THURSDAY, APRIL 16, 1896.

OLD AND NEW THEORIES OF EVOLUTION

The Primary Factors of Organic Evolution. By E. D. Cope, Ph.D., Professor of Zoology and Comparative Anatomy in the University of Pennsylvania. Pp. xvi + 532. (Chicago : The Open Court Publishing Company, 1896.)

The Present Evolution of Man. By G. Archdall Reid. Pp. 370. (London : Chapman and Hall, Limited, 1896.)

PROF. COPE tells us in his preface that his work may be regarded as containing a plea on behalf of the Lamarckian view of the factors of evolution ; and he believes that evidence has now been accumulated to demonstrate the doctrine, which, he says, he has defended as a working hypothesis for twenty-five years. At p. 9 of the introduction, he states, referring to one of his own papers : " By the discovery of the palæontologic succession of modifications of the articulations of the vertebrate, and especially mammalian skeleton, I first furnished an actual demonstration of the reality of the Lamarckian factor of use, or motion, as friction, impact, and strain, as an efficient cause of evolution." Such statements as these lead the reader to expect that at last we shall have something of the nature of proof of the inheritance of acquired characters, and that the difficulties and objections of those who hold Weismann's views will be fairly met and satisfactorily answered.

The work is divided into three parts, headed respectively : "The Nature of Variation," "The Causes of Variation," and "The Inheritance of Variation." The first part deals with variation, phylogeny, parallelism, and catagenesis. Very full accounts are given of the varieties that occur in some of the animals inhabiting the United States, with special reference to climatal conditions. Aridity is said to produce a blanching of colours, while moisture produces intensity. Some groups increase in size as they spread southward, others towards the north, and this is connected with the centre of the area of distribution being in the south or the north. We have also a careful description of the progressive development of several important groups as indicated by their fossil remains, with a general outline of the phylogeny of the mammalia ; while the chapter on parallelism deals with the general correspondence between the course of development of the individual and of the class or order to which it belongs.

At the end of this part of the volume, which has been purely descriptive and has entirely avoided any reference to natural selection or to the broader features of variation, we find this extraordinary statement.

"It has been proved, as it appears to me, that the variation which has resulted in evolution has not been multifarious or promiscuous, but in definite directions. It has been shown that phylogeny exhibits a progressive advance along certain main lines, instead of having been indefinite and multifarious in direction."

Of these two statements the latter is true, and has been fairly proved by the facts which have been set forth ; while the former is absolutely untrue, and if the facts which this volume sets before the student do not show it to be untrue, it is only because they have been selected and set forth in such a way as to illustrate the theory that variations are in definite directions only. For example, although Dr. J. A. Allen is quoted largely to show the variations of birds in definite directions in accordance with changes of climate, nothing is said of his more important work on "The Mammals and Winter Birds of Florida," in which he has given detailed measurements showing that all the commoner species do exhibit "multifarious variations" which are also "multifarious and indefinite in direction." He shows that the total length, as well as the length of the wing, the tail, the beak, and the feet, all vary simultaneously but to a large extent independently. Further, he shows that each of the primary wing feathers, and each of the toes also vary simultaneously and to a large extent independently. Other writers have shown that in mammalia the skull and all its parts vary simultaneously; while what is known of the variation of the muscles, the nerves, the blood-vessels, the intestines, and other internal organs, show that these even exceed the external organs in the multifarious and indefinite character of their variations. All this is the common knowledge of every biologist ; yet we have a great authority and experienced biological teacher, first omitting all reference to these facts, and then declaring that he has *proved* that they do not exist !

Coming now to the second division of the book, we find abundant evidence as to the changes effected in individuals by the action of various external causes, by far the larger portion being devoted to a statement of the supposed mechanical origin of the peculiar forms of the teeth and bones in the vertebrata, illustrated by the various lines of evolution made known by palæontology, and always assumed to be the result of use (or disuse) and motion. Then follows a short chapter on natural selection, which is described in the most cursory manner, almost immediately diverging to sexual selection, to which more space is given. We then have a single paragraph devoted to protective modifications of colour or form ; and the author here takes the opportunity of dealing a blow at the Darwinians by first misstating their views, and then demolishing his own misstatement. He says :

"Much is to be found of interest on this attractive subject in the writings of Wallace, Poulton, Beddard, and others. The two authors first named ascribe these colour and form characters to natural selection *as a cause*. This is, however, impossible ; yet natural selection has undoubtedly been the cause of their survival."

The italics are Prof. Cope's. He then goes on :

"The first objection to the belief that natural selection is the primary cause of organic evolution has already been stated as follows : 'A selection cannot be the cause of those alternatives from which it selects. The alternatives must be presented before the selection can commence.' But the supporters of the view that natural selection is the origin of variation, allege that it produces this result by the continual survival of minute differences which are useful, thus accumulating variation. That minute advantageous differences will secure survival no one can doubt, but it must be remembered that the variations which constitute evolution have been in a vast number of cases too minute

to be useful. But the general question is not affected by the supposition that advantageous variations may be sometimes minute. Minute or great, they have to be assumed in the argument for selection; and whether minute or great, they have a definite cause."

This very ingenious argument is well calculated to impress those readers of Prof. Cope's book who have no other sources of information that natural selection is quite a subsidiary agent in causing evolution, and that—as he says in his concluding paragraph—"the stimuli of chemical and physical forces and also molar motion, or use, or its absence, are abundantly sufficient to produce variations of all kinds in organic beings."

But they can produce this effect only on the assumption that all the modifications so produced in individuals are, partially at least, transmitted to their offspring; while those very numerous cases in which essential characters could not possibly have been produced by the causes he suggests, are entirely unnoticed. Such are all those curious structures which are only used once in a lifetime; those whose only function is to alarm enemies; most of the protective forms, motions, and colours of insects, as illustrated in the stick and leaf insects, or in those which are deceptively like moss, or flowers, or the dung of birds; the poison-fangs of snakes and the stench-glands of skunks, and innumerable other examples which will occur to every naturalist. Note, too, how "*as a cause*" in the first quotation is changed immediately afterwards to "the primary cause," and the implication that we believe natural selection to be the "origin of variation" and "the cause of the alternatives from which it selects," a theory for which Prof. Cope never states his authority, and which, so far as I know, has never been even suggested, except by incompetent or careless reviewers. Strange to say we have the acknowledgment that "minute advantageous differences will secure survival," but it is followed by the proviso that "the variations which constitute evolution have been in a vast number of cases too minute to be useful." This, I suppose, means that the changes produced by external causes in the individual are too minute to be useful till transmitted and accumulated by inheritance. Whether that is so or not, no evidence whatever has been adduced; while abundant evidence exists in the works of Prof. Cope's own countrymen, and in the measurement of many hundreds of specimens of common species in this country, that normal variability is *not* minute but very large, and that this variability extends to every part and structure, and to every external and internal organ when search has been made for it. That such well-known facts as these should be entirely ignored, and the extraordinary and wholly unprovable statement made, that the variations which constitute evolution "have been in a vast number of cases too minute to be useful," seems to show that the advocates of Neo-Lamarckism feel that they have a very bad case.

In the third part, on the inheritance of variation, we expect to find some experimental facts bearing on the question at issue. But I can only find assumptions and opinions. Breeders of animals, it is said, all believe in the inheritance of the results of nutrition and exercise, and pages are given to prove such beliefs; and after describing the evolution of the American trotting-horse, Prof. Cope says:

"Viewed as phenomena, there is every appearance and indication that the changes acquired by individuals through the exercise of function have been to some degree transmitted, and have been cumulative, and that this has been one factor in the evolution of speed."

However unsatisfactory is the author's treatment of the evidence for the doctrine which forms the main subject-matter of the book, we did not expect that he would repeat the absurd argument which Lord Salisbury used at Oxford, and which has been so destructively criticised by Herbert Spencer. Yet in the chapter on "The Energy of Evolution" he gives, among the "weighty considerations" showing that natural selection cannot be the cause of the origin of new characters, the following statement:

(3) "In order that a variation of structure shall survive, it is necessary that it shall appear simultaneously in two individuals of opposite sex. But if the chance of its appearing in one individual is very small, the chance of its appearing in two individuals is very much smaller. But even this concurrence of chances would not be sufficient to secure its survival, since it would be immediately bred out by the immensely preponderant number of individuals which should not possess the variation."

Whence of course it follows, that without the Lamarckian factors to produce the right variations at the right time, natural selection is powerless, as it will have nothing to select from! It really seems incredible that after nearly forty years' discussion of evolution and natural selection such an argument as that here quoted can be set forth in a serious book by a life-long teacher and worker in the field of biology.

It is refreshing to turn to Mr. Archdall Reid's volume which, though unnecessarily diffuse, is full of original ideas and acute reasoning. The larger part of it is devoted to a discussion of the general subject of organic evolution. This is exceedingly well done, and it contains a very forcible argument against the possibility of the inheritance of acquired characters in the higher animals, derived from the facts of cell-division and specialisation in the development of the individual. This argument has not, within my knowledge, been so clearly and forcibly set forth by any other writer. There are also some very acute criticisms of the writings of Herbert Spencer and others on evolution, and great stress is laid on a rather neglected subject, the development of acquired characters during the growth of the individual, though on this point the author's views seem rather exaggerated and open to criticism. The latter portion of the book, which gives the title to the work, though original is somewhat disappointing, as it is entirely limited to evolution against disease. The author argues that this is effected solely by natural selection, and in the facts presented by the various amounts of resistance of different races to certain zymotic diseases he finds another powerful argument against the Lamarckian theory. He maintains that there is no such thing as hereditary disease, but only hereditary tendency to contract the disease. He traces most of the zymotic diseases to the unhealthy crowding that is universal in civilised communities, and he has some very strong remarks on the way in which our false civilisation is exterminating so many of the lower races. One of

these passages may be quoted as a fair example both of the author's style and of the interesting subjects he discusses.

"Are not all our efforts, whether prompted by philanthropic or religious zeal, by which we seek to protect and preserve the aboriginal races of the New World, wholly mistaken? Are they not in effect absolutely murderous? We gather them into close school-rooms and churches, where teachers and missionaries speak to them from infected lungs. We endeavour to persuade them to abandon their nomadic habits and form settled communities. We—and thereby we prove our own barbarism, the imperfection of our own civilisation—force them in climates where clothes are wholly unnecessary, and therefore a species of dirt, to wear clothes, than which a better vehicle for air and earth-borne disease cannot be well conceived. In fact we strive to bring them at one bound into that state of society which has become possible to us only at the cost of tens of millions of lives during thousands of years."

There are a few errors and perhaps some fallacies in this very interesting and well-written volume; but much may be forgiven in a book that is both original and suggestive; while in its thorough-going advocacy of the main doctrine of Weismann—the non-inheritance of acquired characters—it affords an excellent antidote to the elaborate but one-sided arguments of Prof. Cope.

Alfred R. Wallace.

THE ATOMIC THEORY AGAIN.

A New View of the Origin of Dalton's Atomic Theory: a Contribution to Chemical History, &c. By Henry E. Roscoe and Arthur Harden. Pp. 191. (London: Macmillan and Co., 1896.)

La Théorie Atomique et la Théorie Dualistique. Transformation des formules. Différences Essentielles entre les deux théories. Par E. Lenoble, Professeur de Chimie a l'Université libre de Lille. Pp. 94. (Paris: Gauthier-Villars.)

