THURSDAY, MARCH 21, 1918.

THE ATOM OF ELECTRICITY.

The Electron: Its Isolation and Measurement and the Determination of Some of its Properties. By Prof. R. A. Millikan. (University of Chicago Science Series.) Pp. xii+268. (Chicago, Ill.: University of Chicago Press; London: Cambridge University Press, 1917.) Price 1.50 dollars net.

THE great advances in physical science that have been made during the past twenty years have been largely based on the idea that electricity, like matter, is not infinitely divisible, but that there exists a definite fundamental unit of electrical charge or "atom of electricity" which is incapable of further subdivision, and that all charges, however great, are integral multiples of this unit. While the great mass of experimental observation strongly supported this idea, it has been extremely difficult, as in the case of so many fundamental theories, to obtain a direct and convincing proof of its truth.

In the present monograph Prof. Millikan, of the University of Chicago, gives a most interesting and complete account not only of the general history of this idea, but also of the methods that have been developed to determine, with an accuracy, it is believed, of one in a thousand, the magnitude of the fundamental unit of charge or atom of electricity. When we consider that the atom of electricity is probably the most fundamental and important physical constant in Nature, it is a great triumph for experimental science to have devised within so short a time methods capable of such accuracy. It is to Prof. Millikan himself that we are indebted for the final successful methods of attack of this most difficult problem, and in this monograph we have the advantage of obtaining a first-hand account of his difficulties and triumphs.

From the title of the book, "The Electron," it might be inferred that the author dealt with the general properties of the electron and its *rôle* in electric phenomena. This, however, is not the case, for the first half of the book contains an account of experiments to prove the existence of an atom of electricity and to measure its value, and the latter half is devoted to problems of atomic structure and radiation. There is, however, some historical justification for the title, since the late Johnstone Stoney, when he first introduced the name "electron" in 1891, restricted its meaning to the actual magnitude of the unit charge, quite apart from the mass or properties of the carrier itself, which at that time were quite unknown. While the original meaning has to some extent been conserved, there is now a general tendency to restrict the term "electron" to those atoms of disembodied negative electricity like the cathode particles and β particles of radium which have an apparent mass small compared with that of the hydrogen atom. When the smallest mass associated with the atom of positive electricity has been fixed, it would naturally be termed the "positive electron." So far, however, there appears to be a fundamental distinction between positive and negative electricity, for the atom of positive electricity has never been found associated with a mass less than that of the hydrogen atom. Whether the nucleus of the hydrogen atom is in reality the positive electron or whether it may prove a complex is still an unsettled question.

After a simple sketch of the history of the subject, the author passes in careful review the pioneer methods of J. S. Townsend, Sir J. J. Thomson, and H. A. Wilson for measuring the unit of charge carried by electrified drops of water, and points out the inherent difficulties of accurate measurement under these conditions. The methods employed by Prof. Millikan were similar in general principle to those used in these early researches, with one important distinction. Instead of measuring the average charge carried by a multitude of water drops, subject to variation of size by condensation or volatilisation, he confined his attention to a single charged drop of oil or mercury of small diameter.

A sprayer was used to produce fine drops of oil or mercury, and some of these, charged by friction, fell through a small opening into the space between two charged parallel and horizontal plates, and came into view of a microscope as bright points of light. By adjustment of the electric field a single drop of this kind could be held suspended in the field of view of the microscope for hours at a time. The charge on the drop could be determined from observations on the electric field required to balance the drop, and the velocity of fall of the drop under gravity. The drop usually carried a number of unit charges either positive or negative. By an ingenious method he was able to vary and even reverse this charge at will. For this purpose the drop was allowed to pass for a short time into a region where there was an excess of ions of one sign produced by radium rays and separated by an electric field. In this way it was possible to unload the charge of the drop unit by unit, and to measure it after each exposure. By direct experiment of this kind the author was able to show definitely that all charges gained or lost by the drop were either single or integral values of a definite unit, and still more that the original charge produced on the drop by friction was an integral number of this unit. In this way he was able to prove a number of fundamental points in a most direct way; for example, that the unit of charge produced by friction is the same as the charge carried by the ion in gases, while the unit of positive charge was shown to be identical with the unit of negative charge within a very small margin of error.

As a result of five years' work involving a complete study of numerous corrections, the value e of the atom of electricity was found to be $e=4{\cdot}774\times10^{-10}$ electrostatic units, with a probable error of not more than one in a thousand. With

the knowledge of this constant it is easy to deduce at once the value of a number of other important magnitudes with equal precision, *e.g.* the number of molecules in a cubic centimetre of any gas at standard pressure and temperature, and the mass of each of the atoms of matter. At the same time, the accurate evaluation of *e* throws light on the magnitude of a number of related quantities.

While Prof. Millikan's work was in progress, Ehrenhaft examined the charge carried by particles so small that they showed a marked Brownian movement, and concluded that the charge in some of these cases was smaller than the value found by Prof. Millikan, or, in other words, that there existed a charge less than that carried by the negative electron or gaseous ion. This evidence is carefully examined by the author, who concludes that the discrepancies can be readily accounted for by experimental disturbances, and that there is no trustworthy evidence of the existence of a sub-electron.

Later chapters include a discussion of modern views of the structure of the atom and the nature of radiant energy. Very appreciative references are made to the value of Moseley's work, and its great importance in fixing the relation and modes of vibration of the elements is emphasised. The author is a supporter of the nucleus theory of the structure of the atom, and outlines clearly Bohr's contributions to the origin of spectra.

Prof. Millikan's book is written in a simple, almost popular, style. The argument throughout is well sustained, and the essential points are clearly brought out. Stress is laid on the underlying physical ideas, and the few calculations required are included in an appendix. We can recommend this volume most strongly both to scientific experts and to the general scientific public as an accurate and at the same time inspiriting account of an important field of scientific inquiry opened up in recent years. E. R.

A STUDY OF THE JEWISH CHILD.

The Jewish Child: Its History, Folklore, Biology, and Sociology. By W. M. Feldman. With introduction by Sir James Crichton-Browne. Pp. xxvi+453. (London: Baillière, Tindall, and Cox, 1917.) Price 10*s.* 6*d.* net.

DR. FELDMAN'S study of the Jewish child should be of interest to English readers for at least two reasons. First, because out of a total of twelve million Jews in the world, one-fifth are, at present, living in English-speaking countries—more than two millions in America, and less than a quarter of a million (240,000, to be exact) in the United Kingdom. The second reason is that the British Government, with the consent of the Allies, proposes to use its best endeavours to establish, under the ægis of the British Government, a national home for the Jewish people in Palestine, where they might be at liberty to develop in accordance with their national aspirations.

Dr. Feldman is well qualified to lead us in the study of the Jewish child; for not only is he well acquainted with modern Jewish child-life, having a big practice among the Jews of Whitechapel, but he is also well versed in Jewish literature, ancient and medieval. His book represents the first attempt to give a comprehensive account of Jewish child-life in all its phases and aspects, and takes us through the whole life-cycle of the Jewish child, including the ante-natal, natal, and post-natal periods.

The book may be divided roughly into two parts, historical and scientific. The historical part deals with the state of knowledge of child-life among the ancient and medieval Jews. By means of numerous quotations and citations from the Bible, the Talmud, and Rabbinical literature, the author demonstrates, first that the Jews were keenly interested in all the phases of child-life, and secondly that the amount of true knowledge they possessed on this subject was not inconsiderable. For it must be noted that the broad principles of eugenics and hygiene were strictly enforced by the laws of Moses, and repeatedly enjoined by the teachings of the Rabbis as a religious duty. The scientific part, on the other hand, deals with such questions as the physical, biological, and pathological characteristics of the modern Jewish child.

One of the most important chapters in the book is that which discusses the vital statistics of the Jewish child. At a time when the problem of infant mortality looms large in the public eye, it is interesting to note that among Jews the infant mortality is, at all ages of child-life, considerably lower than among the general population, and not only in England, but in all other countries. The chances of surviving the critical first year are also much greater among Jewish infants. Contrary to the popular belief, the Jewish birth-rate is less, and yet their degree of increase is greater, than that of non-Jews. This is because their infant mortality is considerably lower. As Leroy-Beaulieu puts it, the Jews "bring fewer children into the world, but they bring more of them to maturity." "This low infantile mortality," Dr. Feldman reminds us, "is not due to any inherent racial vitality in the Jewish child, but is due to the almost universal prevalence of breast-feeding among Jewesses, to the lesser incidence or almost entire absence of transmissible taints resulting from diseases acquired by the parents in the worship of Venus and Bacchus, and lastly to the great general care bestowed on their children by Jewish parents, who fly to the doctor for almost every infantile ailment."

The chapter on the system of education among the Jews proves how highly education was valued by them so far back as 2000 years ago. This zeal for education, both Jewish and secular, is still very marked among the Jewish population of the East End. Among other subjects, the author discusses the effects of first-cousin marriages among the Jews. He also gives us an interesting and lucid account of the recent study of Jewish physiognomy by Dr. Redcliffe Salaman, who came to the conclusion that the Jewish type of face is a

recessive Mendelian character, a conclusion which has a bearing on the question of intermarriage and the purity of the Jewish race.

One or two criticisms must be made on an otherwise excellent book. A number of misprints occur, and the author repeats himself occasionally in a way that must affect unpleasantly the attentive reader. Some of the quotations are naïve and often irrelevant to the main purpose of the book. The whole chapter on the mathematical problems of the Talmud is outside the scope of the book. In general, one must say that the author gives too much, and one often wonders whether he is writing about the Jewish child or the Jewish family. Finally, is it to be taken as a compliment to our French Allies that the author gives most of the "indecent" quotations in French? This prudery is perhaps out of place in a scientific book. But these minor imperfections can, no doubt, easily be remedied, and we hope that this excellent compilation will be rendered more perfect in a second edition, which the book richly deserves.

J. BRODETSKY.

OUR BOOKSHELF.

The Linacre Lecture on the Law of the Heart. Given at Cambridge, 1915. By Prof. E. H. Starling. Pp. 27. (London: Longmans, Green, and Co., 1918.) Price 1*s.* 6*d.* net.

IN this lecture Prof. Starling has embodied the main results of the researches which he has carried out during the last few years on the work of the heart. The starting point of the investigation was the introduction by Knowlton and Starling of the heart-lung preparation by means of which the output and efficiency of the heart could be accurately studied under practically normal conditions. By this method the influence of changes in arterial and venous pressure on the output and volume of the heart, its oxygen supply, and its efficiency have been gradually worked out. The evidence obtained from this many-sided research has gradually led up to general conclusions of fundamental importance, one of which gives the lecture its title, and states that "the energy of contraction" of cardiac muscle "is a function of the length of the muscle fibre." In fact, the longer the fibres at the beginning of systole, the stronger is the force of the beat. This property of cardiac muscle, which is equally manifested by skeletal muscle, makes clear, for the first time, the real nature of the so-called "reserve power" of the heart. A rise of arterial pressure or an increase in venous inflow produces a greater diastolic volume of the heart—that is to say, an increased length of its fibres; the heart therefore contracts more forcibly, thereby maintaining its output against a high arterial pressure, or increasing its output when the venous inflow becomes larger.

This principle is not merely of physiological value, but also of far-reaching importance in pathology, and although the author only hints at this aspect, it must have an enormous influence on the clinical treatment of many diseases of the heart.

Plant Materials of Decorative Gardening: The Woody Plants. By Prof. W. Trelease. Pp. 204. (Urbana: Published by the Author, 1917.)

PROF. TRELEASE'S object in this little hand- or pocket-book is an attempt to make it possible for a careful observer to learn the generic and usually the specific names of any hardy tree, shrub, or woody climber that may be found cultivated in the eastern United States—excluding the extreme south—or in northern Europe except in the more pretentious estates or botanical establishments. The manual, which is of a convenient size, has been very carefully and thoughtfully compiled. Some 247 genera and 782 species, with a number of minor forms, are dealt with—in all, 1150 distinct kinds of plants belonging to eighty-three natural families. The book opens with dichotomous keys to the genera, which have been found to work very well, and are followed under each genus by keys to the species, a description of each genus being given before the keys. In addition to the Latin names, the common names of the plants are also given.

For the gardens of eastern North America no doubt the keys to the species are ample, but for Great Britain in many cases they are too meagre. Under Cotoneaster, for instance, of the six species mentioned only one, *C. microphylla*, is commonly found in our gardens, while many familiar species cultivated in this country are omitted. Berberis affords another example, as our gardens are getting filled with new introductions from China, of which no mention is made.

The principle of the manual is good, however, and in such features as it may be lacking we have other books to hand which fill its gaps. One of its chief merits is the vast amount of information it compresses into a small space.

There is a useful glossary at the end, and also a carefully prepared index.

Laboratory Glassware Economy. A Practical Manual on the Renovation of Broken Glass Apparatus. By Prof. H. B. Dunnicliff. Pp. x+92. (London: Macmillan and Co., Ltd., 1917.) Price 4*s.* net.

To overcome the great difficulty experienced by teachers of practical chemistry in Indian colleges in procuring supplies of glassware during the war, Prof. Dunnicliff devised a number of easy methods of renovating and adapting to new uses damaged apparatus made of glass. In this workmanlike little book he describes the processes he has developed and explains how difficulties may be surmounted with success. Teachers in charge of chemical laboratories at home will find the volume very useful, and the uses for damaged calcium chloride tubes, broken test-tubes, flasks, retorts, burettes, and so on, will show them how they may both effect economy and maintain efficiency.

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.]*

International Catalogue of Scientific Literature.

THE Conjoint Board of Scientific Societies, some time last year, appointed—by what mandate is not clear—an International Catalogue Sub-Committee "to obtain information regarding the extent of the use made by scientific men of the present International Catalogue of Scientific Literature, and to obtain recommendations for possible improvement." The sub-committee consisted of Dr. Chalmers Mitchell, Mr. C. V. Boys, and Mr. E. B. Knobel, in addition to the official members. The sub-committee appears to have gone outside the terms of reference and to have reported "that it was advisable to consider suggestions for an alternative scheme." On February 25, the secretary of the sub-committee sent out a circular letter to certain scientific and technical societies, from which I reproduce the three opening paragraphs:—

"A sub-committee of the Conjoint Board of Scientific Societies has been for some time engaged in considering the future of the International Catalogue of Scientific Literature.

