired the agglutinating power, but the animal preserved every appearance of health, although for some weeks afterwards, living bacilli could be found in the liver and spleen.—Contribution to the study of animal chlorophyll. The chlorophyll of the hepatic organ of Invertebrates, by MM. A. Dastre and N. Floresco. The hepatic chlorophyll is of alimentary origin; it is a vegetable chlorophyll which is fixed in a very persistent manner by the hepatic cells.—On an ancient fall of shooting-stars, by M. D. Eginitis. A historical study of the probable nature and identification of the asteroid swarm mentioned as occurring in the reign of Constantine. The date was probably the autumn of 752: the swarm identical with the Andromides.—Comparative measures of chemical intensity during the eclipse of the moon of December 27, 1898, by M. Th. Moreux. The results of the photometric measurements of luminous intensity, of chemical intensity, and of the theoretical luminous intensity are plotted graphically. The three curves do not coincide.—On a series of powers that are always divergent, by M. S. Pincherle.—On the algebraic integrals of the equation of Riccati, by M. Léon Autonne.—On the elastic arch, by M. Georges Poisson.—On the propagation of a gradual elongation in an elastic wire, by M. L. de la Rive.—Influence of magnetism upon the heat conductivity of iron, by M. Désiré Korda. It is found that the heat conductivity of soft iron decreases in the direction of the magnetic lines of force, but remains constant in the direction of equipotential lines, independently of the sense of the magnetising force.—On a particular case of electric oscillations produced by a Ruhm-

korff coil with open secondary circuit, and on a new method of measuring electric capacities, by MM. J. J. Borgman and A. A. Petrowsky. By the method given it is possible to measure capacities of a fraction of an electrostatic unit.—On the transformation of the X-rays by different substances, by M. Hurmuzescu.—The graphical method in the study of vowels, by M. Marage. The method employed was the photography of manometric flames, and diagrams are given for the curves of seven vowel sounds.—On phosphorescent strontium sulphide prepared by means of strontium carbonate and sulphur vapour, by M. J. R. Mourelo. Pure strontium carbonate gave a white, non-phosphorescent sulphide, the best phosphorescence being obtained by using native strontianite.—Combinations obtained with fatty aldehydes and mercuric sulphate, by M. G. Benigès. Acetaldehyde gives a crystallised compound with mercuric sulphate, formaldehyde deposits mercurous sulphate only.—A new method for the qualitative and quantitative examination of the albuminoids, diastases, alkaloids, and leucoptomaines in urine, by M. Paul Chibret. An application of a solution of iodine in potassium iodide. Cocaine hydrochloride is used to obtain a standard turbidity.—On orthoxy-phenoxyacetone, by M. Charles Moureu.—On a synthesis of hydroxylamine, by M. Ad. Jouve. The reaction between nitric oxide and hydrogen, in which ammonia and water are the chief products, can be shown under certain temperature conditions (115°–120°) to give a small quantity of hydroxylamine. The base was separated from the ammonium chloride simultaneously formed by means of alcohol, and identified both by its reactions and by analysis.—On the purity of the trimethylene prepared by the action of zinc powder and alcohol upon trimethylene bromide, by M. Gustavson. In reply to the criticisms of MM. Wolkoff and Menschutkin, it is shown that pure trimethylene may give rise with bromine to propylene bromide, and hence that the production of this latter substance is not a proof of the presence of propylene in the original gas.—On the tests for methyl alcohol in alcoholic liquids, by M. A. Trillat.—The fermentation of saccharides, by M. E. Dubourg.—On a mode of action of *Bacillus subtilis* in phenomena of devitrification, by Mlle. A. Fichtenholtz. *B. subtilis* was grown in nutrient solutions, in which no nitrogen was present except as potassium nitrate. The latter was converted into ammonia.—The yeasts as parasites, in their relations to Sorghum blight, by M. Radais.—Explanation of the formation of twins by mechanical action, by M. Fréd. Wallerant.—Variation of acuteness of vision with azimuth. Modification of the section of the cone by astigmatic accommodation, by M. André Broca.—Influence of slight traction upon the excitability of a nerve, by M. G. Weiss.—On the development of *Convoluta Roscoffensis*, by M. Jivoïn Georgévitch.—On three new Orthonectida, parasites of the Annelids; and the hermaphrodism of one of them (*Staecharthrum Giardi*), by MM. Maurice Caullery and Félix Mesnil.—On the seeds of *Allanblackia floribunda*, and on the Bouandja butter which it contains, by M. Edouard Heckel.—Modifications in the primary bark of the Dicotyledons, by M. Eberhardt.—On the structure of the Briançonnais, by M. P. Termier.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 23.