THE origin of the former of these two books is well explained in the following passage from the short introduction:

"It may seem remarkable that after the lapse of nearly a century since John Dalton first applied the atomic theory of matter to chemical phenomena, it should be possible to find anything new respecting the genesis of his ideas. And this is the more remarkable when we remember that the life and scientific labours of the great Manchester chemist have formed the subject of independent memoirs at the hands of two such able contemporaries as Charles Henry and Angus Smith. The explanation is to be found in the unlooked-for discovery, in the rooms of the Literary and Philosophical Society of Manchester, where the whole of Dalton's experimental work was carried out, of his laboratory and lecture note-books contained in a number of manuscript volumes. A careful study of these has led us to conclusions concerning the origin of the atomic theory of chemistry which differ widely from those which have been generally accepted. It has hitherto been supposed that it was the experimental discovery of the law of combination in multiple proportions which led Dalton, seeking for an explanation of this most remarkable fact, to the idea that chemical combination consists in the approximation of atoms of definite and characteristic weight, the atomic theory being thus adopted to explain the facts ascertained by chemical analysis. This prevailing view is found on examination to rest upon the authority of contemporary chemists, rather than on any explicit statement on the part of the author himself; for, strange as it may appear, no attempt to explain the genesis of his ideas is to be found in any of Dalton's published writings."

It now appears that Dalton was probably led to his theory by an attempt to apply the Newtonian doctrine of the atomic constitution of matter to the explanation of the physical properties of gases, and more especially to the case of the gases present in atmospheric air.

The evidence upon which this conclusion is based is derived partly from the newly-discovered manuscript notes of a course of lectures given by Dalton at the Royal Institution in London early in 1810. In the course of these he says that it was the consideration of the constitution of mixed elastic fluids which led him to contemplate the effect of differences of size in the particles, and thus "it became an object to determine the relative *sizes* and *weights*, together with the relative *numbers* of atoms in a given volume. This led the way to the combinations of gases, and to the *number* of atoms entering into such combinations. . . . Thus a train of investigation was laid for determining the *number* and *weight* of all chemical elementary principles which enter into any sort of combination one with another." This is a statement of Dalton's own recollection of the course of events after the lapse of seven or eight years from the time when he made his first attempts at estimating atomic weights. To this must be added the fact that the first part of his "New System of Chemical Philosophy," published in 1808, contains no account of any chemical analyses, and in the short chapter on chemical synthesis, at the end of this first part, the author speaks of the application of certain general rules which he lays down "to the chemical facts already well ascertained," the experiments conducted by himself being reserved for part ii., published two and a half years later.

On the other hand, Dr. Thomas Thomson, after a visit to Dalton in 1804, makes the very definite statement upon which chemists have generally relied. He says: "Mr. Dalton informed me that the atomic theory first occurred to him during his investigations of olefiant gas and carburetted hydrogen gas." If this was the impression carried away by an interested visitor at the time when Dalton was occupied by the earlier stages of his investigations, it is impossible to avoid the conclusion that there was some foundation for it. Dalton was occupied with the idea of atoms, their relative sizes, &c., from 1801. In the summer of 1804 he collected and analysed the gas from ponds ("System Chem. Phil.," p. 445). In 1805, he says (MS. Lecture 17, p. 16 in the book) the idea occurred to him that the sizes of the particles of elastic fluids *must* be different. We cannot, therefore, admit that the authors have fully made out their case, though it does appear probable that the idea of atomic structure was growing in Dalton's mind before he made any chemical analyses for himself; but whether it had taken the final definite shape in which it appears in the notes of the lectures at the Royal Institution, and in the "New System of Chemical Philosophy," appears to us to be still open to question.

The second book on our list is a production of wholly different type. This little volume explains how to trans-

late the language and the formula of the dualistic system into the language and formulæ current at the present day. The process is simple. It consists in writing down the dualistic formula in equivalents say HO, from this deducing *the formula of M. Berthelot*, H_2O_2, and then dividing by two the number of equivalents of all elements in the formula not comprised in a table given in the book; that is, the elements of uneven valency, and so in this case we arrive at the unitary atomic formula H_2O. This little book is not wanted in England. It might have been useful thirty years ago, but for very shame it should not have been published now, and addressed to university students by a university professor in the land of Laurent, of Gerhardt, and of Wurtz. French chemistry half a century ago was still in the front rank. For the last generation it has been practically nowhere. France owes a debt to M. Berthelot for his labours of the last forty years, first in the development of chemical synthesis, and latterly for his store of exact calorimetric determinations; but whatever gratitude the chemical part of the nation may feel for these substantial labours, the warmth of such feeling must be considerably reduced by the reflection, that chiefly to the obstinacy of M. le Ministre de l'Instruction publique, an office held for many years by the great chemist, is due the position to which French chemistry has sunk, and from which, spite of the brilliant work of a few men like le Bel, Lecocq de Boisbaudran, and Moissan, it will take the best part of another generation to rise.

OUR BOOK SHELF.

Die Mikroskopische Thierwelt des Süsswassers. Abth. I. Protozoa. Von Dr. Friedrich Blochmann. Zweite Aufl. 4to xv + 134 pp., 8 plates, 259 figs. (Hamburg: Lucas Gräfe and Sillem, 1895.)

IT is true that there are many books dealing with the microscopic fauna of fresh waters, but it is also probably the case that there are many more students and amateurs working more or less seriously at this than at any other branch of microscopic zoology. This is the first section of the second part of Kirchner and Blochmann's "Microscopic Fauna and Flora of the Fresh-waters," and the present second edition has been completely reorganised and enlarged. It treats of the Protozoa alone, and discusses them from the systematic point of view. The classification adopted is, in the main, that of Bütschli, but our author agrees with Klebs in the grouping of the Flagellata. We have general accounts of the classes and other divisions, dichotomising tables, and definitions of the genera and species, beginning with *Hyalodiscus* and *Amœba*, and working through to *Stylocometes* in the Suctorial Infusoria. *Volvox* and other forms sometimes claimed by the botanists are here included in the Flagellata, and of course the Dinoflagellata (*Peridinium* and *Ceratium* and their allies) are placed along with the Flagellata in the Mastigophora. The figures on the plates (Werner and Winter) are abundant, and are excellently drawn; a large number of them are tinted so as to show natural colours. Many of them are now very familiar, being taken from the classic works of Bütschli, Leidy, Cienkowsky, Hertwig, Greef, Stein, Klebs and Kent. The last plate gives in outline over forty selected types (the best-known forms) from the various groups of Protozoa, all magnified 100 times so as to show the relative sizes, and enable the student to realise the contrast between *Urotricha* and *Spirostomum*, between *Oikomonas* and *Pelomyxa*, and between *Actinophrys* and *Actinosphærium*. W. A. H.

Manual of Lithology: treating of the Principles of the Science, with special reference to Megascopic Analysis. By Edward H. Williams, jun. 418 pp. Six plates. (New York: Wiley and Sons. London: Chapman and Hall, 1895.)

IN general plan this book differs little from many other text-books on the same subject. The main portion is devoted to the systematic description of the different types of rocks belonging to the three groups, primary or igneous, secondary and metamorphic. By way of introduction to this part, about a hundred pages are occupied with an account of the principal rock-forming minerals and with definitions of the structures exhibited by rocks; while at the end is added a short chapter, intended for the engineer, dealing with the economic value of rocks. Throughout the book the subject is treated as far as possible from the macroscopic point of view. In the classification of the igneous rocks, a two-fold division into intrusives and extrusives is adopted. In this system the line of distinction appears to be drawn in the wrong place. The result is that types presenting very similar characters are separated widely from each other; and owing, it would seem, to the influence of the German school, this separation appears to be effected, in many cases, not so much because the rocks differ in mode of origin as because they have been kept apart by German writers who still uphold the criterion of geological age, a method of distinction, however, which we are glad to see the author clearly repudiates in the introduction.

In the description of varieties of the main types many new names, and some old ones which we hoped had become obsolete, will be met with; so that, in this part of the book, the author's own pages hardly serve to impress upon the reader the truth of the statement made in the introduction that "the tendency of modern rock analysis is toward a simplification of the subject, and the discarding of useless and misleading divisions and names."

If the book had been kept within narrower limits, we are inclined to think that it would have been more useful to the class of student for whom it is intended, viz. "the beginner in the subject who wishes a thorough knowledge in the megascopic presentation of the subject, in a fuller and more compact arrangement, than can be obtained in geological text-books." G. T. P.

LETTERS TO THE EDITOR.

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

The Sacred Tree of Kum-Bum.

THE identification of the Kum-Bum tree with *Ligustrina amurensis* (not *amurentis*) (see p. 534) has already been communicated by M. Grigoriev to the *Bulletin du Muséum d'Histoire Naturelle* (1896, p. 33). But the Paris botanists appear to consider it doubtful.

As, however, *Ligustrina* is now merged in *Syringa*, there is a general agreement that the Kum-Bum tree belongs to that genus. We are still of opinion that the authentic leaves brought back by Mr. Rockhill belong to *S. villosa*.

Kew, April 10. W. T. THISELTON-DYER.

The Röntgen Rays and Optically Active Substances.

IN an article in NATURE (February 27) by Prof. J. J. Thomson, it is suggested that the leakage of electricity through non-conductors under the influence of the Röntgen rays is "due to a kind of electrolysis, the molecule of the non-conductor being split up, or nearly split up, by the Röntgen rays, which act the part played by the solvent in ordinary electrolytic solutions." It has occurred to me that if such ionisation really

does take place, independent evidence of it should be obtainable in the case of optically active substances by a change in their rotatory power taking place when they are exposed to the X-rays, as it is well known that the ionised molecules of active compounds are possessed of very different activity from the undissociated molecules themselves. To put this point to the test, Mr. MacGregor and I have polarimetrically examined two optically active compounds, ethylic dibenzoylglycerate and methylic acetylglycerate, interposing a Crookes' focus tube between the polarising Nicol and the column of active liquid; but although the discharge was maintained in both cases for three-quarters of an hour, there was not the slightest change in the rotation observable. To facilitate the passage of the rays, we employed a thin microscope cover-glass to close the polarimeter tube at the end nearest to the Crookes' tube, and that the rays were actually traversing the column of active liquid was demonstrated by obtaining a photographic effect at the other extremity of the tube, whilst the efficiency of the Crookes' tube was further proved by the favourite test of the skeletal photograph of a hand, which yielded an impression of great sharpness and exhibiting a most remarkable amount of detail. It would appear, therefore, that the Röntgen rays either do not give rise to any ionisation at all, or that the concentration of the ions is so small as not to be detectable by means of a sensitive polarimeter. I have previously shown, in conjunction with Mr. Pickard (*Trans. Chem. Soc.*, 1896), that the active bodies in question exhibit what appears to be a process of ionisation when dissolved in certain organic solvents, which process is accompanied by a very conspicuous change in their rotatory power, so that they appeared to be specially adapted for testing this suggested influence of the X-rays.

Incidentally we have roughly tested the relative opacity of a number of organic compounds to these rays by spreading approximately equal thicknesses of each on a number of microscope cover-glasses, which were placed on a photographic plate enclosed in a black envelope, and then exposing them all simultaneously to a Crookes' tube placed a few inches above. Out of nearly forty organic compounds belonging to both the fatty and the aromatic series, the only ones exhibiting any marked opacity contained iodine, bromine, or chlorine, the iodine compounds being the most and the chlorine compounds the least opaque. Thus methyl iodide, ethyl bromide, ethylene iodide, ethylene bromide, monobromacetic acid, tribromacetic acid, bromobenzoic acid, and trimethylenebromide were very markedly opaque, and curiously monochloracetic acid was much more distinctly opaque than either dichlor- or trichlor-acetic acid.

Mason College, Birmingham. PERCY F. FRANKLAND.

Radiographs by Fluorescent Screens.