"As the outcome of several meetings the sub-committee is prepared to recommend that all papers and books dealing with both pure and applied science should be catalogued by authors and subjects, and that it is more practicable for such a catalogue to be prepared by a single country than by an international organisation.

"In order to bring this about, the sub-committee is considering a plan for the establishment of a central institution in London which shall assemble all the material required to be catalogued, and shall prepare from it cards showing (1) author; (2) title; (3) date and full references; (4) branch of science."

It will be noted that the committee has quietly put the International Catalogue and its organisation aside, and has acted as if the former were a negligible quantity and the catalogue defunct!

The history of the International Catalogue is briefly as follows. In 1893 the Royal Society was memorialised to take into consideration the preparation of complete author and subject catalogues, by international co-operation, in continuation of the society's Catalogue of Scientific Papers, which the society did not propose to continue beyond the century. The proposal being viewed with favour, the Royal Society solicited the opinion of scientific workers all over the world. There was practically but one reply—that such catalogues were essential, and almost universal agreement that the only way of carrying the work into execution was by international co-operation. Representative committees were appointed, and after two years of very hard work a scheme was prepared which was forwarded abroad, together with the invitation to attend the first international conference on the subject. This was held in July, 1896. Two subsequent international conferences were held in London in October, 1898, and June, 1900. All three were highly representative. Ultimately it was decided, at the third conference, to establish the catalogue as an international enterprise. Work was begun in 1901, and has been continued up to the present time. The organisation has grown steadily in weight and efficiency, and at the beginning of the war there were thirty-four regional bureaux in operation. The harmony which has prevailed throughout among the nations is one of the most remarkable features of the enterprise: notwithstanding the complexity of the work, there has not been the slightest friction. I believe no other international enterprise of like magnitude has been called into existence or worked more smoothly.

There is no doubt that the original establishment of the organisation was effected almost solely owing to the prestige of the Royal Society. The society has always been the responsible publishing agent, and is therefore financially liable.

The one chief difficulty in the way, which has retarded the work, has been the lack of working capital, owing to the fact that most Governments will only pay for the volumes after delivery. This has been met in part by a rather heavy loan from the Royal Society, on which interest has to be paid. The late Dr. Mond was one of the most ardent supporters of the catalogue and a convinced believer in international co-operation as the only effective means of producing a satisfactory result; he bequeathed a large sum to the Royal Society. I know that one of the chief objects he had in mind was to enable the society, when the bequest became available, to release the international enterprise from its indebtedness, and generally to promote the undertaking.

As war went on, it became necessary for the society to evaluate its responsibilities towards the catalogue. It was decided that the society could not guarantee the publication of the catalogue beyond the fourteenth issue. An issue consists of seventeen volumes, each dealing with a separate science. The fourteenth issue is now being published, and it is noteworthy that special contributions in aid of publication have been made by the Carnegie Foundation of New York, by the Department of Scientific and Industrial Research, and by certain private donors.

The Royal Society has also undertaken the direct control of the enterprise during the period of the war. Early last year it was intimated to workers abroad that the future of the catalogue must be left for the decision of an international council to be called as soon as possible after the conclusion of peace.

Why the Conjoint Board has intervened is not clear. It certainly has no right to give the catalogue its quietus. That it should have taken the action it has *without ever consulting the international organisation* passes belief. I attended the meeting of the board on Wednesday last, and protested most strongly against the discourtesy the sub-committee has displayed towards our Allies and the neutral countries concerned in the enterprise.

It is unnecessary to dwell on the special need at the present time of maintaining and cementing relationships that have been so happily established, and to comment further on the unhappy policy adumbrated by the sub-committee.

HENRY E. ARMSTRONG,
Chairman of the Executive Committee of the International Council.
Central Bureau of the International Catalogue,
34–35 Southampton Street, Strand, London.

Mercury's Perihelion Progress.

IF Mercury sweeps up solar matter in its course round the sun—such matter as yields the Zodiacal light, for example—there will be no effect on its transverse or centripetal acceleration, but it will experience tangential retardation. This, if uniform, so that $m=a+b\theta$, would give a spiral character to the orbit; but if the sweeping up were periodic, with the planet's

period, the orbit would suffer cumulative perturbations of the ordinary *de* and *edϖ* type.

Now, considering the eccentricity of Mercury's orbit, it seems quite possible that at perihelion it may sweep up more matter than at aphelion; and, if so, the perturbation caused would be roughly parallel to the minor axis, so that it would give a large *edϖ* and a small *de*. Which is what is wanted.

Perhaps also the fact that the Zodiacal light is best seen from the earth's position early in March indicates that the hypothetical matter extends mainly in the direction of Mercury's perihelion, which corresponds with the position of the earth early in December, for that would be at right angles to the March line of vision.

Probably this idea, in some form or other, has been already mooted by astronomers in connection with Mercury's outstanding discrepancy, and rejected by them on the ground that no sweeping up of matter was permissible which would exert any perceptible influence on the periodic time. It may be questioned, however, whether such minute influence could be recognised, otherwise than by its cumulative syntonic fluctuations, if it had been on the average uniform throughout recent centuries.

March 11. OLIVER LODGE.

The British Association and the Nation.

MAY I, as an outsider deeply interested in the organisation and use of competent knowledge in the nation's business, thank NATURE for the note in its issue of March 7 on the decision of the council of the British Association to suspend for yet another year the association's corporate life? I do not challenge the opinion of the Cardiff Committee, nor would I criticise the disinclination of the council, when so many of its prominent members are working hard at urgent problems, to hold a meeting of the customary peace type. But why should there not be a meeting suitable to a time of war and of real peril? Would it not be wise to show that the association stands for something in the stress of a great storm? I would respectfully suggest that a two days' meeting be arranged this year in London, and that two things be attempted thereat:—

(1) To elicit authoritative statements, so far as they can be made, of the services scientific men have rendered the country they have done so much to save from extinction, the extent to which these services have been improvised, and the circumstances in which they have been contributed.

(2) To make possible equally cogent statements illustrative of the future dependence of this country upon competent and organised knowledge, and hard and persistent effort on scientific lines, if its people are to be fit for their place and equal to their duty.

Facts are abundant; demonstrators are available; the time is opportune; the audiences are assured.

Imagine the verdict if nothing of this sort is attempted; a verdict passed on its own purpose by the British Association. The material interests can have their conferences—political, financial, industrial. Even the occupational categories can assemble, be voluminously reported and advertised, and pass resolutions of interminable length on matters far removed either from their knowledge or their experience. One interest only—that of competent and ascertained knowledge—the supreme need of an honest white race, fails the nation. Those who know are to be silent!

Will not that be the truth?

I feel certain that a group of students could easily put a different complexion on the matter, and I suggest that they should be permitted to try. As practically interested in administration, it would be a great privilege to assist in many ways open to me.

If the British Association, by reason of its constitution, finds it difficult to organise such a meeting, are there no other associations or groups of workers who will play their part? J. J. ROBINSON.

The West Sussex Gazette, Arundel, March 11.

Whales and Seals as Food.

MUCH correspondence has recently taken place regarding the use of whale flesh as food, but the writers, regarding it as an experiment or as a last resort, have overlooked the fact that for centuries it formed a regular diet of the islanders of Scotland. In both the western and northern isles the capture of the round-headed porpoise, or "ca'aing whale," has for long been a systematised industry, whenever opportunity offered, and indeed the earliest evidence of man's presence in Scotland, in Neolithic times, is associated with the demolition of a whale stranded on the shores of the Firth of Forth.

Seals also formed a staple food of the islanders, a slaughter of 200 or 300 being no unusual reward for a visit to Suleskerry, in the Orkneys, or to Haskeir, in the Outer Hebrides, during the eighteenth century. To this destruction is mainly to be attributed the decline of the grey seal in Scottish waters, which made necessary the legislative protection granted in 1914. In Martin's day (1703) the seal flesh was preserved for winter use, but difficulties accompanied the eating of it:—"The Natives salt the Seals with the ashes of burnt Sea Ware, and say they are good Food, the Vulgar eat them commonly in Spring time with a long pointed Stick instead of a Fork to prevent the strong smell which their Hands would otherwise have for several Hours after." It was not only the vulgar who feasted, however, for an innocent make-believe adapted the unusual fare to the palates of the great:—"The Seal, tho' esteemed fit only for the Vulgar, is also eaten by Persons of Distinction, though under a different name, to wit, Hamm." JAMES RITCHIE.

Edinburgh, March 15.

THE EDUCATION (NO. 2) BILL.

THE course of the debates in the House of Commons on Wednesday, March 13, and on Monday last, when the second reading was taken, augurs well for the passage of the new Education Bill into law. With one or two exceptions, which might in any circumstances have been expected, every speaker accepted cordially the proposals embodied in the measure, and some even went so far as to regret that more drastic changes had not been submitted, having regard to the grave position in which the nation finds itself, not merely from an industrial and commercial point of view, but also in respect of the responsibilities, personal and public, which the coming generation must perforce accept if we are to maintain and enhance our pride of place among the nations of the earth. Nothing is more gratifying to read in the course of an animated and informing debate than the all but unanimous demand from all parties for a better-paid teaching body with a much improved status. Without doubt the Bill is but a tentative measure, far exceeding, however, the most sanguine hopes of ardent

educationists prior to the war. Let it be remembered how many Education Bills since the Act of 1902 have proved still-born or abortive.

The present Bill has at least achieved one victory: it has killed "half-time" for children under the age of fourteen years, and will thus bring into full-time education in the schools upwards of 207,000 children (who are now either partially or wholly excluded), to their manifest great advantage. The Lancashire and Yorkshire textile employers have almost unanimously accepted the inevitable judgment on this iniquitous system. The Bill further proposes, as perhaps its cardinal feature, and upon which serious opposition will concentrate itself, to establish the means of continued education within working hours for young persons between the ages of fourteen and eighteen years, by requiring at least eight hours per week during forty weeks of each year, or a total of 320 hours, to be devoted to their physical, mental, and moral training.

The necessity for such a measure, having regard to the large expenditure upon public elementary education, which must otherwise largely fail of its purpose, is to be seen in the fact that at the present time, despite the provision now made in evening classes, there are considerably more than $2\frac{1}{2}$ millions of our youth between twelve and eighteen years of age who have ceased all opportunities of education, many of whom grow up uncared for in large measure in body, mind, and soul. There are those who, like the Workers' Educational Association, deeply regret that opportunity has not been taken to place before Parliament and the people at this crucial time a measure of a much more drastic and far-reaching character. They regard the time as opportune for great and vital changes in the sphere of education. They point out the ineffectiveness and unfruitful results of our elementary education, how it is little better than a blind alley lacking organic relation with the system of secondary schools, to which fewer than 5 per cent. of the children in public elementary schools in England proceed; that the provision of secondary education and the facilities for enjoying it are lamentably deficient, and, even when taken advantage of, are pursued to such small effect that the school life of a secondary-school boy is but two years and nine months, and of a girl two years and eleven months, and that the average leaving age of boys is only fifteen years and seven months, and of girls sixteen years, a large number ceasing to attend the secondary schools at all after fourteen.

This reacts upon institutions of higher learning with disastrous results, seeing that from the secondary schools upon the grant list in England and Wales in 1910 only 1008 pupils went forward to the universities, being 2·2 per cent. of the total number (44,934) who left secondary schools in that year.

Of these, more than half (51·66 per cent.) were ex-elementary-school children. As 600,000 children leave the elementary schools annually, only about one per thousand receive a university education, and so unequally are the facilities distributed for such advanced training that more than one-half of the 566 boys passing from English public secondary schools to the universities come from three counties, and there are actually three counties which contribute no candidates at all.

It is doubtless true that many of the proposals of the Bill, which are now merely permissive, should be made mandatory, as, for example, the provision of nursery schools, open to all children whose parents wish them to attend; the duty of making adequate provision for medical and dental treatment; and of providing the means of physical training, baths, and playing fields.

Other desirable features would be the prohibition of all employment of children for profit or wages during the compulsory full-time school period; the provision of maintenance allowances; the raising of the elementary-school age to fifteen within a defined period; the abolition of fees in secondary schools; the continued education for practically half-time for all young persons not receiving full-time education; the serious limitation of the hours of labour for young persons below eighteen years of age; reduction in the size of classes in elementary schools to forty, and ultimately to thirty; an increase in the amount of State grant to 75 per cent., where all the conditions of a satisfactory provision for education are fulfilled, together with provision for the continued education of children who, being less than fourteen, left school before the Act comes into force, as well as that large body of children, estimated at 600,000, who have been exempted from school attendance during the war.

It is satisfactory to find that the Bill is to be committed to a Committee of the whole House, where it will have the advantage of public debate, and where a number of amendments will be submitted, not all of them with a view to its improvement, but rather with the purpose of delay and of ultimate defeat. Mr. Fisher, who has shown conspicuous zeal and industry in the advocacy of his measure, and would doubtless welcome any agreed amendments widening its scope, will need all the help of its friends to ensure its safe passage through the House. The measure is without question a considerable advance, and may be regarded as a step towards the realisation of the ideals to which the best friends of education for all the people aspire. "We have," said Mr. Fisher in the course of the debate, "in this country a continual wastage of ability, of character, and of physique. That is the principal evil which it is proposed to remedy in this Bill. In other words, this Bill acclaims the principle of the rights of youth. We hold that young people have a right to be educated, and that youth is the period specially set apart for that purpose. . . . The State must make up its mind as to the minimum of the education that its citizens should receive, and then require that minimum to be given."

BEE DISEASES

IN the article which appeared in NATURE of August 23, 1917 (vol. xcix., p. 507), upon the above subject, it was pointed out that, as popularly used at all events, the expression "Isle of Wight disease" connotes not so much a disease as a group of diseases, due to different organisms. The cause of this misuse of the term is the inability of the honey-bee to express otherwise than by certain simple means the changes wrought on its system by the introduction of various parasites or poisons. The symptoms which are noticed by lay observers, when bees are suffering from any severe attack, are hastily assumed to be characteristic of "Isle of Wight disease," and the appearance of such symptoms in another colony is considered sufficient evidence that the same disease is present.