ROYAL SOCIETY, at 4.30.—On the Order of Appearance of Chemical Substances at different Stellar Temperatures; Sir J. N. Lockyer, F.R.S.—The Efficiency of Man, or Economic Coefficient of the Human Machine: Dr. Marcet, F.R.S., and R. B. Floris.—Some Experiments bearing on the Theory of Voltaic Action: J. Brown.—Deposition of Barium Sulphate as a Cementing Material of Sandstone: Dr. F. Clowes.

ROYAL INSTITUTION, at 3.—Toxins and Antitoxins: Dr. Allan Macfadyen.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.

FRIDAY, FEBRUARY 24.

ROYAL INSTITUTION, at 9.—Coherers: Prof. Oliver Lodge, F.R.S.

PHYSICAL SOCIETY, at 5.—The Joule-Thomson Thermal Effect: E. F. J. Love.—(1) A Study of an Apparatus for the Determination of the Rate of Diffusion of Solids dissolved in Liquids; (2) Note on the Source of Energy in Diffusive Convection; Albert Griffiths.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Loss of Heat from Buildings: R. Gordon Mackay.

SATURDAY, FEBRUARY 25.

ROYAL INSTITUTION, at 3.—Mechanical Properties of Bodies: Lord Rayleigh, F.R.S.

ESSEX FIELD CLUB (at Technical Institute, Stratford), at 6.30.—British Well-Worms (*Phreoryctes*), with special reference to a Unique Specimen from Chelmsford: Rev. Hilderic Friend.—On a Neolithic "Fascine" Lake Settlement at Skitts Hill, Braintree, Essex: Rev. J. W. Kenworthy.—Some Illustrations of Pond-Life: D. J. Scourfield.

MONDAY, FEBRUARY 27.

SOCIETY OF ARTS, at 8.—Cycle Construction and Design: Archibald Sharp.

IMPERIAL INSTITUTE, at 8.30.—The Right and Wrong Routes to the Klondyke Goldfields: E. P. Rathbone.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Travels and Researches in Rhodesia: Dr. H. Schlichter.

INSTITUTE OF ACTUARIES, at 5.30.—Some Notes on Life Assurance in Greater Britain, particularly with reference to the Work and Development of the Native Offices: Arthur Wyndham Tarn

TUESDAY, FEBRUARY 28.

ROYAL INSTITUTION, at 3.—Morphology of the Mollusca: Prof. E. Ray Lankester, F.R.S.

SOCIETY OF ARTS (Foreign and Colonial Section), at 4.30.—Persian Trade Routes: A. Hotz.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Improvements in Dioptric Apparatus for Lighthouses: W. T. Douglass and J. A. Purves.

ROYAL PHOTOGRAPHIC SOCIETY, at 8.—Apparatus for Animated Photography: Birt Acres.

WEDNESDAY, MARCH 1.

SOCIETY OF ARTS, at 8.—Leadless Glazes: Wilton P. Rix.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY, MARCH 2.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Perturbations of the Leonids: Dr. G. J. Stoney, F.R.S., and Dr. Downing, F.R.S.—On Flapping Flight of Aeroplanes: Prof. M. F. Fitzgerald.—On Hydrogen Peroxide as the Active Agent in producing Pictures on a Photographic Plate in the Dark: Dr. Russell, F.R.S.

ROYAL INSTITUTION, at 3.—Toxins and Antitoxins: Dr. Allan Macfadyen.

LINNEAN SOCIETY, at 8.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Wireless Telegraphy: G. Marconi.

CHEMICAL SOCIETY, at 8.—Bromomethylfurfuraldehyde: H. J. H. Fenton and Mildred Gostling.—The Action of Metallic Thiocyanates on certain Substituted Carbamic and Oxamic Chlorides, and a New Method for the Production of Thiobiurets: Dr. Augustus Edward Dixon.—Ethylic ββ-Dimethylpropane Tetracarboxylate: W. Trevor Lawrence.—The Action of Alkyl Iodides on Hydroxylamine: Prof. Wyndham R. Dunstan, F.R.S., and Ernest Goulding.

FRIDAY, MARCH 3.

QUEKETT MICROSCOPICAL CLUB, at 8.

SATURDAY, MARCH 4.

ROYAL INSTITUTION, at 3.—Mechanical Properties of Bodies: Lord Rayleigh, F.R.S.

CONTENTS.