IT may perhaps interest those who occupy themselves in photographing with Röntgen rays to know that a very effective and rapid method is obtained when proceeding as I will explain. I had a piece of scheelite or native tungstate of calcium, such as occurs in a collection of minerals, crushed to a somewhat coarse powder, and made it into an emulsion with gelatine; this was applied in a consistent and uniform layer on a piece of stiff black paper, and after this was dried the surface showed numerous crystalline, glittering particles. The right condition for fluorescing was attained, as was evident, when a Crookes' tube in action was placed behind and looked at in the dark, though the luminosity was not so strong as with a screen covered with crystals of platinocyanide of barium. The paper, thus prepared, was simply laid down on a very sensitive photographic glass plate, with its fluorescent side of course in contact with the film; on the upper surface metallic objects or the fingers were put. Applying now Newton's focus tube (which, I may add, gave me excellent results in former experiments) with an induction coil, regulated to give sparks of five to six inches, I obtained sharply-defined radiographs of keys, &c., in twenty-five seconds, and of the fingers, showing the bones and metallic objects hidden between them and the plate, in ninety seconds, distinct enough to perceive even the eye in a needle that was put in the epidermis. I also tried the fluoride of calcium mentioned by Prof. Winkelmann, of Jena; but I perceived no fluorescence, perhaps because the powder was amorphous throughout. As scheelite is a very cheap mineral, large screens with fluorescent surfaces may be constructed at a trifling expense. L. BLEEKRODE.

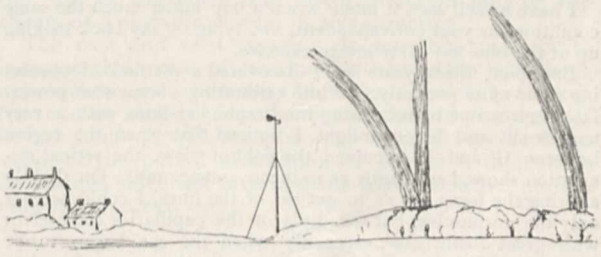
The Hague, April 6.

PERHAPS some of your readers who are practising electrography are not aware that those of them who possess a potassium platino-cyanide screen can diminish their exposures to a quarter of the time now necessary. I tried the experiment yesterday, and have been more than pleased with the results. The *modus operandi* is as follows. The screen is first laid on the dark-room table, platino-cyanide uppermost. A celluloid rapid sensitive film is then placed upon it, gelatine side downwards, and in contact with platino-cyanide. Upon the top of all is placed the hand or other object to be electrographed, and in contact with the celluloid. The whole, including screen, celluloid film, and object, are then raised from the table, and a light tight cloth bag drawn over them and properly secured. This arrangement, exposed under the Crookes' tube in the usual way, gives about four times the speed attainable without the reinforcing action of the screen. The "grain" of the screen shows; but if the salt has been finely powdered before preparing it, this is no great objection. Glass-sensitive plates are of course inadmissible.

Oaklands, Chard, April 13. J. WILLIAM GIFFORD.

Abnormal Rainbows.

ON March 22, about 6 p.m., a rainsquall was passing south-east of this station, and as the sun was shining clear and bright in the opposite quarter of the sky, a rainbow soon appeared. The colours were very brilliant, and a secondary bow was at once seen. From the base of the primary bow a perfectly straight vertical pillar arose of similar width, and the same colours, arranged in similar order from right to left; this was quite as distinct, and persisted quite as long as the usual rainbow, and the singular spectacle of the two rainbows with the vertical shaft attracted considerable attention, and was noticed by a large number of persons. It was described by several as the V-shaped rainbow. The sketch, made by my assistant, Mr. C. Grover, shows it as seen from the East Lodge, Rousdon, over the Coast Guard Station. C. E. PEEK.



Coast Guard Station.

Rousdon Observatory, Lyme Regis, Dorset.

Family Data.

A YEAR ago circulars were printed and cards issued with a view to the formation of a collection of simple measurements on parents and children, which would be of service in testing theories of heredity. In particular, such problems as are dealt with by me in a memoir on regression, heredity, and panmixia (printed in the *Phil. Trans.* of the current year), which treats of biparental inheritance, require statistics far more numerous than have been hitherto available. The measurements are of a simple character, involving but little elaboration, and all that is required is a willing father, mother, and one or more sons or daughters.

Three thousand cards and circulars were distributed, but experience has shown that general distribution is of little practical value. The cards are readily taken, but rarely returned. The only satisfactory method is to find a willing helper who is sufficiently conscious of the importance of the problems of heredity to distribute and collect himself ten or twelve data cards.

Up to the present I have obtained measurements on about 700 families. I am most anxious to reach at least 1000. May I make an appeal through NATURE for such helpers? I am prepared to send full directions and any number of cards to any of your readers who are willing to help. All I would ask is that

they do not merely give the cards away, but themselves collect them and forward to me, as my experience has so fully demonstrated that not 5 per cent. of the recipients will take the trouble of returning them directly to me.

A collection of 1000 family measurements would be of immense value for testing various problems in heredity, and, if it be formed, I shall be only too glad that it should be ultimately deposited where it would be available for all future students of heredity.

It is, perhaps, needless to remark that the measurements required are of normal and not pathological characteristics, and no name except that of the recorder (in case of there being need of reference) is required.

All communications should be addressed to me at University College, London. KARL PEARSON.

University College, London, April 10.

The Retinal Circulation.

THE phenomenon of the retinal circulation, referred to in Mr. James W. Barrett's letter in NATURE of April 2, was, I believe, first described by Dr. Robert Waring Darwin in 1786. He writes:—"By being accustomed to observe such small sensations in the eye, it is easy to see the circulation of the blood in this organ." . . . "It is sometimes necessary to rub the eyes with a certain degree of force after they are closed, and to hold the breath rather longer than is agreeable, which by accumulating more blood in the eye, facilitates the experiment." He further states that it depends on the state of health, is most distinct when the eye is fatigued, and is best seen by looking at the sky, shading the eyes with the hand.

I have myself seen it often when a boy under much the same conditions as your correspondent, viz. lying on my back looking up at the blue sky after severe exercise.

But about fifteen years ago I discovered a method of observing it far more perfectly. While calibrating a somewhat powerful spectroscope by measuring the Fraunhofer lines with a very narrow slit and direct sunlight, I noticed that when the region between G and H occupied the field of view, the retinal circulation showed so plainly as to inconvenience me. On slightly altering the focus, so as to get rid of the lines, I could see not only the corpuscles, but the walls of the capillaries themselves with great distinctness, especially when the eye began to be fatigued. With a sufficiently narrow slit the corpuscles were visible against the other parts of the spectrum, even the red, but they appeared as mere specks, and the outlines of the vessels could no longer be discerned. Judging from this that violet light was more important than a narrow slit, I tried last year the effect of various coloured media. Of these the most successful was ammonio-sulphate of copper. A six-ounce flask, filled with a solution of this substance, held close to the eye about a yard from an arc-lamp, enabled me to see the retinal circulation and some of the vessels, but not nearly so distinctly as with the violet light of the pure spectrum. GEORGE J. BURCH.

Oxford.

JUPITER AND HIS PERIOD OF ROTATION.

A QUESTION which has recently been attracting considerable interest with regard to the greatest of our planets, Jupiter, relates to the determination of the time of rotation deduced from observations of markings on the visible surface of this planet's disc. The difficulty to be contended with here is that the appearance of the markings on the disc is always changing, and further great changes, even in short intervals of time, are noticeable. The chief characteristic features of the disc are the dark belts situated on each side of the equator, resembling to some extent the two belts of trade winds on the earth, which lie on either side of the belt of equatorial calms and rains. More minute scrutiny reveals to us other belts which are sometimes seen in considerable numbers, while their individual structure is by no means simple. These details are for the most part only temporary, and so quickly do changes take place, that the surface of the planet seldom, if ever, appears the same two nights together. Often spots are observed among these belts, which are generally of a more distinct nature than the usual markings; these are for the most part dark, but in some cases they are bright, round, and small, resembling the satellites as they travel across the primary's disc.

The extreme lack of constancy in the positions and forms of all the surface-markings has long ago taught us to cast aside the idea that we are looking at the surface of a rigid body. What we really see is the dense vapour and cloudlike formations between us and the real surface, encircling the whole planet from pole to pole, and always in a state of turmoil. This and other reasons have given us sufficient evidence to form some idea of the temperature of the planet itself, and it is now thought that the internal temperature is considerable, and probably sufficient to render the planet capable of shining to a small extent by its own light.

In consequence of the proper motion of several spots observed on Jupiter's surface and the primitive state of his atmosphere, the planet is said to resemble the sun to some extent. On account of these many points of similarity, Zöllner was led to believe that perhaps a similar law of rotation might here be in vogue which had been proved to hold good in the case of the sun by observations of spots on his surface. Lohse also, some time afterwards, after a minute discussion of all the available evidence, came to a similar conclusion, namely, that Jupiter in the region of his equator rotated quicker than in regions some distance from it.

Now this question is by no means so easy to settle as may seem at first sight. In the first place, in the cases of both the sun and this planet, the spots that are generally visible are confined to two belts north and south of the equator, while the equator and the poles are, for the most part, devoid of all such markings.

In the case of the sun, however, one need not necessarily be restricted to spot observation to determine the time of rotation near the poles, for we possess a very simple means of solving this problem by the application of Doppler's principle. The sun's limb on the east and west sides will be rotating towards and away from the observer, and an examination with the spectroscope of these regions will show us, by measuring the displacement of the lines in the spectrum from their normal positions, the velocities in the two directions. Curiously enough, both Crew and Dunér made investigations on this principle, and the results obtained were by no means the same, but, on the contrary, apparently antagonistic. The former, who observed the photosphere, found that for all latitudes the time of rotation was the same, while the latter, who examined the spots spectroscopically, obtained a decrease in the velocity as their distance from the equator increased. To explain these apparently contradictory results, Brester suggested that it seemed probable that Dunér observed the spectral lines of gases situated inside the photosphere, while Crew's observations were restricted in all probability to gases in those atmospheric layers which lie above the photosphere.

As yet no such observations near the poles of Jupiter have been attempted, although, as will be seen further on, this application of Doppler's principle has been employed for the region near the equator. Fortunately, however, in the year 1892 (October 10) a short dusky streak, oblong in shape, was observed by Stanley Williams near the north limb, extending nearly to north latitude 85°. Other similar streaks have been subsequently noticed, and frequent determinations of the times of mid-transit have been made. By good fortune the observers at the Lick Observatory had secured at the same time some good photographs of the planet, the surface-markings of which, on the negative, were sufficiently distinct for measurement.

A comparison of the times of rotation deduced from both the visual and photographic records seemed to give very satisfactory results, the mean periods differing only

by two seconds. The mean result for the surface material of Jupiter between latitudes 40° to 85° north gave 9h. 55m. 38·9s. ± 1·20s., this being the length of a sidereal rotation expressed in mean solar time. Observations of some dark, well-defined spots in 1891 gave as a value for the period of rotation 9h. 55m. 38·5s., while Denning found (1894–5) the value 9h. 55m. 39·0s., still closer to that given above.

It will be noticed that up to the present the observations of Stanley Williams do not corroborate a reduction in the rate of rotation in higher latitudes, as would be expected from Lohse's discussion. The observations of the two may, however, be harmonised to some extent if, as before, one supposes that they observed markings at different levels in the atmosphere of the planet. If this were so, then very probably Stanley Williams generally watched those markings in the higher regions, while the spots observed by Lohse were situated at a far deeper level, and in which perhaps were strong currents.