As a result of this misconception thousands of cases have been diagnosed as "Isle of Wight disease" merely because "crawling" or dysentery has been observed, while the dwindling of the colony or the death of the entire stock has often been accepted as conclusive proof without any trouble being taken to ascertain whether some other influence has been at work. If the honey-bee were a dangerous pest, the extirpation of which was desired by man for economic reasons, this unwarranted assumption might be of comparatively little importance, but in the case of a highly valuable insect, one of the very few which are of direct service to man, and which it is to his interest to keep alive, the error of thought leads to serious consequences. It appears to have led some scientific workers to the conclusion that *Nosema apis* is not the cause of any bee disease, just as it has led unscientific observers to the belief that "Isle of Wight disease" must be the cause of every case of extensive mortality in their apiaries, when no other obvious explanation is forthcoming. From every point of view, therefore, it is desirable that it should be universally recognised that bees are liable to many diseases, though their macroscropic symptoms are almost, if not entirely, identical, and that the only satisfactory definition of "Isle of Wight disease" is "the disease caused by *Nosema apis*." Bee-keepers should also realise that the presence of this parasite can be determined, in our present state of knowledge, only by the examination of the affected organs of a bee under a microscope of high power. As it has been objected to this definition that certain bees of great resistant power may harbour *Nosema apis* in their intestines without apparent ill-effects on their system, a further definition is needed, and either it must be admitted that every bee in which the parasite is found is scientifically "diseased," or a distinction must be drawn between actual and potential disease, since it is believed that, in certain circumstances, even resistant parasite-carriers may suddenly, and without ascertainable cause, sicken and succumb to an attack.

The importance of this definition of "Isle of Wight disease" becomes clear when its bearing on scientific research into the treatment of bee diseases is considered. During the last six or seven years several remedies or preventives have been tried, and reports on the results of the experiments published in the journals devoted to bee culture. First it was a coal-tar preparation, then a compound of several well-known and powerful antiseptics, then peroxide of hydrogen, and at the present time "Flavine" is being widely recommended. Each of these remedies has had its vogue for a time, and the columns of the technical Press have been filled with enthusiastic testimonials from bee-keepers who have tried them with apparent success, only to be followed at a later date by letters from other bee-keepers who have completely failed to get any good results from their use. It is not suggested that any of these testimonials were other than genuine, but in view of what has been stated above it is at least regrettable that in no case that can be traced has the experimenter taken the trouble to ascertain by microscopical examination whether *Nosema apis* was present in the intestines of any of his bees, or, in other words, whether his colonies were really affected with "Isle of Wight disease" at all. The result of such treatment may be satisfactory to the owner of the bees, but it can have no bearing on its value in other equally undetermined cases of sickness.

The neglect to ascertain beforehand whether the causal organism of "Isle of Wight disease" is actually present when the experiment is begun must also invalidate the results in another way. So long as the parasite is present even in a more or less quiescent state, the affected bee is liable to an attack of "actual disease," and complete success cannot be claimed for any treatment unless it can be shown that after a considerable lapse of time the treated bees are free not only from the symptoms of sickness, but also from the parasites which may cause a fresh attack. In many cases statements as to the efficacy of this or that drug have been made within a few days, and even a few hours, of its application, though it is well known to all who have had any experience of bee diseases that bees respond very readily to a stimulus, and may under its influence reassume the appearance of perfect health for a time. The recovery, however, seldom lasts for long, and the influence of the stimulus declines progressively. Results should not, therefore, be published until after a delay of several weeks, during which time the bees should be carefully examined, and as the susceptibility of bees to "Isle of Wight disease" is greatest in the winter it would be better always to postpone judgment in every case until the spring, when the activity of the bees affords presumptive evidence of a cure. Nothing, however, but a careful microscopical examination of several specimens of the treated bees is sufficient to justify the confident statement that a cure has been effected.

Further investigation into "Isle of Wight disease" is urgently needed, but it should proceed

on ascertained facts, and in the main should be devoted to the discovery of a method whereby the infection of the bee by the protozoon *Nosema apis* can be prevented or remedied, and the test of the success of any experiment to cure an affected colony must include, first, the determination of the presence of the causal organisms; secondly, the elimination of any other influence; and, finally, the proof of the freedom of the colony from the parasite after a considerable lapse of time.

THE DAMAGE TO AGRICULTURE BY VERMIN AND BIRDS.[1]

THAT farm vermin and certain wild birds annually commit an extraordinary amount of damage to agriculture and agricultural crops has long been recognised, and the need for more careful and systematic study of the subject has been frequently dwelt upon in these pages. The personal opinion held by "landowners, sportsmen, farmers, rat-catchers, and naturalists," as well as by a large class of bird-lovers, is really of very little moment. Anyone who has had to sift the evidence obtained from such sources knows how thoroughly untrustworthy and misleading it usually is. It is now universally recognised that a very definite and careful procedure is necessary, carried out by experienced and well-trained workers, if one wishes to arrive at a trustworthy and just conclusion respecting the economic status of any wild animal.

During part of 1916–17 an inquiry was undertaken upon this subject under the auspices of the Oxford School of Rural Economy in the counties of Oxfordshire and Norfolk. The method of inquiry will, we feel sure, strike every economic ornithologist, or, indeed, anyone versed in investigating the economic status of any wild animal, as peculiar, if not unscientific. The whole of the data here collected are practically obtained from local sources, viz. the opinions of "landowners, sportsmen, farmers, rat-catchers, and naturalists," and innumerable quotations from various newspapers. True, there are a few references to the writings of Tegetmeier, Gurney, and others, but the bulk of the work that has been done during the past twelve or fifteen years seems to have been ignored. Surely the conditions existing in the two above-mentioned counties do not differ so materially from those in all other counties as to make the results of such investigations superfluous to the farmers of Oxfordshire and Norfolk.

Dr. Gunther would, we feel certain, strongly deprecate such a method in any other biological inquiry. All investigators know how exceedingly difficult it is to arrive at a just conclusion with reference to the feeding habits of any particular species of wild bird and to be able to state definitely whether or not it is beneficial or injurious. To weigh the evidence rightly, long experience in such work is imperative, and whilst the author of this report has no doubt brought together much material that is interesting, it is not such as could be introduced into any scientific inquiry upon the subject, and it carries little, if any, conviction.

What this correspondent thinks or what that one has seen is really of very little importance, and, so far as the species of wild birds are concerned, only a prolonged inquiry, by an experienced investigator, upon the data obtained from numerous stomach and crop contents, as well as careful field observations, will ever prove of any practical service.

The only really valuable item in the whole report is that with reference to the pheasant, and, curiously, this is largely based on the careful investigations of a member of the Cambridge University School of Agriculture, Miss A. F. C.-H. Evershed. The much-maligned pheasant does not support existence upon a diet of mangels, in spite of weighty statements to the contrary. Miss Evershed and others have shown that unless excessive numbers of birds are kept upon a small area, it is distinctly beneficial to agriculture. Dr. Gunther directs attention to the fact that on some estates where many pheasants are reared there is an absence of wireworm, whereas on others where there are no pheasants wireworm is found in abundance.

In many cases the information given is exceedingly scrappy, *e.g.* in the case of the wild goose, the gull, the crow, the jackdaw, and the lark. As regards the author's conclusions, they do not materially differ from those that have been before the public for some years. We do not think that such reports as these are likely to enhance the reputation of the Oxford School of Rural Economy in the eyes either of the agriculturist or of the more restricted world of science; moreover, in our opinion, they are to be deprecated, as the work is based, not on "the solid ground of Nature," but on a loose and very heterogeneous mass of details obtained from sources not always trustworthy and free from prejudice.

Finally, if the report were intended for the instruction and benefit of farmers, surely a summary of the results obtained elsewhere, from exhaustive inquiries on large numbers of each species, during different months of the year and from various counties, should have been given.

WALTER E. COLLINGE.

[1] "Report on Agricultural Damage by Vermin and Birds in the Counties of Norfolk and Oxfordshire in 1916." By R. T. Gunther. Pp. 92. (Oxford University Press, 1917.) Price 2*s.* 6*d.* net.

NOTES.

FROM the *Scotsman* of March 13 we take this interesting illustration of the intervention of biological Providence in Scotland. "On a recent week-end there was a remarkable run of salmon in one of the Border rivers. The fish ascended the cauld in large numbers, and in the shallow water on either side it was a matter of no difficulty to seize some of them as they made the passage. The spectacle of so many fish passing to the upper waters led to a general relaxation of the ordinary conditions. On one of the days of the week-end, men, women, and boys could be seen in the water up to the knees and armed with gaffs. The operations of those actively engaged were watched by large crowds on the banks. The natural instinct for capture, aided by the food stringency, became so

prevalent that an unprecedented spectacle was witnessed on the Sunday. Many who had been attending the morning service found the spectacle of one particular hole, which had practically become a moving mass of fish, too much for ordinary restraint." This is a sad decadence, but it was a miraculous draught of fishes! "The quantity of salmon taken at this point is understood to have been extraordinary. In the town in question, for the space of a week at least, there was no difficulty in keeping within the strictest meat rations. Two of the captured fish weighed 50 lb. and 48 lb. respectively." We have seen in peace-times this extraordinary miracle of fishes—a vivid illustration of the abundance and insurgence of life—and we can vouch, by analogy, for the accuracy of the *Scotsman* account, though "Dora," in her mysterious reticence, forbids us revealing the locus of the recent occurrence.

SOME articles on recent developments in marine lighting have appeared in the *Engineer*, and the article in the issue for March 15 gives an account of arrangements in unattended lightships and lighthouses, and unattended fog signals, all of which are features of recent practice. There are several methods of operating fog signals on beacons. It is now five years since an automatic acetylene fog gun was introduced by Messrs. Stevenson at Dhuheartach lighthouse. This gun is claimed to have great advantages over the ordinary tonite explosive signal. It is entirely automatic and fires as frequently as four times every minute, whereas the tonite apparatus can scarcely fire more often than once in five minutes, and requires constant attendance. Two acetylene fog guns have been installed on the Clyde at Roseneath Beacon and at Fort Matilda Pier, the operating station being at Gourock Pier. Wireless methods of operation are adopted. When fog appears, an aerial at Gourock transmits energy to aerials on the beacon and at Fort Matilda, thereby completing the circuits of the local batteries, and switches on the fog signals. Once set in action the guns work automatically, giving reports at predetermined intervals which can be heard over a distance of three miles in favourable weather. The guns are supplied with acetylene in measured quantities, the gas being mixed with the necessary proportion of air to produce a good explosive mixture. This application of wireless to other than telegraphic purposes is an important step in the field of marine lighting and signalling.

AT a recent meeting of the Royal Society of Arts, Prof. W. Frecheville read an interesting paper on the development of the mineral resources of the British Empire. He outlined briefly the main sources of production, and discussed more fully the measures that he considers necessary in order to increase the production of metals within the Empire. Like many other authorities, he is convinced that a Mineral Resources Bureau, properly constituted, might play a most important part in such development, and whilst fully admitting the great results attained in the past by our characteristic individualistic methods, he very properly raises the question whether we have not carried the practice of Government aloofness too far. Prof. Frecheville suggests that in Great Britain mining enterprise is hampered by the customary conditions of the mineral lease, inasmuch as this is often for a strictly limited term of years, and sometimes "royalties are exacted from mines which are not paying." He further touches on the injustice inflicted on mining ventures by the existing methods of levying income tax, a question which is at the present moment agitating many of those engaged in studying and fostering British mining industry. Prof. Frecheville rightly lays most stress of all upon the labour problem, and he suggests that "it should not be beyond the bounds of human ingenuity to devise some way by which, in conceding higher wages, more strenuous and intelligent labour should be obtained." This is beyond question the correct attitude towards labour, and if the Government Departments dealing with labour throughout the country had only pursued this policy instead of raising wages without demanding any increase of producing activity, the country would be in every way in a sounder position than it is in to-day.

WE regret to note that the *Engineer* for March 15 records the death of Mr. Greville Jones, who held the position of works manager at Port Clarence Iron and Steel Works for nearly twenty-five years. Mr. Jones, who was born in 1864, took a keen interest in the Cleveland Institution of Engineers, of which he was a past president, and read several papers before this body and also before the Iron and Steel Institute.

DR. ADDISON, Minister of Reconstruction, attended the Women's Liberal Federation Conference at Westminster on March 15, and spoke in support of a resolution (which was adopted) urging the Government to create a Ministry of Health. He said that the Government fully accepted the importance of establishing a Health Ministry as soon as possible. He thought that there was little doubt that very shortly the various authorities concerned would arrive at substantial agreement.

IN NATURE of January 31 mention was made of the suggestion by Mr. R. E. Dennett as to the desirability of a showroom in a London thoroughfare for exhibition of produce and photographs of West Africa, and it was added that further means of transport are required in that part of the globe. We are informed that the British West African Association, which organised the West African Section of the Coronation Exhibition, is establishing such an Exhibition Bureau in the City shortly, and will be glad of any loans or gifts from readers of NATURE interested in tropical Africa.

WE notice with regret the announcement of the death, in his seventy-seventh year, of Sir Swire Smith, M.P., who was well known as a strong advocate of technical education. From 1881–84 Sir Swire Smith was the representative of the woollen industries on the Royal Commission on Technical Education; in 1909 he acted as vice-chairman of the Royal Commission on International Exhibitions; and he was a member of the committee of the National Association for Technical Education, of which the late Duke of Devonshire was president.

THE issue of the *Comptes rendus* of the Paris Academy of Sciences for February 11 contains a note entitled "Observations sur le langage scientifique moderne," signed by twenty well-known French savants, including MM. Bigourdan, Bouvier, Guignard, Haller, Lacroix, and Emile Picard. This memorandum severely criticises the French of some recent scientific papers, and gives examples of badly constructed or unnecessary new words, of the incorrect use of recognised words and of new technical words left undefined, and of a too literal translation or adoption of foreign words. The examples chosen are mainly from papers on electricity, chemistry, biology, and bacteriology.

THE question of restrictions on coarse fresh-water fishes was discussed in the House of Lords on March 13. Lord Desborough proposed that the close season for angling for these fish should be shortened, and also that the restrictions on angling for eels should be removed at all times. It was announced that the Board of Agriculture and Fisheries had decided to

reduce the close season for coarse fish by one month. Lord Buckmaster also referred to the general neglect of the culture of fresh-water fishes other than Salmonidæ. Little had been done in addition to the imposition of close times. The question of the destruction of fish by seagulls ought to be considered; steps should be taken to prevent pollution, as, for instance, that of fishing waters by tar from roads, and the whole question of the development of the fresh-water fisheries, from both the practical and the scientific viewpoints, ought to be considered in the interest of the food supply of the country.

AT the general meeting of the British Ornithologists' Union, held in the rooms of the Zoological Society of London, on March 13, Dr. W. Eagle Clarke, keeper of the Natural History Department of the Royal Scottish Museum, Edinburgh, was elected president in succession to Col. Wardlaw Ramsay. As a leading authority upon bird-life, Dr. Clarke's writings, especially upon migration, and his activities on the late British Association Committee on Bird Migration, and on the Government Departmental Committee of the Home Office at present having under revision the Wild Birds' Protection Acts, are well known. It is perhaps less well known that under his care the exhibited collection of British birds in the Royal Scottish Museum has become second to none in the kingdom, and that his forthcoming edition of Yarrell's "British Birds," which will make a special feature of immature plumages and of migration, promises to be one of the most comprehensive guides to the avifauna of the British Isles.

THE *Revue générale des Sciences* for February 15 contains an obituary notice by M. A. Boularic of Prof. G. Meslin, director of the Physical Institute of the University of Montpellier, who died on January 11. Prof. Meslin was born at Poitiers in 1862, and after studying at the Ecole Normale Supérieure became a secondary-school teacher. In 1890 he took his doctor's degree, and became lecturer at the University of Montpellier, and in 1904 director of the Physical Institute. His pleasant voice and his clear way of presenting his facts made his lectures fascinating both to his students and to the general public. His principal scientific work was optical; his paper on the reflection of light from the surfaces of thin metal films, and his modification of Billet's bi-lens experiment to produce semi-circular fringes, are probably best known. He took charge of two solar eclipse expeditions, and proved that there is no elliptical polarisation in the light of the solar corona. Some of his most recent work was on magnetism, and his numerous results for the magnetic susceptibilities of para- and dia-magnetic metallic salts are of great value.

NEWS has just reached us of the death of Miss B. Lindsay, on December 16 last, at Onchan, Isle of Man, who may well rank as one of the women pioneers in morphological studies. Miss Lindsay's career as an investigator started with certain research work in connection with the embryology of the chick—work undertaken at the suggestion of Dr. H. F. Gadow. Later she compiled her "Text-book of Zoology," and afterwards two volumes in Newnes' "Useful Story Series," one on "Animal Life," the other on "The Microscope." Although rather inclined to abstract speculation, Miss Lindsay was yet very matter-of-fact, and methodical in her work. To put her work on the breastbone of birds upon a broader basis than the "everlasting chick," she collected numbers of seabirds' embryos at the Isle of Man, and a fine series of ostrich embryos. She was the first to show that ostriches are descended from birds possessed of the full power of flight. Her little text-book must have made many friends, because it is a sensibly, partly humorously, written introduction for those who take an interest in what have since become known as Nature-studies. It was while she was living at St. Andrews and working at the Gatty Marine Laboratory that Miss Lindsay had the opportunity of carrying out those investigations with regard to molluscs that she had long wished to conduct. Of her own time and labour she was generous in the largest degree, and she will be long remembered by those she lived amongst for her many thoughtful and kindly acts.

GEOLOGISTS who are interested in the unique collection of Silurian fossils in the Ludlow Museum will be glad to learn that the Ludlow Natural History Society has received a bequest of 200*l.* under the will of the late Mrs. Agnes Mary White. Mrs. White was the daughter of Mr. Humphry Salwey, one of the most active geologists in the Ludlow district during the middle of last century.

EGGS of an extinct ostrich are already known from the surface deposits of northern China. One specimen from Yao Kuan Chang, fifty miles south-west of Kalgan, was obtained by Harvard University in 1898, and another specimen from the banks of the Yellow River in Honan was acquired by the American Museum of Natural History last year. Mr. Harold M. Clark, of Wuan, Honan, now writes to the *North China Herald* that eggs of this kind are not uncommon in his neighbourhood, and are washed out of the river banks by floods. They seem to occur in the same manner as the eggs of Æpyornis on the shores of lakes in Madagascar. The Chinese eggs are about 7 in. in length, and thus scarcely larger than those of an average ostrich. No bones of the birds which laid the eggs have hitherto been noticed in the same deposits.

MR. J. REID MOIR has contributed to the Proceedings of the Suffolk Institute of Archæology (vol. xvi., part ii.) a valuable summary of our present knowledge of ancient flint implements in Suffolk. The paper is illustrated with a series of effective diagrams of typical implements of each successive period, and as nearly all stages are represented in Suffolk it becomes a useful work of reference of more than local interest. There may still be differences of opinion as to the rudely chipped flints which are ascribed to the handiwork of Pliocene man, but the arguments for their age and present interpretation are very clearly stated. We can only hope that before long Mr. Moir's persistent researches may be rewarded by the discovery of human remains of the same antiquity. In Suffolk, as in other western European localities, the finely worked Acheulean implements are certainly older than the less skilfully made chipped flakes of the Mousterian type.

SIR THOMAS HOLLAND, in his presidential address at the Chemists' Conference at Lahore, reported in the *Pioneer Mail* for January 18, laid down a far-reaching programme of research—the possibility of preparing in India chemicals used in textile and other industries; of other chemicals now imported but capable of local production; advice to firms and the undertaking of research for which their own staffs have not the time or facilities; preparation of supplies for medical services; systematic investigation of raw materials of probable economic value; and the publication of results when possible. This means the appointment of a large scientific staff, and there can be no doubt that as one result of the war and the obstruction of sea communications the Government of India will devote increased attention to the development of Indian manufactures.

THE *Pioneer Mail* of January 11 announces that much progress has been made in supplying the Indian

hospitals with drugs and other materials from Indian sources. Absolute alcohol, previously imported from abroad, is now made at the Government depôts at Bombay and Lahore, and by private firms at Calcutta and Ahmedabad. Belladonna is being largely cultivated in Kumaun, and among other drugs now supplied from Indian sources are thymol, ether for pharmaceutical purposes, lysol, calcium chloride, lactose, and aniline oil, while arrangements are being made to provide in India all the various nux vomica preparations. Bandages and dressings are now being locally made, and glass is being manufactured for laboratory, medical, and surgical purposes. Artificial limbs of the latest pattern are being manufactured at Bombay. In short, the demands of the war in the domain of medicine and surgery are being met in India on a very considerable scale.

A REPORT of a bacteriological investigation of the City of Dublin milk supply is published by the Co-operative Reference Library, Dublin. Of more than 100 samples analysed, only seventeen could be considered satisfactory; all the others would be classed as low-grade milks unsuited for drinking in the natural state. The examinations were conducted by Mr. D. Houston, who gives a general discussion of the results obtained, and a preface is contributed by Dr. St. John Gogarthy on the importance of a pure milk supply.

THE extraction of quite a small metallic fragment from the brain is recorded in the *Archives of Radiology and Electrotherapy* for February (No. 211). The foreign body was localised by the X-rays, and the skull opened. The points of the forceps extractor were then introduced into the brain, and manipulated so that the shadows of the fragment and of the points of the extractor fell exactly in the middle of a small fluorescent screen attached to the instrument. After some manipulation the fragment was grasped and withdrawn. The blades of the extractor were connected with an electric bell, which rang when the fragment was grasped, the circuit being then completed. The fragment was about 2 in. below the surface of the brain, and the patient made a good recovery. Capt. Barclay was the radiographer and Capt. Rayner the surgeon in charge of the case.

ALTHOUGH the National Seed Testing Station has been in operation only since November last it is clear from the interim report on the quality of existing stocks of agricultural seeds, which is published in the February number of the *Journal of the Board of Agriculture*, that a great deal of useful work has already been accomplished. Up to February 4 tests had already been completed on more than 2400 samples, and although in certain species the numbers of samples are too small to be taken as representative of the stocks of these seeds in the country, it is thought that the figures given in the report may be taken as a fair index of the standard of the more important seeds. It is reassuring to find that good seed in moderate quantity is available in the case of the more important crops, especially the grain crops. At the same time, it is evident that there will be a large amount of low-grade seed offered to farmers this season. This is particularly so in the case of red clover, sainfoin, and meadow fescue, which would seem to be considerably below the average of normal seasons. In the case of cereals, attention is directed to the undesirability in the national interest of making large sowings of grain of low germination when good samples of high germination are obtainable, and permit of a much lower rate of sowing. The staff of the station is to be congratulated upon the large amount of work accomplished under conditions of exceptional difficulty.

A STRIKING object-lesson on the capabilities of water-power, when adapted to industrial and manufacturing uses, was afforded in an exhibition of kinematograph films by Prof. J. C. McLennan, at the Institution of Civil Engineers, on the evening of March 12. The films were prepared by the Water-Power Branch of the Department of the Interior of Canada, of which Mr. J. B. Challis is superintendent. The exhibition was given under the auspices of the Canadian Government, and was intended to demonstrate the wonderful extent of the hydraulic resources of Canada. In his introductory remarks Prof. McLennan alluded briefly to the progress of the country; thirty years ago it might have been described as steady to variable, but during the past twelve years it had undergone a remarkable acceleration, which was apparently destined to become even more accentuated in the immediate future. This was due, in a very large measure, to the construction of the three great highways across the Dominion—the Canadian Pacific, the Canadian Northern, and the Grank Trunk Railways. Arising out of these as primary agencies, a great impetus had been given to agriculture, education, and industry. The water resources of Canada were estimated at twenty million horse-power, as compared with twenty-eight million horse-power in the United States, and of these some two million horse-power were now in use. The importance of the conservation of such stores of energy was fully recognised, and impounding works were being carried out in order to realise the utmost capabilities of supply, as might be instanced by the reservoir dam at La Loutre, which impounds 160,000,000,000 cub. ft., and has an effective drainage area of 16,200 square miles. One of the most important uses to which water-power had been applied was the solution of the problem of the fixation of nitrogen from the atmosphere. The films illustrated a number of waterfalls, reservoirs, and installations of hydro-electric plants in various parts of the Dominion, including Grand Mere, Shawinigan Falls, Cedar Rapids, St. Timothee, Winnipeg, Vancouver, and Niagara.

PART 1 of vol. xxx. of the Proceedings of the Royal Society of Victoria contains a description of a new dividing engine for ruling diffraction gratings by Mr. J. H. Grayson, of the University of Melbourne. The design and construction of this machine have occupied Mr. Grayson, whose skill in work of this type is well known, for seven years, and the completion of the task places spectroscopists under a great debt of gratitude to him. His paper contains a detailed description of the machine, and gives full particulars of the methods used for grinding and testing the screw. The machine is set up in a room of its own in the basement of the University, and is driven by a 1/40-h.p. hot-air engine placed in an adjoining room. Ruling diamonds are broken stones in which the fracture along a cleavage plane intersects an outer crystalline face and gives a good knife edge. Mr. Grayson finds the stones from the diamondiferous drift of New South Wales best for this purpose, and when ruling properly such a diamond makes no noise. The photographs which accompany the paper show that the rulings are extremely regular and warrant the hope that gratings ruled on the machine will give exceptionally clear spectra. The verdict of spectroscopists on the gratings will be awaited with considerable interest. In the meantime all will congratulate Mr. Grayson on the completion of his work, and the University of Melbourne on the public-spirited way in which it has provided facilities for that work.

IN his presidential address to the section of the Indian Science Congress dealing with Physics and Mathematics, Dr. Wali Mohammad has given an interesting account of recent progress in magneto-optics.

He reviews the more important results obtained since the publication of Zeeman's monograph upon the subject in 1912. Amongst the improvements in technique have been the introduction of the Wehnelt cathode lamp devised by Dr. Mohammad himself, the use of crossed spectra from two pieces of apparatus of high resolving power, and the construction of more powerful electromagnets. Nagaoka and Takamine have taken up the study of the Zeeman effect in the ultra-violet region, whilst Croze has extended his observations into the infra-red so far as the photographic methods allow. The effect of a magnetic field on the satellites of complex lines is likely to give a clue as to the mechanism of radiation and the production of spectrum lines. The study of the magnetic resolution of band spectra has attracted much attention. There is now no doubt of the fact that some band spectra show the Zeeman effect, but opinion is divided as to the existence of the effect in other cases. Certain dissymmetries have been observed both in the place and in the position of components, and several complicated types of magnetic resolution have been noticed. Anomalies of a different kind have been found in which the lines of a very close doublet or triplet series appear to influence each other in a peculiar manner. On the theoretical side Voigt has modified and extended the theory of Lorentz, introducing into the equations terms expressing a resistance, a quasi-elastic force, and allowing for the coupling of the electrons. It is to be noted that when the quantum hypothesis, as represented by Bohr's equations, is assumed, there is no place left for the quasi-elastic oscillating electrons which have been used in all theories for the explanation of the Zeeman effect from Lorentz to Voigt.