A spectroscopic investigation of great interest is that due to Dr. Belopolsky, who undertook the determination of the velocity of a point in the equatorial region of Jupiter. The method of procedure was as follows. He assumed that the equatorial region of this planet made one rotation every 9h. 50m.; knowing the angular diameter of the disc from measures made with the micrometer, he then calculated the velocity of a point on the equator, the resulting velocities being 12 and 13 kilometres per second, according to the special value of the diameter used. The second part of the work consisted in observing the east and west limbs of the planet spectroscopically, using the principle of Doppler to find out the displacement of the lines due to the velocities in the line of sight. The value he obtained was 11·4 kilometres per second, a number smaller than that which would apparently be expected. The great difference between the observed and computed velocity may be due to errors of observation, but its magnitude calls for another explanation. Belopolsky himself prefers to account for this difference by regarding it as a result of refraction, an assumption which is quite permissible, as Schmidt has shown in his theory of the sun.

Perhaps the best idea of the drift of the Jovian surface can be gathered from a summary of the determinations of the length of the period made from surface-markings at different Jovian latitudes. This table we owe to Mr. Stanley Williams, and it appeared in a previous number of NATURE (vol. liii. p. 376). It will be noticed that the nine zones represent practically nine distinct currents in the planet's atmosphere, their boundaries being described as sharply defined. These currents completely encircle the planet, and have an east and west direction; very little indications of motion towards the poles having been noticed.

Zone.	Lat.	Period: In time. h. m. s.	Period: In terms of equatorial period.
I.	+85° to +28°	9 55 37·5	1·0089
II.	+28° ,, +24°	9 54 30	1·0071
		9 56 30	1·0104
III.	+24° ,, +20°	9 48 0	
		9 49 30	0·9973
IV.	+20° ,, +10°	9 55 33·9	1·0089
V.	+10° ,, −12°	9 50 20	1·0000
VI.	−12° ,, −18°	9 55 40	1·0090
VII.	−14° ,, −28°	9 55 40	1·0090
VIII.	−18° ,, −37°	9 55 18·1	1·0084
IX.	−37° ,, −55°	9 55 5	1·0081

Curiously enough, the zone numbered VII., which represents the red-spot zone, has not an equivalent in the northern hemisphere, that numbered III. having a much quicker drift.

Apropos of this red spot zone, we may mention that Mr. Stanley Williams expresses the opinion that the mysterious red spot acts in the same way as, and has some analogy to, an island in a river (*Knowledge*, April). The spot lies between the south equatorial belt and the south temperate belt, and as the white material between these two belts drifts past the red spot with a velocity of sixteen miles per hour, it is obliged to force a passage round the spot. Most of this white material passes to the north side of the spot, making a depression in the south equatorial belt; but some of it finds a way through a very narrow channel on the south side. There is less resistance to the passage of the material on the north side of the spot, probably for the reason that the surface is most plastic in the equatorial regions. As the channels on the north and south sides of the red spot are together narrower than the main channel, there is a heaping up of white material on the following side of the spot and in the channels, and this seems to possibly explain the bright annulus which is frequently seen encircling the red spot. The union of the two currents produces a commotion on the preceding side of the spot, giving rise to the hazy patch which is usually visible in that position. As a working hypothesis, the idea seems likely to be of use in suggesting observations, but it is admittedly difficult to conceive how such an effective obstacle as the red spot can drift about in the way it has done.

The latest observations regarding Jupiter's surface thus show us that the whole disc of vapour that we see is in a state of slow circulation in currents more or less parallel to the equator. The rifts that appear to traverse the disc in the north and south direction may be the effects of a slow circulation in this direction.

The east and west currents do not then necessarily increase their rate of rotation the nearer the equator is approached; but there may be zones of quicker rotation, followed by zones of slower rotation before the equator be reached. It will thus be seen that a very accurate value of the period of rotation of Jupiter is difficult to determine, since the several drifts are in relative motion one with another. W. J. S. L.

THE LIFE OF JOSEPH WOLF.[1]

IT seems now to be rather in fashion to write lives of persons still in existence. In some cases, such as the present, there is little to be said against this practice; in others, it may be open to very serious objections. But when the biography of a living person is given to us by an intimate personal acquaintance, we have, at any rate, one advantage: it may be assumed that the narrative has been more or less supervised by the person to whom it relates, and that the facts and incidents stated are generally correct. Such, we know, is not always the case with biographies of departed heroes.

Joseph Wolf, well known to all zoologists as the "Prince of Animal Painters," and one whom savants and artists alike agree to class as "absolutely unrivalled" in his special department, was the son of a German farmer, or what was formerly called in the south of England a "yeoman," farming his own land at the little village of Möerz, between Trèves and Coblentz. Born in 1820, Wolf was sent to the village school at Metternich, where his observant habits and "superior skill in drawing maps" told favourably with the master. But to his fellow-scholars a boy who "refrained from bird-nesting on principle," and would fight any of them in defence of a nest of young birds, was somewhat of a puzzle. Here, however, Wolf had many opportunities, both during his school-days and in the course of the initiation into farm-life which followed, of studying nature. A fine wild country was around him, where beasts and birds were abundant, and he soon taught himself to observe them,

[1] "The Life of Joseph Wolf, Animal Painter." By A. H. Palmer. Illustrated. Pp. xviii + 328. (London: Longmans, 1895.)

to collect them, to capture them as models, and to draw their pictures. Notwithstanding these facilities, which, however, could only be enjoyed at off-times, the monotonous drudgery of farming became at length unbearable to the nascent artist, and he at length secured his father's consent to desert the plough, and to become an apprentice to the brothers Becker, a firm of lithographers at Coblentz. At the age of sixteen, therefore, Wolf managed to struggle out of agriculture into a profession which had, at all events, an artistic character about it, and a good knowledge of which must have been of paramount value to him in after-life.

FIG. 1.—A Family Group of the Eastern Red-footed Hobby.

His apprenticeship being over, Wolf's second step in life was still more decidedly in advance. As he passed through Frankfort in search of work, his sketch-book at once attracted the notice of Rüppell, the distinguished traveller and naturalist, to whom he had been advised to show it. Rüppell sent him on to Kaup, the director of the museum at Darmstadt, where the young artist ultimately settled. At the same time, Rüppell engaged Wolf to prepare the plates for his "Systematische Uebersicht der Vogel Nord-Ost-Afrikas," upon which he was then engaged. The fifty figures of this volume, published in 1845, were the first lithographs of this sort that Wolf ever produced. They are a little rough in execution, but no one can doubt their truthfulness and artistic merit. The receipt of this book in England quickly attracted the attention of our zoologists, who at once understood that an artist had come into existence who could figure birds in a way hitherto almost undreamt of, and very different from Spix's "Aves Brasilienses," or even the best designs of Temminck's "Planches Colorées."

On visiting Leyden shortly afterwards, Kaup showed the young artist's portfolio of sketches to Schlegel, and Schlegel, who was then engaged on his "Traité de Fauconnerie," immediately secured Wolf's services for that work, to which he contributed eleven or twelve excellent plates. But after a few years at Darmstadt, Wolf came to the conclusion that there would be a better market for his artistic talent in England, where several naturalists of the day required his services. The late G. R. Gray, of the British Museum, was then engaged on "The Genera of Birds," which Mitchell had undertaken to illustrate but could not find time to complete. On Wolf's arrival in London, Gray at once set him to work on the plates of this folio work, in the Insect Room at the British Museum. The *Proceedings* and *Transactions* of the Zoological Society were, at this period, also much in want of a good artist for their better illustration. For the *Proceedings*, commencing in 1848, Wolf drew figures of a large number of mammals and birds, of which we have a list given to us in the appendix to the present work. Wolf continued to supply the illustrations of mammals and birds required for the *Proceedings*, and the greater number of those of birds wanted for *The Ibis* for about twenty years. After this our artist grew rather tired of the minute and technical details required for scientific bird-structure, and it became difficult to persuade him to undertake such subjects except on special occasions, when a new parrot was discovered, or a rare antelope brought home from Africa, of which the artist was assured that no one else could make a proper picture.

Among Wolf's drawings in *The Ibis* will be found some of the very best examples of his excellent handicraft. Hawks and falcons were always favourite subjects of his pencil, and the family group of the Eastern Red-footed Hobby (*Erythropus amurensis*), (Fig. 1.) which we are enabled to reproduce here through the favour of the publishers of the present work, is one of the prettiest of them. Not less attractive is the elegant figure of the Guatemalan Swift clinging to its rocky home (p. 8), while its pendent nests and flying companions are shown in the background. Mammals have also been always equally within the range of Wolf's able pencil, and not even Mr. Stacy Marks

himself can surpass Wolf in the introduction of feeling and humour into pictures of mammal-life.

Although after deserting scientific work Wolf was hardly the less active, and executed a large number of pictures, both in oil and in water-colours, these products of his brain and pencil are not, perhaps, so well known as his earlier work. Wolf was not elected a Royal Academician, as he certainly ought to have been, and very seldom exhibited pictures in the galleries of Burlington House. His splendid efforts are mostly hid away in the palaces and country mansions of certain great patrons, who were always ready to give him full employment. Such mansions as Lilford Hall, Colebrooke, and Guisachan, must be visited by those who wish to examine Wolf's paintings of this class. But, after all, we agree with the biographer that oil is not the material in which Wolf most excels, although it may be as an oil-painter that he prefers to be known. The best of his productions are in water-colour, and in charcoal and chalk. Such, at least, is the opinion of those who regard his work from a scientific point of view.

Before concluding this notice, we cannot avoid alluding to the way in which Wolf's scientific work has been plagiarised in Germany. On turning to the last page of the present volume, the "Royal Natural History" will be found given in the list of the most recent works which Wolf's genius has served to illustrate. Wolf's pictures, however, have arrived here in this instance by a curious route. Originally prepared for the *Proceedings* of the Zoological Society and other works, they were copied by the artist employed on Brehm's "Thierleben." Not only was this done, but in some cases Wolf's initials were removed and those of the copier ("G. M.") inserted in their place. The blocks thus altered for Brehm's "Thierleben" were subsequently purchased by Messrs. Warne and Co. for use in the "Royal Natural History," and have been so employed without the slightest acknowledgment that the designs were originally the products of Wolf's pencil. To prove this, we have only to compare the figure of the "Variegated Spider-monkey," in the "Royal Natural History" (vol. i. p. 64), with the original figure of Wolf in the *Proceedings* of the Zoological Society for 1867 (plate xlvii.). It will be seen that the former figure is initialled "G. M.," but the latter "J. W."

We will now only add an anecdote of Wolf, extracted from Mr. J. G. Millais's recently published "Breath from the Veldt." Mr. Millais, who appears to be as great an admirer of Wolf as his father is known to be, tells us that one day, some years ago, Wolf was busy on one of the superb panels which grace the walls of the late Lord Tweedmouth's Highland residence, Guisachan. Landseer, who was staying at the same house, and who, it should be remarked, was a firm believer in the pre-existence of man in other forms, came up behind Wolf, who was hard at work, and stood gazing at his picture for some time without making any remark. At last Wolf got a bit nervous, and fidgeted about. Then turning round to Landseer, on whom he was afraid the picture had created an unfavourable impression: "Well, Landseer," he said, "you might say something: I'm afraid you don't like it." "Well, not exactly that," was the dry reply; "for I was just thinking that before you were a man, Wolf, you must have been an osprey" (the bird at which the artist was working).

CHARLES CHAMBERS, F.R.S.