Now that our rations of food, particularly of meat and wheaten bread, have been so appreciably reduced the necessity of arranging our diet so as to ensure a sufficient supply of those elusive substances, the so-called "vitamines," is more important than ever. It is known that these substances exist in certain foods, and that an adequate supply of them is necessary to health, but they have not yet been isolated in a pure condition, although several workers claim to have done so successfully. As a result of some recent work, McCollum and Davis concluded that two distinct types of vitamine exist, the "fat-soluble A" and the "water-soluble B." In the *Biochemical Journal* for December Mr. J. C. Drummond describes yet another attempt to isolate the latter type of accessory substance. Unfortunately the attempt failed, but several interesting observations were made. In Mr. Drummond's experiments pure-bred rats were fed on a basal artificial diet containing all the necessary constituents except the water-soluble, growth-promoting accessory substance, and also on the same diet together with marmite which had been treated in various ways. From the variation of the live weight of the rats the presence or absence of the "water-soluble B" in the treated marmite is inferred. In this way it is established that the water-soluble accessory substance is (1) soluble in 70 per cent. alcohol, but insoluble in absolute alcohol; (2) dialysable through parchment paper; (3) injured by heating at 120°, but very little affected at 100°; (4) largely destroyed by prolonged boiling with 20 per cent. sulphuric acid, but not with 1 per cent. hydrochloric acid; and (5) much damaged by digestion with hot 5 per cent. sodium hydroxide, but very little affected by the same solution cold. Water solutions containing the active substance give voluminous precipitates with phosphotungstic acid, basic lead acetate, and silver nitrate, but the solutions recovered from these precipitates by the customary methods have little activity. The author attributes this fact to loss of the substance by adsorption rather than to its actual destruction. The results support the view that the so-called "antineuritic vitamine" is identical with the "water-soluble B."

MR. F. EDWARDS, 83 High Street, Marylebone, has just published a catalogue (No. 381) of books on British and foreign birds. It contains some 642 titles. Some of the books are scarce. Two sets of the *Ibis* (1859–1915) are offered for sale.

MESSRS. GAUTHIER-VILLARS ET CIE (Paris) announce the following science books:—Œuvres de Henri Poincaré publiées sous les auspices du Ministère de l'Instruction publique par G. Darboux, tome i.; Œuvres de G. H. Halphen publiées par les soins de C. Jordan, H. Poincaré, E. Picard, avec la collaboration de E. Vessiot, quatre vols., tomes ii., iii., et iv.; Cours de Géométrie pure et appliquée de l'Ecole Polytechnique, Prof. M. d'Ocagne, tome ii., Cinématique appliquée, Stéréotomie, Statique graphique, Calcul graphique, Calcul grapho-mécanique, Nomographie.

OUR ASTRONOMICAL COLUMN.

THE PLANET MARS.—This planet came to opposition with the sun on the morning of March 15. On that date Mars was about sixty-one million miles distant from the earth, and had an apparent diameter of a little more than fourteen seconds of arc. The planet is now situated in Leo, on the eastern border, and moving to the W.N.W.

The present opposition of the planet is by no means a favourable one for the study of his surface markings. It is curious, however, that some excellent views of the markings have been obtained on occasions when the disc was comparatively small, and when little success in this direction was expected. The fact is that certain lineaments on Mars, such as the Syrtis Major, the Mare Sirenum, Cimmerium, and Acidalium, are so conspicuously dark and large that a very small telescope is sufficient to show them, and they may be viewed even when the conditions are not altogether favourable.

Perhaps the features on Mars are, however, scarcely so easily discerned as those on Jupiter, owing to the expansive disc of the latter object. But the study of Martian markings is more interesting from the fact that they represent objects existing on its actual surface, while Jovian details are merely temporary, outside formations of atmospheric character.

The double canals on Mars are now justly regarded as one of the observational romances of astronomy. The single canals have even been assailed as non-existent, but there is no question whatever that a series of linear formations is scattered over the equatorial and south-equatorial regions of the disc. Scepticism was aroused by the hard, dark, and straight lines by which some observers erroneously represented the delicate streaks of shading which really diversify the planet's surface, and certainly look nothing like water channels to an unimaginative observer.

It is to be hoped that the renewed study of the topography of Mars will be successfully made at this opposition, and the revised rotation period of 24h. 37m. 22·57s. tested by fresh data.

WOLF'S NOVA.—Besides the interesting planet found in January, Prof. Wolf also discovered a Nova in Monoceros. The Harvard plates have enabled its previous history to be traced. It was fainter than 9·8 mag. on December 22, rising to 5·4 by January 1 (being thus the brightest Nova since 1912). It declined rapidly, reaching mag. 8·9 on February 4, 9·0 on February 17, 9·1 on February 22. It is 10° north and 2° west of Sirius, and, like most Novæ, lies within the Galactic Zone.

Dr. Mundler gives the position for 1918·0 as R.A. 7h. 22m. 47·00s., S. declination 6° 30′ 34·7″.

A Potsdam spectrograph taken on February 18 shows the typical Nova-spectrum in the stage of decline; broad bright hydrogen bands on a somewhat faint continuous background that could be traced far into the ultra-violet; groups of lines were seen at λ 464, and a trace of the green nebula line.

THE MINOR PLANETS.—In 1866, when only eighty-eight asteroids were known, Prof. Kirkwood detected gaps in their distribution, at points corresponding with commensurability with Jupiter's motion. Prof. Hirayama (in Proc. Tokyo Math.-Phys. Soc., 2nd series, vol. ix., 11) re-examines the question with nearly 900 orbits available. The gaps at the ratios 2/1, 7/3, 5/2, 8/3, 3/1 are still very striking, and some others are probably indicated. Prof. Hirayama makes the interesting remark that for values of the daily motion smaller than 500″ the asteroids seek, instead of avoiding, the points of commensurability; thus the four Trojan planets have the ratio 1/1, one planet has 4/3, and six have 3/2. These cases are shown to correspond with librations of a stable character, while the gaps mentioned above correspond with unstable motion. It would probably have been better to omit all asteroids observed at one opposition only, as the elements of their orbits are subject to considerable uncertainty. The new planet DB (daily motion 881″) lies fairly close to the 3/1 point, so its perturbations by Jupiter will be interesting.

As the war has severed relations with the Berlin Rechen-Institut, formerly the centre for discussion and distribution of minor planet information, an independent bureau has been opened at Marseilles Observatory, whence numerous circulars relating to orbits and observations have been sent to us. One of the ephemerides is that of Deianira, which has been observed at only three oppositions since its discovery. Its position on March 22 is R.A. 12h. 19·3m., N. declination 18° 26′, magnitude 13·1.

THE ROTATION OF THE EARTH.

THE *Revue générale des Sciences* of January 30 contains a full abstract of a very interesting paper by D. Korda in *Archives des Sc. Phys. et Nat.* (Geneva) of November 15 last. It appears that Baron Eötvös, in examining the records of gravitation made at sea, found certain anomalies which he traced to the speed and course of the ship. The weight of a thing on the surface of the earth is less than that due to the attraction of the earth by an amount equal to the centrifugal force, which at the equator amounts to $g/288$, and which, resolved in a vertical direction, varies as the square of the cosine of the latitude. Any variation in the centrifugal force therefore affects the weight to this reduced extent. The velocity at the surface of the earth may be 46,500 cm./sec., while that of a ship in the water may be 1000 cm./sec., so that the motion of the ship round the axis of the earth may vary between 47,500 and 45,500 cm./sec. at the equator. Centrifugal force varies as the square of the velocity, so, calling V and v the velocities of the earth's surface and of the ship in the water, the centrifugal force on a body in the ship may vary between $(V-v)^2$ and $(V+v)^2$ —that is, through a range of $4Vv$ depending on the course. While v may be relatively small, the large factor V may, and does, at times make the product so great as to introduce an error in the apparent gravity as determined on board ship. For example, in the case supposed, which corresponds with a speed of 19·4 knots and at the equator, the difference in weight as shown by a spring balance going east with the earth and west against the earth would be as much as 1/3355, or more than two grains per pound—quite a serious amount in a gravitational survey.

But it is here that the ingenuity, daring, and experimental skill so typical of Eötvös comes in. Not content with finding serious disturbances in weight resulting from velocities of 1000 cm./sec., he conceived the idea of setting up in the laboratory a small delicate balance on a rotating vertical axis with the accurately balanced masses moving at a speed of about 1 cm./sec., with the view of observing the disturbance of the balance. At the equator with such a speed the two masses would alternately seem the heavier by 1/3,355,000 of themselves, whereas at his laboratory at Budapest, which is very nearly at latitude 45°, the difference would be one-half of this—not a very large amount to play with—but Eötvös was able to make manifest the minute change by employing synchronism and the principle of resonance, and so obtaining the large magnification which is possible with a very small degree of damping.

Unfortunately, the published account is most tantalising; for beyond saying that the period employed was about a minute, that the maximum oscillation could be read in an hour, and that the balance was small, not one of the details which would assist in repeating the experiment is given—length of beam, load at each end, decrement, and stability are alike left undefined. The mode of observation, however, is described. A horizontal mirror is carried by the beam so that a vertical ray of light may be reflected up by it. When an experiment is to be made the beam is arrested and the reflected ray of light traces a small circle upon a screen. When the beam is liberated the two ends, alternately becoming the heavier, set up an increasing oscillation made evident by the departure from the original circle, which settles down to an amount determined by the equation:

$$\text{Maximum amplitude} = 2\Omega \cos\phi \frac{K}{k},$$

where Ω is the angular speed of the earth, ϕ the latitude, K the moment of inertia of the balance, and k its coefficient of damping. This formula quoted by the author is remarkable in that almost every feature of the apparatus and of the earth is eliminated.

The present writer, desiring to verify the formula, obtained a different result, and then, testing both formulæ dimensionally, found the formula at which he had arrived dimensionally correct, while that given above is not. He thinks, therefore, that it is desirable to state very shortly the facts as he understands them. The balance is supposed to be rotated accurately at the speed of true synchronism, taking into account the effect of centrifugal stability discussed in the next two paragraphs. In these conditions, treating the vibrations as the projection of a logarithmic spiral, and using the hodograph as given by Tait and explained more clearly in Clerk Maxwell's "Electricity and Magnetism," vol. ii. [731], the radius A of the spiral grows until the resistance proportional to the velocity is equal to the maximum deflecting moment due to the action of $4Vv$. The value of A, then, is the maximum value, and the spiral has become a circle. When this is reached the actual resistance couple will be found to be $\frac{8\pi A k K}{T^2}$, and this must be equal to the couple $\frac{8\pi K\Omega}{T}\cos^2\phi$, due to the $4Vv$ action described. From this it follows that

$$A = \Omega \cos^2\phi \frac{T}{k},$$

where T is the time of a complete rotation of the balance and k is the logarithmic decrement. This A is the angular deviation from the mean position, so if by A is meant the complete amplitude, the expression must be multiplied by 2. It will be noticed

that the difference is of serious importance. The cosine should be squared and the moment of inertia of the balance should be replaced by the time of its swing! A little thought will show that K must come in equally on both sides of the equation and so be eliminated. It is somewhat surprising to find T in the numerator, for this would seem to indicate that if the balance did not turn at all there would be—as measured by its tangent—an infinite deflection—*i.e.* 90°. Of course, the real meaning is that while the deflecting couple becomes less as T is greater, the sensibility becomes greater in the proportion of the square of the time, and the deflection goes on getting greater with increasing slowness of rotation until the whole thing becomes unmanageable on account of its too great delicacy, or until the decrement, by its consequent increase, more than compensates for the diminished stability. It is not clear what numerical results, if any, were obtained by Eötvös. By the formula now given, taking T as 60, K as 300 or thereabouts, and ϕ as 45°, the amplitude should only come out about one-seventh of the amount that the published formula would require.

It may be worth while to point out that the centrifugal force of the balance about its vertical axis, if the beam is 20 cm. long and turns once a minute, is about 720 times as great as the alteration of weight at the equator, so that if the beam were exactly in neutral equilibrium when stationary and pointing east and west it would have, in virtue of its rotation, a stability given to it under which the change in weight could not produce a steady deflection exceeding about 1/12°. No information is given as to how k was determined, nor is centrifugal stability mentioned. As in any system the logarithmic decrement becomes less as the stability is greater, it would be useless to determine k with any but the correct stability. The only method apparent to the present writer would be the addition of a stability bob equal in effect to the calculated centrifugal stability and a determination with the rotation stopped.

No mention is made of the most interesting feature in the scheme of the experiment. If the balance is in perfectly neutral equilibrium when not rotating, then the centrifugal stability is the only stability, and perfect synchronism is obtained whatever be the speed of rotation, whereas if there had been any initial stability or instability it could never be attained at any speed.

If the direction of rotation is such as to make the north end heavier than the south end, then with very small damping this end should be in nearly its highest, not in its lowest, position, as might at first be expected, at each turn.

This experiment, which, like those with the gyrostatic compass, and unlike Foucault's pendulum experiment, is best done in the tropics, is one of such interest and beauty that it is to be hoped, even in these difficult times, it may be set up and exhibited in some physical laboratory.

It is unfortunate that the author has not done justice to Eötvös, but he has prepared somewhat of a tangle which it has been a pleasure to unravel.

C. V. Boys.

RESULTS OF VOLCANO STUDY IN HAWAII.

THE Hawaiian Observatory was founded in 1912 by the Massachusetts Institute of Technology, and financed in large measure by business men in Hawaii. Its publications have been systematic volcanologic and seismometric bulletins, and two larger reports, as well as numerous special articles. The scientific work has been done by Mr. T. A. Jaggar, director of the station, and Mr. H. O. Wood, associate. Preliminary announcement of results[1] at the end of the first five years of work reveals discoveries which may be of interest to science at large, and some of these discoveries are briefly reviewed here.

Nature of Hawaiian Gases and Flames.

The gas collected from a blowing-cone in the lava pit of Kilauea in 1912 by Day and Shepherd[2] contained dominantly sulphur dioxide, carbon dioxide, and nitrogen, subordinate amounts of the combustible gases, sulphur, carbon monoxide, and hydrogen, and only 4 per cent. of water vapour. The 79 per cent. of SO_2, CO_2, and H_2O could not, to the writer's thinking, be juvenile, but must in part result from union with atmospheric oxygen. Day had suggested that heat-producing reactions between such gases as free S, CO_2, and H, rising through the lava, would raise the surface temperatures so that the lava column might be at its hottest above instead of in the depths. Continuous recording and observation of flames, with experimental measurements of temperature and soundings of the lava for viscosity differences, show that this generalisation is well founded, and, in addition, that atmospheric oxygen is brought in contact with the magmatic gas so as to produce abundant flames of different colours. Air is sucked down at the convectional whirlpools and cascades. It is carried downward in the liquid lava lakes by foundering of porous crusts which cannot melt in the superfused lava glass. Air is also carried down in broken wall rock, in avalanches, and by burial of old talus. Lastly, with 33 per cent. volume shrinkage due to such gas reaction within the lava column as $2H_2+O_2=2H_2O$, even at high temperatures (1100° C. more or less), and with convectional gas pumping, a Bessemer furnace effect through the liquid lava may be created by indraught of air from the walls.

Of the three combustible gases H, CO, and S, sulphur is most in evidence as surface flames, carbon monoxide along with impurities may be represented by rare flames, while hydrogen probably flashes mostly to water-vapour in depth. There are whitish flames occasionally seen, and intensely hot bluish to violet flames play at all times from the glowing grottoes and chimneys. Some work has been done in an effort to photograph the flames with colour filters and panchromatic plates, and there is a promising field here for the study of flame spectra.

Nature of a Lava Column.

While it was known many years ago that some of the Hawaiian lava pools were shallow, few observers have imagined that the liquid lava rising 600 ft. during a year within a pit much deeper than that would be found by sounding at the end of the period to be only 45 ft. deep, though still fully liquid at the surface. This was the case at Halemaumau, the inner lava pit of Kilauea, in January, 1917 (Fig. 1). Sounding was accomplished by plunging a steel pipe into the lava lake at several different locations, and

1 "The Outbreak of Mauna Loa, Hawaii, 1914," by T. A. Jaggar, *Amer. Journ. Sci.*, vol. xxxix., February, 1915, pp. 167–72. "Activity of Mauna Loa, December, 1914–January, 1915," by T. A. Jaggar, *Amer Journ. Sci.*, vol. xl., December, 1915, pp. 621–39. "Lava Flow from Mauna Loa, 1916," by T. A. Jaggar, *Amer. Journ. Sci.*, vol. xliii., April, 1917, pp. 255–88. "Seismic Prelude to the 1914 Eruption of Mauna Loa," by H. O. Wood, Bull. Seis. Soc. America, vol. v., No. 1, March, 1915, pp. 39–50. "Notes on the 1916 Eruption of Mauna Loa," by H. O. Wood *Journ. of Geol.*, vol. xxv., Nos. 4 and 5, 1917, pp 322–36 and 467–88. "Volcanologic Investigations at Kilauea," by T. A. Jaggar. *Amer. Journ Sci.*, vol. xliv., September, 1917, pp. 161–220. "Live *Aa* Lava at Kilauea," by T. A. Jaggar, Journ. Wash. Acad. Sci., vol. vii., No. 9, May 4. 1917, pp. 241–43. "On the Terms Aphrolith and Dermolith," by T. A. Jaggar, Journ. Wash. Acad. Sci., vol. vii., No. 10, May 19, 1917, pp. 277–81. "Thermal Gradient of Kilauea Lava Lake," by T. A. Jaggar, Journ. Wash. Acad. Sci., vol. vii., No. 13, July 19, 1917, pp. 397–405. "On Cyclical Variations in Eruption at Kilauea," by H. O. Wood, Second Report Hawaiian Vol. Obs. (Cambridge, Mass., 1917).

2 "Water and Volcanic Activity," by A. L. Day and E. S. Shepherd, Bull. Geol. Soc. Amer., vol. xxiv., 1913, pp. 573–606.

always the pasty bottom was found at fewer than 50 ft. of depth, with due allowance for the angle of immersion. This discovery, however, checked perfectly with the results of continued observation and survey which had repeatedly made record of shoals appearing in the lava, and of cascades from the liquid lake into marginal voids and over submerged ledges, after a period of subsidence. These hitherto unexplained facts at once became intelligible when it was realised that the lava column in reality is a semi-solid body filling the true crater from side to side, while the liquid lake is a gas-heated froth maintained through conduit holes honeycombing the upper part of the harder column. The basin of the lake is a shallow saucer, and convectional circulation keeps the liquid lava in motion. The famous islands and benches are of the bench magma, or semi-solid substance which forms the bottom of the liquid lake.

Thermal Gradient of Lava Lake.

With batteries of Seger cones encased in iron netting and strung on a wire, which in turn was placed within long steel pipes, measurement was made in 1917 of the thermal gradient (Fig. 2) of the liquid lava pool. Individual temperature measurements were also made of the fountaining grottoes at the margin of the lava and of flaming chimneys through blowing-cones above it. The highest temperatures, about 1350° C., were found in this air zone of free oxidation of gases; the fountaining lava reached a maximum of about 1180° C., the bright lines of the lake surface were at about 1000° C., while just below the surface the temperature was 100° lower. From here to the bottom of the lake 40 ft. down there was rising temperature. A thick lower stratum of the shallow lake showed uniform temperature between 1100° and 1200°. This lower stratum probably represents reheating due to oxidation of gas in contact with air carried down by foundering crusts. The fall in temperature towards the lake surface from the bottom up, which in the middle region amounts to 70° C. per metre, is due to surface radiation aided by gas expansion. The localised surface heating is due to surface oxygen and completion of reactions between rising unstable gas mixtures.

Dermolith and Aphrolith.

The writer has proposed these terms for fluidal lava and block lava respectively, called *pahoehoe* and *aa* by the Hawaiians, because, as the result of the investigations here recorded, he believes dermolithic *versus* aphrolithic process to represent respectively the liquefaction of lake magma and the gas expansion solidification of bench magma. The dermolithic basalts of Kilauea crater, characterised by wrinkled skins, have sufficiently adjusted and diminished their gas-bubble content to solidify from without inward. The aphro-

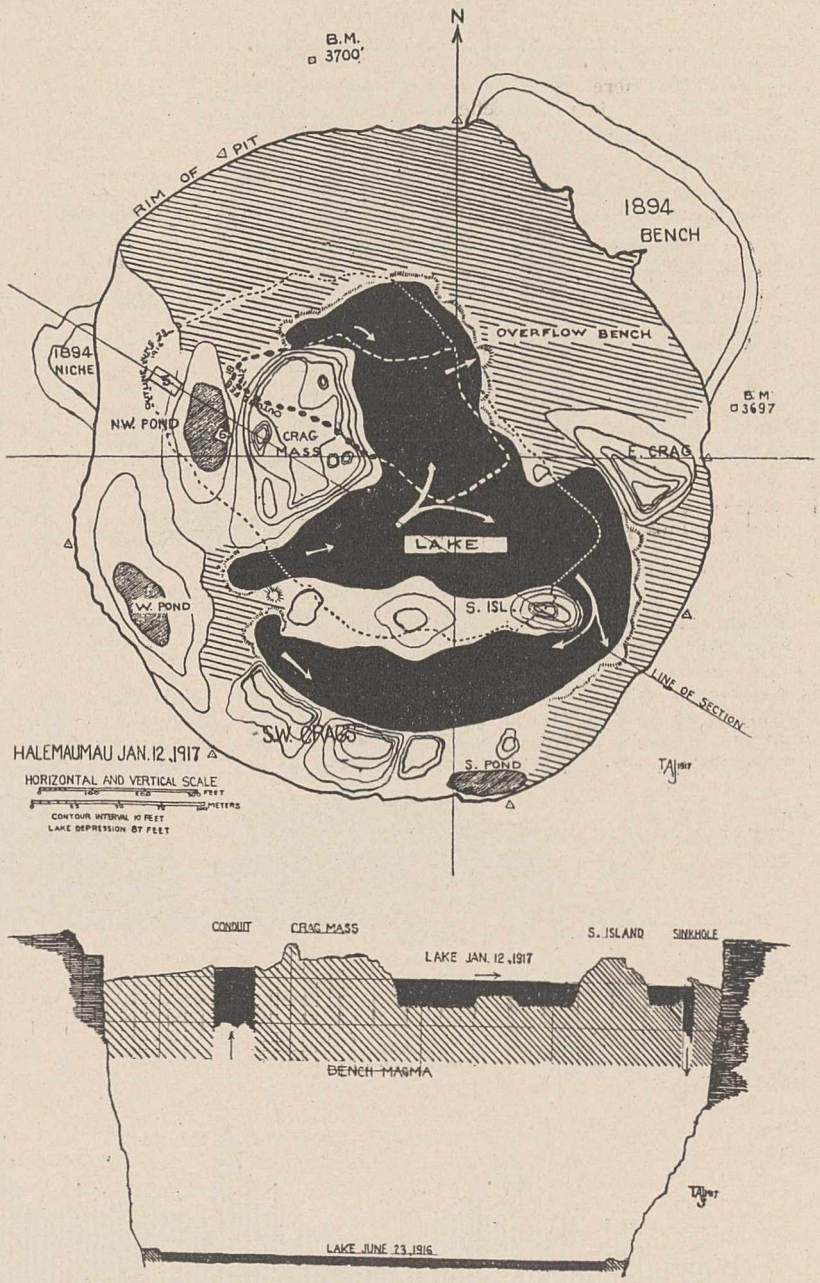

FIG. 1.—Map and diagrammatic section of Halemaumau, January 12, 1917. Lava lake in black, crusted conduit ponds shaded, overflow benches diagonal lines, raised crags contoured. Coarse dotted outline, lava lake of February 18, 1912. Fine dotted outline, June 23, 1916. Rectangle (5), site of lava spring of June 5, 1916. Rectangle (6), west corner of pool June 6, 1916. Note that N.W. corner has been conduit source on all these dates. Slight slope lake surface from conduits W. to overflow bench E. Bench magma elevated on conduit side W.S.W., subsided on sinkhole side E.N.E. Section without vertical exaggeration, lower profile shows simple rising pool of June 23, 1916. Shoal shown in lake bottom was revealed by subsidence February, 1917. Depths from soundings and subsidence records. Note progressive shoalings from W. to E. Diagrammatic sinkhole E. shows ridge of accretion on lake bottom margin which produces cascade ledge when subsidence takes place. Surveys with transit by T. A. Jaggar. Bench marks (B.M.) U.S. Geological Survey, trig stations Hawaiian Volcano Observatory. Meridian approximately 155° 17′ 8″ W., lat. 17° 24′ 33″ N. This is a typical survey of the kind made frequently at Halemaumau.—From *Amer. Journ. Sci.*, September, 1917.

lithic or *aa* lava, a "foam-stone," which is expelled in a Mauna Loa flow, cools from within outward by expanding gas suddenly released from solution, and the lava disintegrates into rough units. Lava drawn up from deep within the Kilauea lake tended, on sudden cooling, to effloresce in aphrolithic fashion. An island which rapidly rose from the lake bottom proved to be typical *aa* or aphrolithic lava. The most satisfactory feature of the discovery that the Hawaiian lava column is probably stiff within the mountain is the correlation now possible with such volcanoes as Pelée, Bogoslof, or Tarumai, which exhibited hard domes and spines instead of lava flows. The liquid or dermolithic lavas now become products of surface fusion induced by escape of gases from solution in a very stiff intratelluric magma as solvent. A volcano like Kilauea, which among volcanoes exhibits maximum temperatures, probably owes the liquidity of its surface lava to the nature of its gas reactions.

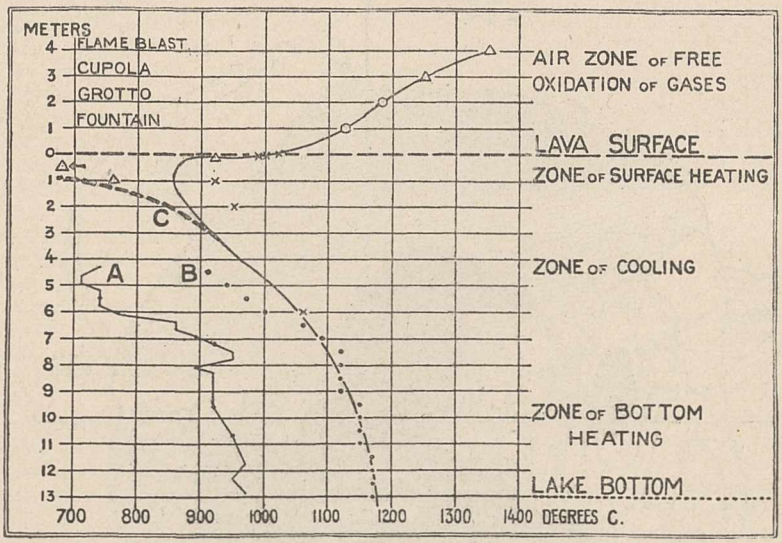

FIG. 2.—Thermal gradient of Kilauea lava lake, temperatures measured with Seger cones, 1917, by T. A. Jaggar. Triangles, circles, crosses, and dots each different series of measurements. A=actual uncorrected readings in large steel pipe. B=corrected gradient of lower lake. C=gradient to crusted lake surface when solidified.—From Journ. Wash. Acad. Sci., July 19, 1917.

Cyclical and Sympathetic Lava Movements.

A complete eruption of Mauna Loa, the summit crater of which is twenty-two miles from the Kilauea sink and about 10,000 ft. higher, consists of a preliminary summit outburst, followed, after months or a few years, by a flank discharge with lava flow. Recently the intervals between identical phases of complete eruptions have averaged something above nine years. Kilauea has shown no hydrostatic response to Mauna Loa lava, hence it was supposed they were unconnected. It will be clear, however, that if a main lava column depends for liquefaction on surface release of gas from a stiff silicate magma solution, hydrostatics plays only a superficial *rôle*, while varying viscosity, differential expansion, and tidal stress control relative heights of lava in adjacent and connected conduits of different sizes.