WE have already briefly announced the death of Mr. Charles Chambers, who for thirty years has directed the Calàba Observatory of Bombay, and who, by his zeal and ability, has materially increased its reputation, and worthily upheld the cause of science in the East. Mr. Chambers received his practical and scientific training under the late Prof. Balfour Stewart, at Kew; and when, in 1866, he was appointed Superintendent of the Bombay Observatory, the fortunes of that institution appear to have been at a low ebb, and its continued maintenance by the Indian Government open to question. Mr. Chambers's appointment was at first of a temporary character, and his office the thankless one of discreetly covering the shortcomings of his predecessors, and of making the results of their observations available for scientific use. The difficulties which he had to overcome are hinted at in some of his numerous papers, which have appeared as appendices to the volumes issued from the Bombay Observatory, or in the publications of the Royal Society. For instance, in his discussion on the meteorology of the Bombay Presidency, it is mentioned that the whole of the original manuscript registers prior to the year 1847 (the observatory was founded in 1841) had disappeared, that it was doubtful, in some of the printed records, whether the time was referred to the Bombay or the Göttingen Meridian; while other evidences of looseness hindered the preparation, or necessitated the rejection of his predecessors' work.

The magnetic results appear to have been in a more satisfactory condition, and very soon after his appointment he was able to report the probability of their turning out trustworthy and valuable. With the mass of accumulated arrears Mr. Chambers grappled manfully, and in the *Philosophical Transactions* for 1869, the Bombay observations from 1859–1865 are employed to discuss the solar variation of magnetic declination at that station. The energy displayed by Mr. Chambers, and the favourable position of the observatory, intermediate in longitude between Kew and Nertchinsk, induced the Scientific Committee, consulted by the Indian authorities, at the head of whom was Sir Bartle Frere, to continue the grant to the observatory, and to supply it with new instruments of the Kew pattern. Some delay appears to have occurred in sending out these instruments from England, a delay which permitted Mr. Chambers to organise his staff and reduce his arrears.

Trained in the school of Sabine and Stewart, Mr. Chambers's earliest investigations had reference to the possibility of referring the disturbances of terrestrial magnetism to the sun, considered as a magnet with its axis perpendicular to the plane of the ecliptic. The conclusion at which he arrived was that no effect of the sun's action as a magnet is sensible at the earth. This decision, at the time, received the approval of the late President of the Royal Society, and subsequent and more elaborate investigations have tended to confirm the conclusion. This tendency to trace the magnetism of the earth to the sun, induced Mr. Chambers later to investigate, from long series of observations, the solar and lunar variations of the three magnetic elements observed at Bombay, and likewise the effect of sun-spot on terrestrial phenomena. It is not easy to do full justice to the long series of varied researches which have come from the Bombay Observatory under his able direction, or to the heavy loss which that institution sustains in his removal.

Not the least of his services to science is to enable his successor to continue the observatory under more efficient conditions than he himself found, and with a reputation considerably enhanced by his devotion.

NOTES.

A MEETING for discussion will be held at the Royal Society next Thursday; the subject, "Colour Photography," will be introduced by Prof. Lippmann.

A MEMORIAL has been projected in Germany to the late Prof. Hermann Hellriegel, of Bernburg, who died in September last. It is proposed to erect a monument in the churchyard at

Bernburg, where the remains of the distinguished investigator are interred. An appeal for contributions has been issued, and a small Committee, consisting of the President and Secretary of the Bernburg Agricultural Society and Dr. Wilfarth, Hellriegel's colleague in his researches, has been formed to carry out the details. Contributions from this country may be sent to Sir Henry Gilbert, F.R.S., Harpenden, St. Albans.

AT a quarterly meeting of the Council of the Royal College of Surgeons of England on Thursday, April 9, the Jacksonian prize for the year 1895 (open only to Fellows or members) was awarded to Dr. A. A. Kanthack, of St. Bartholomew's Hospital, the subject of the essay being "Tetanus." The Walker prize, for the best work in advancing the knowledge of the pathology and therapeutics of cancer, done either partially or wholly within the five years preceding the year in which the prize is granted, has been awarded to Mr. Harold J. Stiles, of Edinburgh University. The prize consists of a gift of £100—except on this, the first occasion, when it is only £60—and a document declaratory of the award. It is open to foreigners as well as to British subjects, and the Committee are not restricted in any way as to the selection of persons qualified to receive the prize, with the exception that members of the Council are not eligible.

THE following aids to scientific research are announced in the *British Medical Journal*:—M. Renier has bequeathed to the Belgian Treasury the sum of two million francs (£80,000), to be applied to the foundation of a medical institute to be called the "Institut Rommelaere."—A sum of 5,000 roubles (£500) has been granted to the St. Petersburg Medical Academy for the purposes of experiments with the X-rays. A Committee, consisting of Profs. Jegoroff (Rector of the Academy), Tavnezki, Bechtereff, and Ratimorn, has also been appointed to consider the question of the application of Röntgen's discovery to practical medicine.—A new prize has just been added to the long list of those awarded by the Paris Academy of Medicine. The prize is of the value of 24,000 francs (£960), the proceeds of a capital sum of 800,000 francs (£32,000) bequeathed by Mdme. Audiffred for the purpose. It is to be called the "François-Joseph Audiffred Prize," and is to be awarded to any person, of whatever nationality and of whatever profession, who shall within twenty-five years from January 28, 1896, discover a remedy, curative or preventive, recognised by the Academy as efficacious and specific for tuberculosis. In the meantime, the interest accruing from the bequest is to belong to the Academy, and can be applied in any way which that body may think proper.

WE regret to notice the deaths of Prof. F. R. Fava, Professor of Civil Engineering at the Columbian University; Mr. John Gundlach, known for his works on the fauna of Cuba; Admiral Carlo Alberto Racchia, Vice-President of the Società Geografica Italiana; and Baron Negri, first President of the same Society.

THE *Journal of Botany* for April contains a short biographical sketch of the late Mr. T. H. Buffham, who died on February 9, at the age of fifty-six. He was one of the new English botanists who have devoted themselves to the study of Algæ (especially seaweeds), and had made many interesting observations on their mode of reproduction, which have been published in the botanical journals.

THE death is announced in the *Times* of Dr. William Sharp, F.R.S., at the advanced age of ninety-one. He began the study of medicine in 1821, and in 1827 he obtained the diploma of the Royal College of Surgeons. Going over to Paris he attended the University lectures at the Sorbonne, listening to Gay Lussac on physics and Thenard on chemistry. He also attended Orfila's lectures at the School of Medicine. In 1828 Dr. Sharp returned to England, and settled in Bradford; in the ensuing year he was elected surgeon to the infirmary, and in 1837 senior surgeon. In 1843 he resigned his practice in Bradford, and after four years spent in Hull, where he gave winter courses of lectures on chemistry, he went to Rugby in 1847. As early as 1839 Dr. Sharp spoke in favour of local museums. A Philosophical Society was established in Bradford, of which he was elected first President; and his paper on "Local Museums," read before the British Association, led to the establishment of such museums in most provincial towns. He was elected a Fellow of the Royal Society in 1840. It was in consequence of his urgent recommendation that the teaching of physical science was introduced by Dr. Tait into Rugby School, and Dr. Sharp himself became the first "Reader in Natural Philosophy" in 1849 and 1850. From the latter year onwards he gave all his thought and attention to the improvement of the medical treatment of the sick. He made searching investigations into all the systems and schools of medicine, and embodied the results of his studies in a series of "Essays on Medicine," which appeared at irregular intervals, and reached a total of upwards of sixty treatises before his death.

THE Council of the Society of Arts offer the Fothergill Prize of £25 and a silver medal for a paper on "The Best Means of Effectually Preventing the Leakage of Current to Earth in Electrical Installations from Generating Heat and Setting Buildings on Fire." The paper should consist of about eight thousand words, and be written with a view to being read and discussed at an ordinary meeting of the Society. Papers submitted for the prize must be sent to the Secretary on or before October 1, 1896. Each paper must be type-written, and bear a motto, the name of the writer being enclosed in a sealed envelope with a similar motto.

OUR American correspondent writes, under date April 3:—"Prof. Ogden N. Rood, of Columbia College, has reflected the X-rays from platinum, the amount of reflection being estimated at 1/1260th part of the incident rays.

"THE schooner-yacht *Coronet*, which left Brooklyn on December 5, with an equipment for observing the total eclipse of August 9, at Japan, arrived at San Francisco after a successful voyage of 117 days around Cape Horn. Captain James, the owner, and Prof. Todd and his assistants of the Amherst College observation party, will immediately cross the continent by rail, and the yacht will proceed on her voyage in a few days.

"THE Local Committee of the fourth Buffalo meeting of the American Association for the Advancement of Science has been organised, and all the Sub-committees appointed. Mayor Jewett is President, and E. P. Dorr is Local Secretary. The Association will meet on August 24. The city of Buffalo will also entertain this year the National Educational Association, the League of Press Clubs, and the American Public Health Association.

"THE intense cold weather and numerous severe storms of the past few weeks call for special mention. As late as March 24, a man was frozen to death in central New York. On the 28th the most severe snow-storm of the season, and one of the worst ever known, was reported from Quebec. Even after the month of April began, one of the most severe blizzards on record swept over the north-west, with temperature near zero at some places, accompanied by a remarkable snow-fall, sufficient to blockade roads generally, and to cause snow-drifts from ten to twenty feet deep.

"GROUND will be broken this month for the Polhemus Clinic, an adjunct to the Long Island College Hospital. It is the gift of Mrs. Caroline H. Polhemus, as a memorial of her

deceased husband, Henry D. Polhemus. The building will be eight stories high, 67 by 92 feet in dimension, with the top coping 116 feet above the street. The land and building cost over 300,000 dollars, and apparatus and equipment will bring the total cost up to about 500,000 dollars; being, with perhaps one exception, the largest individual contribution to one charity ever made in Brooklyn. The admirable Hoagland Bacteriological Laboratory is in immediate proximity."

WE learn from *Science* that a Bill has been passed by the Legislature of Maryland, and signed by the Governor, entitled "An Act to establish a State Geological and Economic Survey, and to make provision for the preparation and publication of reports and maps to illustrate the natural resources of the State, together with the necessary investigations preparatory thereto." 10,000 dols. annually is appropriated for carrying out the provisions of the Act, and a Commission has been established, composed of the Governor of the State, the Comptroller, the President of the Johns Hopkins University, and the President of the Maryland Agricultural College. At a meeting of the Commission, on March 25, Prof. William Bullock Clark was appointed State Geologist. He will at once begin work in the field.

A MEETING of the Institution of Mechanical Engineers will be held on Wednesday, April 29, and Friday, May 1. The President, Mr. E. Windsor Richards, will deliver his inaugural address on Wednesday evening. The adjourned discussion will be resumed on the same evening upon the paper, "Notes on Steam Superheating," by Mr. William H. Patchell, read at the last meeting. The following papers will be read and discussed on Friday evening: "Steel Steam-Pipes and Fittings, and Benardos Arc Welding in connection therewith," by Mr. Samuel MacCarthy, of London; "Research Committee on the Value of the Steam-Jacket—Experiment on a Locomotive Engine," by Prof. T. Hudson Beare and Mr. Bryan Donkin. The anniversary dinner will take place on Thursday, April 30.

THE spring meeting of the Iron and Steel Institute of Great Britain will be held on Thursday and Friday, May 7 and 8 next, at the Institution of Civil Engineers, Westminster, under the presidency of Sir David Dale. Upon that occasion the Bessemer Gold Medal, which is awarded annually in recognition of meritorious services in advancing the science or practice of the metallurgy of iron and steel, will be presented to Dr. Hermann Wedding, of Berlin. The list of papers down for reading and discussion is a full and comprehensive one, there being no fewer than ten communications on a variety of metallurgical subjects. Prof. Roberts-Austen, C.B., will contribute a paper on the rate of diffusion of carbon in iron, whilst Mr. J. S. de Benneville, of Philadelphia, will read one on some alloys with iron carbides. The application of Mond gas to steel-making will be described by Mr. John H. Darby, and Mr. B. J. Hall will discuss the subject of hot-blast stones. The Baron von Jonstorff, of Neuberg, will read a paper on standard methods of analysis, whilst the hardening of steel will be dealt with by Mr. H. M. Howe, of Boston, and M. F. Osmond, of Paris. Mr. Perry F. Nursey will read a paper on a new process for the production of metallic bars of any section by extrusion at high temperature. The treatment of magnetic iron sand will be brought under notice by Mr. E. Metcalf Smith, of New Zealand, and the iron ores of Oxfordshire will be dealt with by Mr. E. A. Walford.