During the complete eruptive period of Mauna Loa, 1914–16 (Fig. 3), five seismic spasms in that volcano, two of them accompanied by eruption, were responded to in the active lava pit of Kilauea by a series of pronounced risings of increasing duration, followed by

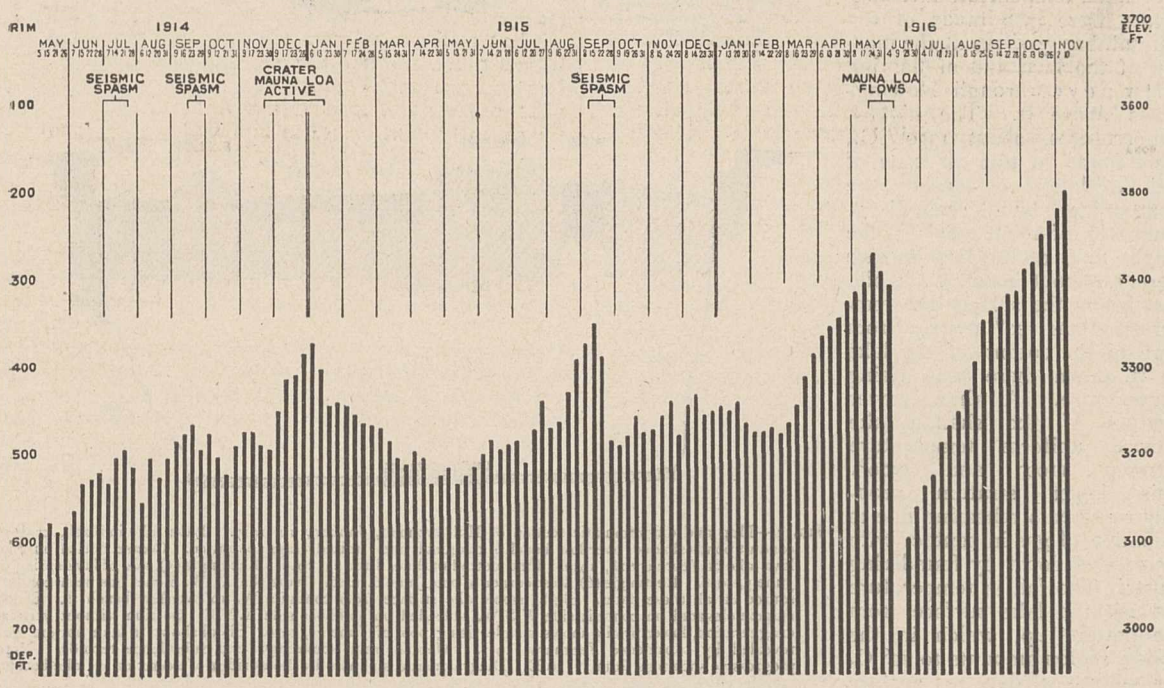

FIG. 3.—Diagram showing fluctuation of level of lava in Halemaumau, in relation to seismic and volcanic activities of Mauna Loa, 1914–16. Measurements from 120 weekly surveys by T. A. Jaggar shown.—Reprinted from *Amer. Journ. Sci.*, April, 1917.

sudden subsidences of increasing amount, as shown on the accompanying chart. The last and greatest subsidence of June 5, 1916, happened at Kilauea just at the close of the lava flow which culminated the eruptive period on Mauna Loa, and the lava column thereafter rose steadily for seven months on the Kilauea side of the system, the Mauna Loa side being sealed. There is good reason to suppose that similar sympathetic relations have existed in previous eruptions. There were no seismometric and volcanometric data on those occasions, and quantitative records are essential to establish such correspondences.

Another line of investigation, based on analysis of such lava-tide charts as Figs. 3 and 4, plotted for four and a half years, and on a study of the imperfect records from 1865 to 1911, indicates that there are larger semi-annual and smaller semi-monthly variations in the height of the lava column, after making due allowance for local interferences and longer term cycles, which vary strikingly with a time curve constructed to express the relative amounts of the forced nutational strains in the globe attributable respectively to sun and moon. Mr. H. O. Wood computed this curve, and the writer executed the lava measurements with alidade or transit for the years 1912, 1913 (Fig. 4), 1914, 1915, and 1916 (Fig. 3). It is possible that the longer term cycles vary with a strain curve of free nutation (Chandler) due to variation of latitude.

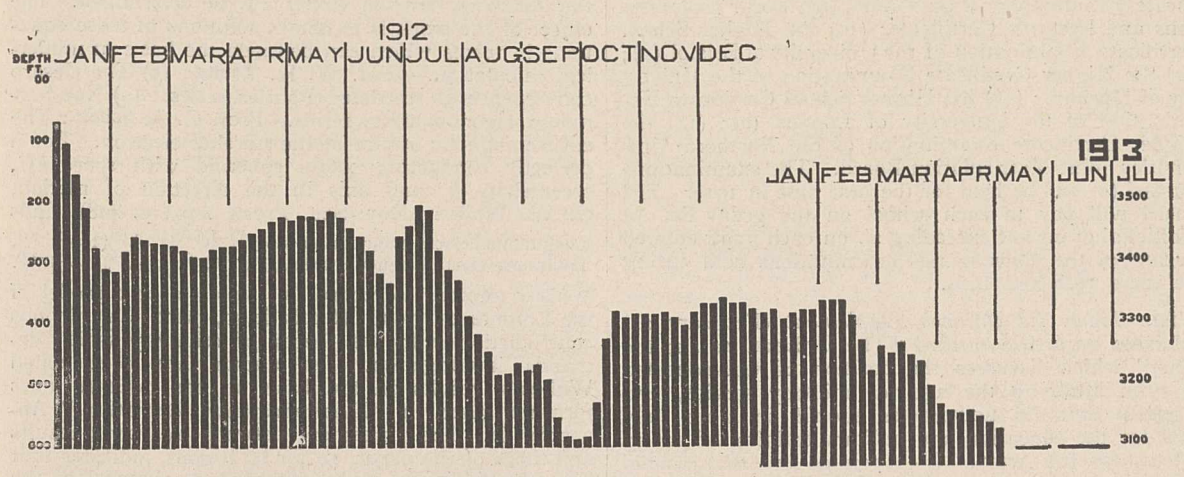

FIG. 4.—Chart showing measured rise and fall of Kilauea lava at five-day intervals during general subsidence 1911-13. Maxima near solstice, minima near equinox; supposed lunar fluctuation superposed upon this curve. Depths below rim of Halemaumau in feet (left), elevations above sea-level (right).

Seismic Indication of Volcanic Activity.

As stated above, there were earthquake swarms accompanying and preceding the outbreaks of Mauna Loa, and there have been similar groupings of local shocks accompanying the ups and downs of the Kilauea lava column. In addition, there are volcanic vibrations and extraordinary tiltings of the ground, the latter both periodic and prolonged, which promise intensely interesting data concerning the movements of the hard lava underground. Remembering the permanent surface deformation determined geodetically after the San Francisco earthquake, and after the eruptions at Usu and Sakurajima, in Japan, the writer believes, from experimental evidence, that a volcano station is most advantageously placed for critical seismometric investigation of the progress of such displacements. The co-ordination of deep magmatic movements with the earthquake problem is the profoundest enigma of geology. T. A. JAGGAR.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The School of Geography has published its programme of lectures and other work for next term. Mr. H. O. Beckit, the acting director, will lecture on the historical geography of Europe and on problems of social and political geography; he will conduct classes on elementary surveying and on Indian geography; also, in concert with the Rev. E. C. Spicer and Miss MacMunn respectively, a field class and a special class for the study of the Oxford district. Miss MacMunn will lecture on Indo-China, and Mr. J. Cossar on "Eastern Trade Routes." Informal instruction in geography will also be given.

The Committee for Anthropology announces lectures by Prof. A. Thomson (human anatomy), Miss Czaplicka (ethnology), Mr. H. O. Beckit (distribution of man), Mr. H. Balfour (comparative technology—æsthetic arts), Prof. Sollas (stages of human culture and the latest episodes in the earth's history), Mr. Griffith (questions relating to ancient Egypt), Dr. Marett (primitive morals, religion: rudimentary forms, legal institutions of savages), Mr. T. R. Glover (progress in religion), Dr. Farnell (Greek religion), Sir P. Vinogradoff (historical jurisprudence), Prof. Macdonell (Indian religion, customs, and archæology), Mr. V. A. Smith (Indian archæology and art), and Mr. S. Langdon (questions relating to ancient Babylonia). The instruction given in many of the foregoing subjects will be of an informal character.

LORD BRYCE and Prof. R. H. Chittenden, of Yale University, were the chief guests at a dinner of American University men now in England, including the graduates of the United States Military and Naval Academies, held under the auspices of the American Universities Alumni Association, at the Criterion Restaurant on March 14. The dinner marked the inauguration of a London branch of the American University Union in Europe. Lord Bryce, in the course of an address, said he cherishes the hope that after the war there will be more and more British students in American universities to learn those subjects which are best taught there, and more and more American students in British universities. The war has given convincing proof of the unity of spirit between England and America; and in the future the two nations will

stand together to stop aggression and to guarantee to the world the peaceful development for which it is waiting.

THE Board of Education announces, in Circular 1034, that the following examinations have been recognised for the calendar years 1918 and 1919 as approved examinations, under the Board's scheme for the better organisation of examinations in secondary schools:—*As First Examinations:* (1) The School Certificate Examination of the Oxford and Cambridge Schools Examination Board; (2) the Senior Local Examination of the Oxford Delegacy for Local Examinations; (3) the Senior Local Examination of the Cambridge Local Examinations and Lectures Syndicate; (4) the School Certificate Examination of the University of Bristol; (5) the First School Certificate Examination of the University of Durham; (6) the General School Examination of the University of London; (7) the School Certificate Examination of the Northern Universities Joint Matriculation Board. *As Second Examinations:* (8) The Higher Certificate Examination of the Oxford and Cambridge Schools Examination Board; (9) the Higher School Certificate Examination of the Oxford Delegacy for Local Examinations; (10) the Higher School Certificate Examination of the Cambridge Local Examinations and Lectures Certificate; (11) the Higher School Certificate Examination of the University of Bristol (*a*); (12) the Higher Certificate Examination of the University of Durham; (13) the Higher School Certificate Examination of the University of London (*a*); (14) the Higher Certificate Examination of the Northern Universities Joint Matriculation Board. The examinations marked (*a*) will be held for the first time in 1919. The Board will pay to each school on the grant list an additional grant not exceeding 2*l.* on each pupil entered for any of the above-named examinations held during the years 1918 and 1919.

THE *Times Educational Supplement* (February 21) publishes an article entitled "The Universities and the War," which discusses the position of well-educated boys on attaining the age for military service, and suggests that the universities should be more fully used for the education and military training of young officers for the Army. It is pointed out that public-school boys who are members of the Officers Training Corps remain at school until attaining the age of eighteen and a half, when they are sent to officer cadet units for further training for commissions, whereas well-educated boys from all other secondary schools must enlist at about the age of eighteen, unless they go to a university and join an O.T.C. there. Those who enlist receive no special training for commissions for six months. The writer of the article therefore suggests that boys suitable for commissions should be encouraged by the War Office to join the universities and to receive military training in the O.T.C. Mr. Macpherson, in dealing with the question of the supply of officers in his statement in the House of Commons on February 20, admitted that invaluable work was done at the beginning of the war by the Officers Training Corps, but the War Office now expected a man to have served abroad before obtaining a commission, save in a few exceptional cases, and to have attained the rank of corporal, thereby having shown signs of leadership. For the Regular Army the period of training at Sandhurst and Woolwich had been extended. "It was not always the case that a boy who was able to pass with flying colours examinations in languages and mathematics made the best officer." The chances were that a boy who was captain of his school Rugby fifteen, who found it difficult to pass such an examination, had all the qualities of leadership, and should be given scope for the display of these qualities in the Regular Army. "The authorities at Woolwich considered the nominated candidates [those not entering by competitive examination] far and away the best, most capable, and hard-working, and they often produced the best officers." It appears extraordinary that, at this stage of the war, Mr. Macpherson should offer official encouragement to boys training for commissions not to apply themselves to their studies.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 7.—Sir J. J. Thomson, president, in the chair.—Prof. E. T. **Whittaker**: The numerical solution of integral equations. The present communication is concerned with integral equations of Abel's type

$$\int_0^x \phi(s)\mathrm{K}(x-s)\,ds = f(x),$$

and of Poisson's type,

$$\phi(x) + \int_0^x \phi(s)\mathrm{K}(x-s)\,ds = f(x),$$

where $\mathrm{K}(x)$ and $f(x)$ are given functions, and $\phi(x)$ is the unknown function which is to be determined. The object of the work is to obtain solutions of these equations in forms which can be made the basis of numerical calculation.—Prof. W. H. **Young**: (1) The Cesaro convergence of restricted Fourier series. (2) Non-harmonic trigonometrical series.—Prof. G. A. **Schott**: The electromagnetic inertia of the Lorentz electron. For a perfectly conducting oblate spheroid with speed $k\mathrm{C}$, eccentricity k, and axis in the direction of motion, G. W. Walker (Roy. Soc. Proc., A 93, p. 448) finds

Longitudinal electromagnetic mass $= \frac{2}{3}e^2a^{-1}\mathrm{C}^{-2}(1-\frac{1}{5}k^2)(1-k^2)^{-3/2}$,
Transverse electromagnetic mass $= \frac{2}{3}e^2a^{-1}\mathrm{C}^{-2}(1+\frac{1}{10}k^2)(1-k^2)^{-1/2}$.

Walker appears to regard this spheroid as a model of the Lorentz electron. If this be so, there is an obvious contradiction with the theory of relativity which demands investigation. The author has recalculated Walker's results on the basis of the general mass formulæ given in "Electromagnetic Radiation," Appendix D. The agreement between Walker's results and those of the paper, so far as it goes, indicates that his spheroid is not to be regarded as a model of the Lorentz electron.—Sir J. C. **Bose**: Researches on growth and movement in plants by means of the high magnification crescograph.