THE sixty-fourth annual meeting of the British Medical Association will be held at Carlisle on Tuesday, Wednesday, Thursday, and Friday, July 28–31. The officers are as follows:—President: Sir J. Russell Reynolds, Bart., F.R.S., President of the Royal College of Physicians. President-Elect: Dr. Henry Barnes. President of the Council: Dr. J. Ward Cousins. Treasurer: Dr. Henry T. Butlin. The scientific business of the meeting will be conducted in nine sections, of which the respective Presidents are as follows, namely:—(A) Medicine, Dr. George F. Duffey; (B) Surgery, Dr. Alexander Ogston; (C) Obstetrics and Gynæcology, Dr. J. Halliday Croom; (D) Public Medicine, Sir Joseph Ewart; (E) Psychology, Dr. J. A. Campbell; (F) Pathology and Bacteriology, Mr. Sheridan Delépine; (G) Ophthalmology, Dr. David Little; (H) Diseases of Children, Dr. James Finlayson; (I) Ethics, Dr. T. F. I'Anson. An address in Medicine will be delivered by Sir Dyce Duckworth, and one in Surgery by Dr. R. Maclaren.

AN instructive article on "The General Bearings of Magnetic Observation," contributed to the current number of *Science Progress* by Captain E. W. Creak, should be read by all who are interested in terrestrial magnetism. What the article chiefly aims at showing is the great importance of magnetic observations. As an example of the application of the same, it is remarked: "We have now heavily armed, protected steel cruisers steaming over all parts of the world with less change of deviation of the compass than the wood-built *Erebus* and *Terror* of Ross's Antarctic expedition, and this remarkable result could not have been achieved if the terrestrial magnetic observer had not done his work." Still, much more remains to be done before sufficient is known about the secular change of terrestrial magnetism to enable magnetic charts to be provided to navigators for years in advance, just as the tides can now be tabulated for his use.

THE Council of the Physical Society, in a circular issued to the members, call attention to the expense attending the publication of abstracts of physical papers, which has been so successfully undertaken by the Society for a little over a year. The proposals now submitted to the consideration of members with a view to meeting this expense are, firstly, that the annual subscription should be raised to two guineas; secondly, that existing life members should pay an annual subscription of one guinea or an additional composition of fifteen guineas; and, lastly, that an annual guarantee fund should be raised for the next five years to cover the probable deficit. Towards this fund nearly £100 per annum has been already promised. It is universally admitted that these abstracts have proved an incalculable boon to physicists all over the world, and we therefore hope that the last proposal will commend itself to all, whether members or non-members, who appreciate this useful and important work.

A FINE series of photographs of flying bullets, both in free air and in different stages of penetrating through a pane of glass, have been taken in Italy by Dr. Q. Majorana Calatabiano and Dr. A. Fontana, of the Italian Artillery. The apparatus described is a modification of that employed by Prof. C. V. Boys, and these photographs might, perhaps, more correctly be described as skiagraphs, since they are shadow-pictures produced on the photographic plate by the light from an electric spark produced by the discharge of a condenser. The chief peculiarity of the present figures is that, in addition to the anterior wave produced by the advance of the aërial disturbance, they exhibit dark striæ just in front of the projectile—a result not previously observed, and which the authors account for by supposing that the sudden compression of the air causes condensation of moisture producing an opaque cloud. In support of this theory, it is stated that the experiments were performed in a moist atmosphere. This blurred appearance is very similar to that which would be produced by the sparks arising from an oscillatory discharge of the condenser, but the careful precautions adopted by the experimenters to prevent any secondary discharge negative this explanation.

IN two papers which appear in English, in No. 22 of the *Communications* from the Laboratory of Physics at the University of Leyden, Dr. P. Zeeman gives the results of the measurements he has made on the absorption of electrical vibrations in electrolytes. The method employed consists in starting oscillations in a Lecher wire system by means of a Blondlot oscillator; the wires passing for a part of their length through a trough containing the electrolyte. In order to measure the energy of the vibrations at any point of the wire, the arrangement employed by Rubens, consisting of two very small Leyden jars, the outside coatings of which are connected through a bolometer, is used by the author. In a preliminary series of experiments, in which a solution of sodium chloride having a conductivity $3{\cdot}2 \times 10^{-7}$ times that of mercury was employed, it was found that, for oscillations having a wave-length in air of 6·4 metres, and for which the logarithmic decrement (the γ of Bjerknes) was 0·34, the intensity of the oscillations are reduced to $1/e$ of their initial intensity after passing through 5·7 c.m. of the solution. These results were somewhat vitiated by the fact that the deflections of the bolometer decreased as the jars were moved along the wires in the electolyte, but instead of becoming zero they gradually reach a constant value. The result given above was obtained by diminishing all the readings by this constant amount. In a subsequent series of experiments, in which the spark gap of the primary oscillator was altered, this constant deflection was practically eliminated. In this series experiments were also made, using a solution of copper sulphate having the same specific resistance as the solution of common salt, and it was found that in both cases the intensity of the vibrations was reduced to $1/e$ after passing through 5·1 c.m. of the electrolyte. Hence, the author concludes that, in dilute solutions of different electrolytes having equal conductivities, electrical vibrations of the same period are equally absorbed.

THE velocity of an earthquake-wave within a short distance from the epicentre is so difficult to ascertain on account of the large error resulting from a small error in the recorded times, that all estimates with an approach to accuracy are of value. In the Brescian earthquake of November 27, 1894, good time-determinations were obtained at ten stations, all within 445 km. from the epicentre. Assuming the velocity to be uniform in all directions, Dr. M. Baratta calculates it to be 1·411 km. per second. Taking account of the nature and extent of the rock traversed by the earth-wave, he also finds the average velocity to be ·782 km. per second in alluvium, and 1·569 km. per second in the older and more coherent rocks.

A COUPLE of teeth found at Taubach, near Weimar, are claimed by Dr. A. Nehring to be the oldest human teeth yet found in Europe (*Verhandl. Berlin Anthrop. Ges.*, 1896, p. 573). One of these is a milk molar, and the other a permanent first molar of the left lower jaw. The crown of the latter measures 11·7 by 9·9 mm., and has three outer and two inner cusps, besides minor cusps and folds; in this, and in the occurrence of grooves and holes in the outer side of crown, the tooth is remarkably like that of the chimpanzee, but not much like that of the gorilla or orang. Dr. Nehring calls attention to the fact that the first pre-molar and last molar are reduced in size in modern man as compared with early man, and he finds exactly the same in domesticated, as compared with wild, dogs. In domesticated dogs, as in civilised man, the jaw is relatively feebly developed, and there is a tendency to reduction of the last molar.

IN the collection of mammals, made in connection with the recent re-survey of the boundary line between Mexico and the United States, are several which appear to be new to science. In view of the probable delay in issuing the complete report on these collections, advance sheets are being issued containing preliminary diagnoses of the new forms. In one of these sheets, just received, Dr. E. A. Mearns describes as new sub-species *Spermophilus mexicanus parvidens* (Rio Grande Spermophile) and *S. harrisi saxicolus* (Rock Spermophile). The common "Jackrabbit" of the Rio Grande, described by Audubon and Bachman, Baird, Allen, and other writers as *Lepus callotis* and *L. texianus*, is taken to represent a new species, which has been named *L. merriami*. Two new species of mouse, *Peromyscus canus* (Texas grey mouse) and *P. tornillo* (Tornillo mouse), are described, and two new sub-species, *P. texanus medius* (San Dilgo-plains mouse) and *P. t. clementis* (San Clemente mouse).

TECHNICAL bacteriology has received an interesting addition to its list of useful fermenting moulds, in the shape of a recent contribution from Dr. C. Wehmer. At the instigation of and with the assistance of Dr. Went, of Java, Dr. Wehmer has isolated and carefully studied the organism responsible for the production of the well-known Soja (Tao-Yu). So far, it appears to have every right to be regarded as a novelty, although in some respects closely allied to the *Aspergillus oryzæ* of Japanese fame. In designating this organism as *Aspergillus Wentii*, Dr. Wehmer gracefully acknowledges Dr. Went's important share in its discovery and identification. In artificial cultures it is readily distinguished from its Japanese *confrère*, as it produces a pigment approaching a light chocolate in colour, whilst the former elaborates a greenish-yellow growth. The method adopted for its collection is very simple, merely consisting in covering up boiled beans, subsequently superficially sun-dried, with the leaves of *Hibiscus tileacus*; the much-valued *Aspergillus* then invariably makes its appearance on the beans, and the usual process of manufacture is then proceeded with. Curiously no other article of food offers any attraction to the Aspergillus, beans alone serving for its capture. This method of collecting the mould exactly resembles that employed by the Chinese in their process of arrak manufacture. The original memoir is accompanied by some beautiful plates, and one of these shows very clearly the different appearance on rice-cultures of the *Aspergillus oryzæ* and the *Aspergillus Wentii* respectively.

WE have received the first part of a *Handbuch der praktischen Zimmergärtnerei*, by Max Hesdörffer (Berlin: Oppenheim). It appears to be a very complete practical guide to the indoor cultivation of plants, published at a very low price (75 pf. when complete). The present part contains a chromolithograph, and a number of wood-block illustrations of utensils and of gardening processes.

THE Rebman Publishing Company, Limited, have in the press for publication a serial work exemplifying the uses of the new photography in medical and surgical diagnosis, entitled "Archives of Clinical Skiagraphy," by Mr. Sydney Rowland. The first part will consist of six collotypes (10 by 12½ inches), illustrating cases in which the method has been successfully applied to elucidating obscure injuries to the knee, elbow, and other parts of the body. The first plate is a skiagram of the complete osseous system of a full-grown child—the largest subject as yet done.

A NEW local bi-monthly magazine—the *Halifax Naturalist*—has made its appearance, its object being to publish information concerning the natural history and archæology of the ancient parish of Halifax, and to record the doings of the Halifax Scientific Society. The first number contains a coloured geological map of Halifax, by Mr. C. E. Fox, and articles on some physiographical features of the district, by Mr. W. Simpson; the birds of the Luddenden Valley, by Mr. H. Waterford; and the flora of Halifax, by the editor, Mr. W. B. Crump. Such a magazine should awaken interest in the wild life of the parish to which it belongs, and lead to a keener and wider appreciation of the works of nature.

WE have received the meteorological *Jahrbuch* of the observatory of the Magdeburg *Journal* for the year 1894. The results are given in the same form as in the previous twelve volumes, and the work is a good sample of the way in which complete observations and means may be condensed into a compact and convenient form. The first part contains eye observations made thrice daily, and the second part contains hourly observations from self-recording instruments with facsimile traces of the sunshine recorder, and also curves of the barograph and thermograph for periods of disturbance, mostly during thunderstorms. The highest shade temperature recorded during the year was 94°·3 in July, and the lowest 0°·9, in January. The total annual rainfall amounted only to 19·4 inches, and the greatest fall in twenty-four hours was 1·6 inches.

AMONG the papers published in the March number of the *Journal* of the Royal Horticultural Society (vol. xix. part 3, 1896), are three to which attention may profitably be directed here. Mr. Francis Darwin has a paper on "Etiolation as a Phenomenon of Adaptation." Mr. A. W. Sutton contributes an account of the introduction and cultivation of the potato, illustrated by numerous figures. He has made some grafting experiments with the potato and tomato, and describes his results in his paper. As a result of introducing a tomato graft upon a potato stem, the potato roots, maintained in growth by tomato foliage, produced a crop of potatoes in the pot, while the tomato foliage above ground produced a crop of tomatoes, nourished by the potato roots in the pot. In a short paper, Dr. Maxwell Masters describes a number of substitutes for larch. He shows that there are many conifers which more or less fully realise the characteristics of an ideal substitute for larch trees.

WHEN Henri St. Claire Deville, in company with Debray, Morin, and Rousseau Bros., erected the first plant specially designed for the manufacture of aluminium, forty years ago, they did not foresee the greatness of the future of the industry they founded. A sign of the growth of the industry in the United Kingdom is the appearance of a monthly periodical, *Aluminium and Electrolysis*, which will be concerned with all matters pertaining to the manufacture and use of the metal. France and the United States have for some time led the way in aluminium manufacture, and have had their special journals, but no paper primarily devoted to the interests of aluminium has hitherto been published in the United Kingdom. The addition to the ranks of industrial journals is made at an opportune time, for, after a period of quiet, once more increased attention is being given to aluminium in Great Britain.

IT is not given to many scientific discoveries to command so much popular attention as Röntgen's discovery of the X-rays; and the demand for information on the subject has resulted in a copious supply of lectures and literature, while the desire to revel in the marvellous has been gratified by a plenitude of photographs of invisible objects, published in various forms. Messrs. Valentine and Sons have added to their series of collotype view-books a brochure containing reproductions of eight Röntgen photographs taken by Profs. E. Waymouth Reid and J. P. Kuenen at University College, Dundee. A brief description is given of the method of work, and of each photograph. Another publication on the same subject, by August Dittmar, has been published by Mr. F. Bauermeister, Glasgow. This pamphlet contains a general statement of the elementary principles which result in the production of kathode rays and Röntgen photography, illustrated with eleven text-figures and one photograph obtained by means of X-rays.

AMONGST the products of the reaction at 400°-500° of hydrobromic acid upon phosphoryl trichloride, M. Besson (*Comptes rendus*, April 11) has succeeded in isolating the missing phosphoryl chlorobromide $POClBr_2$. This is a solid substance at the ordinary temperature, melting at 30°, and distilling under normal atmospheric pressure at 165°. Its boiling-point is not fixed, however, as it slowly decomposes into the chlorobromide $POCl_2Br$ of Menschutkin and phosphoryl tribromide, a property which renders its isolation by fractional distillation difficult. Besides these two chlorobromides and the tribromide, M. Besson obtained considerable quantities of solid phosphorus pentabromide from the product of the original reaction. The formation of this substance is remarkable, as it involves the replacement of the oxygen of the phosphoryl group by bromine with elimination of water, whereas at ordinary temperatures the inverse change is known to take place with great vigour.

THE additions to the Zoological Society's Gardens during the past week include a Rhesus Monkey (*Macacus rhesus*, ♂) from India, presented by Mr. Owen L. Hancock; a Red and Blue Macaw (*Ara macao*) from Central America, presented by Mr. Eugene E. G. Jones; a Dusky Duck (*Anas obscura*, ♀) from North America, presented by Mr. W. H. St. Quintin; an Indian Elephant (*Elephas indicus*, ♂) from India, two Red-beaked Weaver Birds (*Quelea sanguinirostris*) from West Africa, a Java Sparrow (*Padda oryzivora*) from Java, a Rose-breasted Grosbeak (*Hedymeles ludovicianus*) from North America, a Lesser Black-backed Gull (*Larus fuscus*), British, deposited; a Caffer Cat (*Felis caffra*) from South Africa, purchased.

OUR ASTRONOMICAL COLUMN.

MIRA CETI.—For some years past it has been found that the predicted maxima of this famous variable star, based upon a period of 331 days, have been several weeks in advance of the actual maxima, and it would seem that the time has arrived when a new discussion of its light-curve should be undertaken. According to the ephemeris, the last maximum was due on December 9, but the greatest brightness did not occur until towards the end of January, as shown by the following summary of the observations (*Bull. Soc. Ast. de France*, April):—

Date.	Mag.	Date.	Mag.
Nov. 1-11	9·0	Jan. 15	3·7
15-30	8·2	18	3·5
Dec. 1-10	7·8-7·5	20	3·2
15-31	7·5-6·5	Feb. 1	3·2
Jan. 1	6·0	15	3·4
7	4·8	20	3·6
9	4·2	March 1	3·8
10	3·8	10	4·2

According to M. Dumenil (*Comptes rendus*, March 30), the magnitude at maximum during the last twelve periods has varied between 2·5 and 4·7. This fact, in conjunction with the apparent irregularity of the light-curve, indicates that there is more than one source of variability. On the meteoritic hypothesis the variations are produced by two or more swarms of meteorites revolving round a larger central swarm, and passing through its outlying parts near periastron. On this supposition it may be possible to analyse the light-curve of Mira so as to determine the part played by the individual sources of variation, each of which may be perfectly regular.

AN EXHIBITION OF ASTRONOMICAL PHOTOGRAPHS.—An international exhibition of astronomical photography will form part of the Berlin Industrial Exhibition to be held this year, from May 1 to October 15. Herr F. S. Archenhold, who is arranging the collection, has just sent out a circular asking for contributions of photographs of astronomical instruments of historic interest, of plans and buildings of observatories, as also the reproductions of astronomical drawings and kindred subjects (such as spectra, luminous night-clouds, &c.), lantern-slides $8\frac{1}{2}/10$ cm. in size, or larger, also separate heliogravures already published in the annals of observatories, may be sent in to complete the photographic collection. In all cases, where it is not especially requested that they shall be returned, photographs will be retained and preserved as a complete collection, which, together

with the models of telescopes, made especially for this purpose in the mechanical department of the Grunewald-Sternwarte, will form the foundation for an astronomical museum. It is requested that every photograph shall be furnished with the name of the observatory sending it in, also the exact particulars as to date and time of exposure, method of developing, name of object, and any thing of interest connected therewith. It would also be desirable to state on the backs of the photographs, if, and in what publication, any further particulars may be found concerning the same subject. Though the exhibition opens on May 1, any pictures, which owing to the distance of the observatory sending them, should not arrive by that date, can be received at any subsequent period. As, however, a catalogue is to be completed by July 1, it will be to the interest of exhibitors to see that their contributions arrive in Berlin on July 15 at latest. Particulars as to the number and extent of intended contributions should be sent as early as possible to Herr F. S. Archenhold, Grunewald-Sternwarte, bei Berlin.

THE SUN'S ROTATION.—Two methods have hitherto been chiefly employed to determine the period of the sun's rotation, namely, observations of sun-spots and determinations of the displacements of lines in the spectrum of the sun's limb. A third method, depending upon the movements of faculæ, has recently been utilised by W. Stratonoff (*Ast. Nach.*, 3344). His results are based upon an investigation of 400 photographs of the sun, taken during 1891–1894, and the number of daily angular movements available for discussion amounts to 1024, after rejecting those in which identifications on successive photographs were at all uncertain. All the facts which are brought together clearly indicate that faculæ in different heliographic latitudes move with different velocities, and that the rate of movement diminishes in passing from the equator towards the poles. In the zone 10°–19° the retardation amounts to 0°·37 per day as compared with the equatorial angular velocity, while in the zones 20°–29° and 30°–40° it is 0°·47 and 1°·0 respectively. The law of variation of the velocity of the faculæ with the latitude is much more complex than in the case of spots; from 0° to 8° the angular velocity is almost constant, from 9° to 16° it decreases very rapidly, between 16° and 25° it remains nearly uniform, while from 25° to 34° it again diminishes quickly. Similar results are obtained for both solar hemispheres. The faculæ appear to move more rapidly than the spots in all solar latitudes from 0° to 40°, as shown by the following mean values :—

Heliographic latitude.	Diurnal angle of rotation. Faculæ.	Spots.
° °	°	°
0–9 ...	14·61 ...	14·30
10–19 ...	14·24 ...	14·15
20–29 ...	14·14 ...	13·83
30–40 ...	13·61 ...	13·40

The spectroscopic measurements made by Dunér indicate that the photosphere rotates even more slowly than the spots, and the following comparison shows the relation of the surface rotation with that of the faculæ :—

Heliographic latitude.	Diurnal angle. Stratonoff.	Dunér.
°	°	°
0 ...	14·61 ...	14·14
15 ...	14·24 ...	13·66
30 ...	13·87 ...	13·06

So far as the available data permit any conclusions to be drawn, it thus appears that there are three distinct laws of rotation for what in all probability correspond to three different solar levels.

THE TSETSE FLY-DISEASE.[1]

FOR forty-six years the Tsetse fly has been notorious as a terrible scourge to live-stock, and the most formidable of impediments to colonisation in Equatorial and South Africa. First brought into prominent notice by the explorers Gordon-Cumming Oswell and Captain Vardon, it was described by Westwood[2] in 1850, under the name *Glossina morsitans*, from specimens collected by the last-named traveller. The genus, an ally of our common blood-sucking *Stomoxys*, contains six described African species, for all of which Tsetse appears now to serve as a common name.

The peculiarities of the fly and "fly-disease" have been made familiar by most other African travellers, Livingstone, Andersson, Chapman, Selous, &c. The Tsetse (Fig. 1) is a dipterous insect, of no striking appearance, grey, with darker stripes on the thorax, and a pale or yellowish abdomen furnished with two dark spots on the anterior portion of each segment; it is rather larger than the house-fly, but is narrower when at rest, the wings overlapping. The mouth-parts form a powerful, piercing and suctorial beak. Local in distribution, the fly occurs in numerous detached regions of Africa south of the Equator, its headquarters appearing to be along the Zambesi and its tributary the Chobe. "Fly-country" is hot, moist and low alluvial ground, along river-banks, covered with forest or scrub vegetation, and uninhabited save by wild animals. Within its sharply-defined limits, which may extend along one bank only of a river, the Tsetse swarms; it is extremely active, and eagerly attacks man or animals for the purpose of sucking blood. On man no effect is produced beyond temporary irritation, of which the extent has been very variously described, probably in accordance with the idiosyncrasy of the victims. Wild animals do not suffer; but domestic animals, which have entered fly-districts, are seized in the course of a few days with fever and wasting, and almost invariably die. Horses and dogs rapidly succumb, while goats, donkeys and unweaned calves are said by some travellers to be resistant; this, however, is not generally true of the two former kinds. Slight non-fatal attacks confer no immunity, but some native breeds of dogs enjoy partial protection, although a certain number of pups

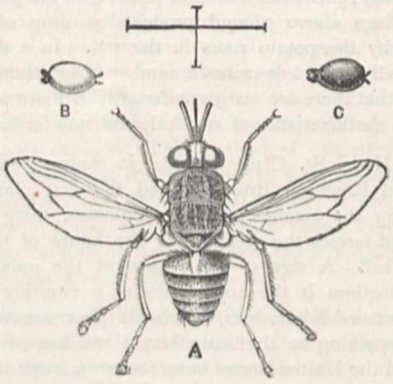


FIG. 1.—A, Tsetse fly (*Glossina* sp.), Transvaal; B, larva; and C, puparium of a Tsetse (after Bruce).

in each litter perish. Books of African travel are full of records of horses, teams of oxen, or herds of native cattle having been destroyed by entering fly-districts, and on one occasion a Masai army, proceeding to the attack of a neighbouring tribe, was effectually routed by having incautiously crossed fly-country.