Linnean Society, February 21.—Sir David Prain, president, in the chair.—J. B. **Gatenby**: Notes on the bionomics, embryology, and anatomy of certain Hymenoptera Parasitica, with special reference to *Microgaster connexus,* Nees. The author remarked that *Microgaster connexus,* a parasite of *Porthesia similis,* was hyperparasitised by *Mesochorus pallidus.* The anatomy of Microgaster had been investigated; the larva has the posterior end of the body enlarged into the form of a spherical vesicle; the latter was thought by previous workers to be the ninth abdominal segment, but from anatomical and other evidence it is now considered to be the evaginated proctodæum. The embryonic membranes in Microgaster were also described, and notes were given on the various Hymenoptera parasitic on Aphidæ, and the embryonic membrane of an Aphidius was described. It was stated that internal entomophagous hymenopterous larvæ do not feed during practically the first third of their growth, but live by means of highly developed embryonic membranes; in their middle and later life they do not defecate; later larval and pupal stages were found to be generally normal.—W. B. **Brierley**: Experimental studies in the specific value of morphological characters in the fungi. In all systematic treatment of the fungi there is implied

constancy of morphological characters, and particularly of the size and shape of the mature reproductive bodies or spores. An experimental study of the specificity of these criteria is in process, the work being carried out primarily upon the fungus *Botrytis cinerea*. This species is contained in the "Polyactis" group of the genus, and the species in this group are separated partly by reason of their different hosts, but more critically by minute differences in the branching and septation of the conidiophore and by the size and shape of the spore.

March 7.—Sir David Prain, president, in the chair.—Prof. E. B. **Poulton**: The mimetic and Mendelian relationships of the "White Admirals" of North America. The "White Admiral" butterflies of the Nymphaline genus Limenitis or Basilarchia (the North American subgenus) form an interesting group with peculiar larvæ and pupæ. Their conspicuous patterns are displayed in a floating flight, and the under surface of the wings is not procryptically coloured like that of the Vanessas—characteristics which are found in the specially protected models for mimicry, and the Müllerian mimics of other still more distasteful species; and so it is with Limenitis. The English *L. sibylla* is resembled by the female of the "Purple Emperor" (*Apatura iris*), which flies in the same woods, while the tropical American representatives of Limenitis—the powerful genus Adelpha—are beautifully mimicked by the females of the representatives of Apatura—the genus Chlorippe. The African representatives of Limenitis—the genus Pseudacræa—are almost all of them wonderful mimics of the Acræas, and in one instance of a Danaine

Zoological Society, March 5.—Dr. A. Smith Woodward, vice-president, in the chair.—R. I. **Pocock**: The external characters of the lemurs and Tarsius. The observations recorded were based, except in the case of Tarsius, upon specimens that had lived in the society's gardens. The author stated his opinion that Tarsius should be removed from the lemuroid primates and classified with the monkeys. He proposed to divide the primates into two primary groups, the Strepsirhini for the lemurs and the Haplorhini for Tarsius and the rest, the Haplorhini being further divided into the Tarsioidea for Tarsius and the Pithecoidea for monkeys, apes, and man.—Sir G. F. **Hampson**: Classification of the Hypsotropinæ. The author described the Hypsotropinæ as a rather obscure group of the Pyralidæ, of very uniform appearance and differing chiefly in structure.

Mathematical Society, March 14.—Prof. E. W. Hobson, vice-president, in the chair.—G. H. **Hardy**: The representation of a number as the sum of any number of squares.—G. N. **Watson**: A problem in the theory of numbers.—Prof. W. H. **Young**: Non-harmonic Fourier series.

PARIS.

Academy of Sciences, February 11.—M. Léon Guignard in the chair.—M. **Hamy**: A particular case of diffraction of circular stars and its application to the sun.—A. **Carnot**: New methods of estimation of copper, zinc, cadmium, nickel, and cobalt. The method is based on precipitation with sodium carbonate, solution of the precipitate in ammonia, and reprecipitation of the metallic hydroxide or carbonate by boiling.—M. Cuénot was elected a correspondant for the section of anatomy and zoology in succession to the late M. Maupas.—T. **Lalesco**: The classes of nuclei capable of symmetry.—E. **Léger**: The mechanism of the formation of certain isomers of cinchonine and their hydrohalides.—P. **Nicolardot** and J. **Boudet**: The examination of mercury fulminate and the analysis of mixtures for detonators. The methods suggested are based on treatment with yellow ammonium sulphide to form mercury sulphide, and precipitation of antimony sulphide from the solution by ammonium sulphite.—J. **Clarens**: The precipitation of phosphoric acid as ammonium phosphomolybdate. Practical estimation of phosphoric acid by a simple nitrometer measurement. A method is described for obtaining a phosphomolybdate precipitate in which the ratio of ammonia to phosphorus is fixed, so that the phosphorus is ultimately determined by a gasometric measurement.—L. **Dubreuil-Chambardel**: An anatomical variation of the second metacarpal.—E. **Roubaud**: Disappearance of the infective power in *Anopheles maculipennis* in the course of hibernation.—M. **Folley**: The cross of the aorta in exophthalmic goitre.

February 18.—M. Léon Guignard in the chair.—G. **Bigourdan**: Various French astronomical observatories of the seventeenth century.—M. Vayssière was elected a correspondant for the section of anatomy and zoology in succession to the late M. Renaut.—P. E. **Gau**: The integration of partial differential equations of the second order.—M. T. **Beritch**: The extension of Rolle's theorem to the case of several variables.—B. de **Fontviolant**: A new theory relating to the effects of the wind on bridges supported on arches.—M. **Maggini**: A new stellar photometer. A description of a modified wedge photometer.—A. **Véronnet**: The contraction of a gaseous mass and the evolution of the sun.—A. **Travers**: The estimation of vanadium in presence of molybdenum by titanous chloride.—L. **Gentil**, M. **Lugeon**, and L. **Joleaud**: Geology of the Sebou basin (Morocco).—L. **Dunoyer**: The diurnal variation of the wind in altitude and the influence of the distribution of the cloud masses.—M. **Reboul**: The diurnal variations of the wind in altitude.—L. **Daniel**: Extension of the limits of culture of the vine by means of certain hybrids.—L. **Lapicque** and J. **Chaussin**: The food value of whole wheat and of flour of 85 per cent. extraction compared with white flour. Medium wheat leaves 12 per cent. of indigestible residue; its nutritive value is equal to 90 per cent. of its weight of white flour.—P. **Brodin** and Fr. **Saint-Girons**: Contribution to the study of digestive leucocytosis.—H. **Colin**: Transformations of inulin in the tuber of the Jerusalem artichoke during the period of repose.—F. **Diénert** and A. **Guillerd**: The concentration of the micro-organisms of water. After trying and discarding various types of filters, and removal by formation of precipitates, a workable concentrating agent was found in alumina cream. Prepared and used in the manner laid down, from 80 per cent. to 100 per cent. of added *B. coli* were recovered.—A. **Bouquet** and L. **Nègre**: Culture of the parasite of epizootic lymphangitis and the experimental reproduction of the disease in the horse.—M. **Folley**: The aortic cross in exophthalmic goitre. Dilation of the aorta is a constant symptom of Basedow's disease, and may be used as a means of diagnosis in doubtful cases.—E. Le **Moignic** and J. **Gautrelet**: Intravenous injections of oil. Contribution to the physiological study of the T.A.B. lipo-vaccine. From 1 c.c. to 1·5 c.c. of oil can be safely injected into the circulation of a dog, and vaccines with an oil basis are proved to be less toxic than aqueous vaccines.

February 25.—M. Paul Painlevé in the chair.—G. **Bigourdan**: The old astronomical stations of Nantes and Pau. Historical notices of the work of Anastase, Fontenay, Pallu, Graindorge, and Jean de Bonnécamp at Pau.—A. **Blondel**: The graphical determination of total inductances, direct and transversal, of alternators by means of the partial characteristics calculated or observed.—A. **Carnot**: Some new separations of the five metals of the group soluble in ammonia. Examples of

the application of the method outlined in an earlier communication to the analysis of brass, German silver, and other alloys.—E. **Ariès**: The critical constants of mercury. The formula given in a previous paper, and worked out for the cases of argon, xenon, and crypton, is now applied to mercury, the vapour of which is also monatomic. The formula leads to 1077° C. for the critical temperature, and 420 atmospheres for the critical pressure of mercury.—W. **Kilian**: Contributions to the knowledge of the Delphino-Provençal and Rhodanian lower Cretaceous.—M. Flahault was elected a non-resident member in the place of the late M. Gosselet.—B. **Jekhowsky**: The generalisation of a theorem of Cauchy relating to developments in series.—R. de Montessus de **Ballore**: Skew quartics of the first species.—J. **Guillaume**: Observations of the sun made at the Observatory of Lyons during the fourth quarter of 1917. Details of observations made on fifty-seven days.—E. **Vessiot**: Propagation by waves and the theory of general relativity.—P. **Weiss** and A. **Piccard**: A new magneto-thermal phenomenon. In the course of a magnetic study of nickel in the neighbourhood of the Curie point, the establishment of the field (15,000 g.) caused a marked rise of temperature (0·7°). The suppression of the field produced a cooling of the same order. The reversibility and order of magnitude distinguish this effect from heating due to hysteresis. Above the Curie point (629·6° Absolute) the rise of temperature is proportional to the square of the magnetisation, a result which can be deduced from the theory of the molecular field.—Ph. **Flajolet**: Perturbations of the magnetic declination at Lyons (Saint-Genis-Laval) during the fourth quarter of 1917.—J. **Dufrénoy**: Tumours on the maritime pine.—C. **Cépède**: New method of staining the tubercle bacillus.—H. **Vincent**: The prophylaxy of Maltese fever by the active immunisation of the germ-carrying animals.

BOOKS RECEIVED.

Précis de Radiodiagnostic Technique et Chirurgie. By Dr. Jaugeas. Second edition. Pp. xxviii+563. (Paris: Masson et Cie.) 20 francs.

Localisation et Extraction des Projectiles. By L. Ombrédanne and R. Ledoux-Lebard. Second edition. Pp. iv+305. (Paris: Masson et Cie.) 4 francs.

Theory of Functions of a Complex Variable. By Prof. A. R. Forsyth. Third edition. Pp. xxiv+855. (Cambridge: At the University Press.) 30*s*. net.

The War and the Bagdad Railway. By Prof. M. Jastrow, jun. Pp. 160. (Philadelphia and London: J. B. Lippincott Co.) 6*s*. net.

Department of Commerce. U.S. Coast and Geodetic Survey. Terrestrial Magnetism. U.S. Magnetic Tables and Magnetic Charts for 1915. By D. L. Hazard. Pp. 256+illustrations in pocket. (Washington: Government Printing Office.)

The Advanced Montessori Method. By M. Montessori. ii., The Montessori Elementary Material. Translated by A. Livingston. Pp. xviii+455. (London: W. Heinemann.) 12*s*. 6*d*. net.

What Industry Owes to Chemical Science. By R. B. Pilcher. Pp. xiv+150. (London: Constable and Co., Ltd.) 3*s*. net.

The Systematic Treatment of Gonorrhœa. By N. P. L. Lumb. Pp. viii+116. (London: H. K. Lewis and Co., Ltd.) 4*s*. 6*d*. net.

Anti-Malaria Work in Macedonia among British Troops. By Dr. W. G. Willoughby and L. Cassidy. Pp. x+68. (London: H. K. Lewis and Co., Ltd.) 3*s*. 6*d*. net.

Tumours: Their Nature and Causation. By Dr. W. d'Este Emery. Pp. xx+146. (London: H. K. Lewis and Co., Ltd.) 5*s*. net.

Aids to Rational Therapeutics, with U.S.A. Pharmacopœia Equivalents. By Dr. R. W. Leftwich. Pp. x+233. (London: Baillière and Co.) 3*s*. 6*d*. net.

Aviation Engines: Design, Construction, Operation, and Repair. By First Lieut. V. W. Pagé. Pp. 589. (London: Crosby Lockwood and Son.) 15*s*. net.

DIARY OF SOCIETIES.

THURSDAY, MARCH 21.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—The Mechanical Design and Specification of the Turbo-alternator Rotor: Dr. S. F. Barclay.

INSTITUTION OF MINING AND METALLURGY, at 5.30.—Annual General Meeting.

INSTITUTION OF NAVAL ARCHITECTS, at 11 a.m.—Problems of the Future in the Design and Construction of Merchant Ships: W. S. Abell.—Research in Marine Engineering: A. E. Seaton.—The Effect of the Longitudinal Motion of a Ship on its Statical Transverse Stability: G. S. Baker and Miss E. M. Keary.—At 3 p.m.—The Iron Carbon Equilibrium Diagram and its Practical Usefulness: Prof. H. C. H. Carpenter.—Stress Distribution in Bolts and Nuts: C. E. Stromeyer.

LINNEAN SOCIETY, at 5.—The Shoulder-girdle of a Dicynodont Reptile from South Africa: E. S. Goodrich.—Fossil Charas from Oligocene Beds: J. Groves.—Malayan Form of *Chlorococcum humicola* (Nacq.), Rabenh.: Miss B. Muriel Bristol.

FRIDAY, MARCH 22.

ROYAL INSTITUTION, at 5.30.—Radiation from System of Electrons: Sir J. J. Thomson.

INSTITUTION OF NAVAL ARCHITECTS, at 11 a.m.—A Preliminary Survey of the Possibilities of Reinforced Concrete as a Material for Ship Construction: Major M. Denny.—Reinforced Concrete Vessels: W. Pollock.—Design and Construction of a Self-propelled Reinforced Concrete Seagoing Cargo Steamer building in Great Britain: T. G. O. Thurston.—An Investigation of the Shearing Force and Bending Moment acting on the Structure of a Ship including Dynamic Effects: A. M. Robb.—At 3 p.m.—Air Supply to Boiler Rooms: R. W. Allen.

PHYSICAL SOCIETY, at 5.—The Fourth Guthrie Lecture: The Origin of Spectra: Prof. J. C. McLennan.

SATURDAY, MARCH 23.

ROYAL INSTITUTION, at 3.—Problems in Atomic Structure: Sir J. J. Thomson.

MONDAY, MARCH 25.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Some Cottonseed Products in Relation to Present-day Needs: E. C. de Segundo.

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MACMILLAN AND CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.
Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.