For some years the accounts of fly-disease were not seriously questioned, until in 1870 a Mr. St. Vincent Erskine[1] endeavoured to show that it was due solely to change of grass or climate, and severely criticised Livingstone's account, forgetting that the proper course lay in attempting to reconcile the apparent discordance between his own and other observations. Since then Hartmann, Marno, Falkenstein and other travellers who found either the fly present and disease absent (as on the Loango coast), or the reverse, have further discredited the earlier statements, and so eminent a dipterologist as Van der Wulp,[2] in summarising the evidence, has concluded that the Tsetse is not injurious, or that its ill-effects are exaggerated. Nevertheless travellers, especially in the Zambesi district, whilst adding nothing to our knowledge, have constantly reaffirmed the connection between the fly and the disease.

One or two naturalists have indeed hit the truth, and among them Schoch, who in an ably-reasoned little paper[3] concluded that the facts pointed, not to the action of a specific fly-virus, as was originally supposed, but to the transmission of a bacterial

[1] "Preliminary Report on the Tsetse Fly-Disease, or Nagana, in Zululand." By Surgeon-Major David Bruce, A.M.S. (Bennett and Davis, Field Street, Durban.)

[2] *Proc. Zool. Soc. Lond.*, 1850, pp. 258–270.

[1] Paper read before the Nat. Hist. Assoc. of Natal, reported in *The Entomologist*, v. p. 217.

[2] *Tijdschr. Ent.*, 1884, pp. 143–150.

[3] *Mitth. Schweiz. ent. Ges.*, 1884, pp. 685–686.

poison-matter. It will be seen that this conclusion is substantially correct.

Mysterious as has been the connection between the Tsetse and the animal-disease endemic in its haunts, there has been never any reason to doubt that a properly-conducted investigation would throw much light on the subject. At last, on behalf of the Natal Government, such a research is being made by Surgeon-Major Bruce, and the results of the first three months' work are just published. They are of great interest, and are full of promise that our knowledge of this disorder will be placed at least on a level with that of kindred diseases.

Dr. Bruce, in a somewhat brief recapitulation of the characteristics and habits of the fly, adds one important new fact, of which he appears scarcely to recognise the significance. The fly investigated, which is not necessarily Westwood's species, is viviparous, giving birth to an adult larva (Fig. 1, B), which creeps about actively in search of a hiding-place, where, in the course of a few hours, it changes by the usual skin-hardening to a jet-black puparium (Fig. 1, C). Hitherto the accounts of Bradshaw and Chapman have asserted, on native authority, that the maggot lives in buffalo-droppings, and a statement of Edwards, quoted by Castelnau,[1] that the Bushmen declared and demonstrated the Tsetse to be viviparous, has gone almost unnoticed.

This fresh observation must be accepted with some reserve, as the fly has not yet been bred from the puparium. Assuming it to be correct, it is of two-fold interest; the mode of reproduction is substantially that which exists in the Pupipara, though, to judge from Dr. Bruce's account and rough figures, the newly-extruded Tsetse-larva, though equally mature, is somewhat less abnormal than that, for instance, of *Melophagus*.[2] A transitional series from oviparous forms has been described in Muscidae by Portschinsky,[3] and viviparous Oestridae are well known to occur. Nevertheless, this peculiarity of *Glossina*, which could not have been prognosticated on systematic grounds, sufficiently demonstrates the unsoundness of separating the Pupipara from Muscidae on account of developmental differences.

Moreover it shows that the Tsetse, unlike most blood-sucking insects, such as the flea or mosquito, is absolutely dependent for its continued existence upon the food taken in the imaginal state, and, unless it is capable of feeding upon other matters than blood, which, though unlikely, should not be disregarded in the inquiry, its life is bound up with that of the indigenous mammalia. And this both confirms and explains the observation made by Livingstone, Selous and others, that it is constantly associated with large game, such as the buffalo, and ceases to frequent districts from which they retreat.

Fly-disease or Nagana (a Zulu term, aptly signifying to be low or depressed in spirits) is due, according to Dr. Bruce, to the presence in the blood of a flagellated infusorian. This hæmatozoon (Fig. 2) is of elongate form, about 10–20 μ long by 2 μ wide, furnished with a membrane or "fin" running along one side of the body, and a flagellum at one end.

It is intimately allied to, if not actually identical with, *Trypanosoma evansi*, the hæmatozoon of "Horse Surra." At present Dr. Lingard, the leading authority on that Indian animal-disease, hesitates to regard the two complaints as the same, because Surra does not attack cattle. But when it is recollected that Nagana pursues a much slower course in cattle than in horses, and that wild game are immune to it, just as African sheep are to anthrax, the objection does not seem very formidable.

The hæmatozoa of Nagana make their appearance, which is signalised by a rise in temperature, in the blood after an incubation period of 7 to 20 days, swimming actively among, and apparently "worrying" the corpuscles. With the progress of the disease they increase in numbers and, at the time of their host's death, may amount, in the dog, to 310,000 per cub. mm. of blood! Neither reproductive nor any other stages of the parasite are yet known, nor has it been found in the blood of any wild animal, inoculation of which (the best test for the presence of the hæmatozoon) has hitherto failed to produce disease.

Dr. Bruce has demonstrated that it is possible repeatedly to feed Tsetse on a healthy dog without producing disease in that animal—that is, the flies possess no specific venom; but that, if allowed to draw blood from a diseased animal or the carcase of one, they will communicate Nagana to any healthy animals on which they are subsequently fed, and the same result is obtained by inoculation of diseased blood, or, in dogs, by feeding them on the flesh of an animal dead of Nagana.

Thus far is the cause of the disease ascertained, as is the fact that the Tsetse can serve as a transmissive agent; but the natural source, other than diseased animals, which are not known to occur in a wild state, whence the flies obtain the parasite is still undetermined, nor is it proved that, unlike malaria, the disease cannot be acquired by breathing the air of the fly-country.

Repeating an old experiment of Captain Vardon's, Dr. Bruce has shown that a few hours' sojourn in a fly-district is sufficient exposure to induce the disease in a horse, which is prevented from eating and drinking there; but to complete the proof that the flies are indispensable as carriers of infection, it has further to be shown that domestic animals, if protected from their bites, can remain in such a region with impunity. As yet Dr. Bruce has not been able to make the experiment, but it may be observed that the concurrent testimony of many travellers, that animals can safely cross a fly-country on nights when the insects are inactive, goes to prove that the infection is not air-borne.

If Dr. Lingard's very voluminous report on Surra[1] be compared with the one under consideration, the points of identity between the two diseases will be found to be remarkably numerous, though not quite universal, and the fact that two such investigations are in progress by workers in touch with each other ought materially to quicken and extend the results arrived at. The complete life-history of the Surra parasite has yet to be published, and in discussing the ætiology of that complaint, Dr. Lingard attaches much importance to the eating of grass from swamps and marshy ground, and the drinking of stagnant water, and but little to fly-infection, which he considers to occur chiefly when healthy and diseased horses are crowded together. Such infection is, therefore, regarded as being of the purely transmissive form of fly-inoculation found in anthrax and possibly other septic diseases.

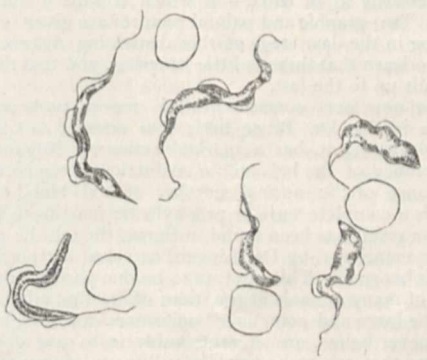


FIG. 2.—Hæmatozoa of Nagana in the blood of a horse (after Bruce).

But a more intimate relationship of the fly and the parasite, at least in Nagána, suggests itself. In 1884, Dr. Manson showed[2] that the mosquito is the intermediate host of filaria, and applying his observations to the building-up of a working hypothesis as to the life-history of the malaria parasite (Laveran's hæmacytozoon) outside the body, he suggested, in 1894, that the mosquito also served as host for that form, and that the "flagellation-stage" assumed by a certain number of the parasites in drawn blood was an incipient change designed for life in the mosquito. In a course of lectures,[3] in process of being delivered as we write, for the unpublished text of which we have to return him our warm acknowledgments, this theory is developed in greater detail, and is supported by the observations of Surgeon-Major Ross, that examination of the blood imbibed from a malarial patient by mosquitoes shows, shortly after its extraction, that not a few, but the majority of parasites undergo flagellation. That the destiny of the flagella is still untraced is due to the extreme difficulty of the observations.

Dr. Manson's theory still awaits its final proof or disproof,

[1] *Compt. rend.*, 1858 (1), pp. 984-986.
[2] Leuckart, *Abh. Naturf. Ges.* Halle, 1858, pp. 145-226; and Pratt, *Arch. Naturg.* 1893, i. pp. 151-200.
[3] Osten Sacken, *Berl. ent. Zeitschr.*, 1887, pp. 17-27.

[1] "Report on Horse Surra," vol. i. (Bombay, 1893); and "Summary of further Report on Surra." (Bombay, 1895).
[2] *Trans. Linn. Soc.* (2), II. pp. 367-388, pl. xxxix.
[3] "The Goulstonian Lectures on the Life-History of the Malaria Germ outside the Human Body," delivered before the Royal College of Physicians of London, March 1896, by Dr. Patrick Manson.

and has been developed to a stage in which, failing the latter contingency, it is likely to be widely accepted. Assuming it to be correct, man occupies to the parasite the position of what he terms an "optional host," in which parasitism is neither necessary for nor inimical to the continuance of the species.

Another case of such possible relationship may be mentioned. In 1889, it was shown by Drs. Smith and Kilborne [1] that the so-called "Red-water" or "Texas fever" of cattle is a disease of malarial type due to the presence in the red blood-corpuscles of bodies presenting a certain similarity to Laveran's parasite. In this disease the sole form of infection known is by the agency of cattle-ticks (Ixodidæ), in which, notwithstanding their undoubted transmissive part, we believe the entozoon has hitherto not been detected in any stage.

Without attempting in any way to prescribe a line of research which Dr. Bruce is unlikely to overlook, it is impossible not to foreshadow the interest which will attach to an examination of the evolutions of the parasite in the body of the Tsetse, an examination which may end by showing that the insect, even if it possesses no specific virus in the older sense, may play an essential part in the economy of the hæmatozoon.

The symptoms, course, and pathology of Nagana are treated very fully by Dr. Bruce in a series of clinical cases, accompanied by charts indicating the variations of temperature, and the percentages of red blood-corpuscles and hæmatozoa. Suffice it here to say that the red blood-corpuscles may be reduced to one-third of their normal amount, and in one dog, at the point of death, bore to the parasites the proportion only of ten to one. He finds it invariably fatal in the horse, ass and dog—perhaps not necessarily so in cattle—in which it runs a much slower course. Two graphic and painful pictures are given of a donkey and a dog in the last stage of this distressing disease, and one is glad to learn that there is little suffering, and that the appetite rarely fails up to the last.

Of the new facts contained in this report, perhaps the most welcome is that Dr. Bruce finds that arsenic, so far as he has been able to try it, has a marked action on Nagana, causing disappearance of the hæmatozoa, reduction in temperature, and maintenance of the normal number of red blood-corpuscles. That it is a complete cure or prophylactic remains to be shown. The same result has been found in Surra, though the proportion of cases mentioned by Dr. Lingard as cured by treatment with arsenic is but small. This appears to be due partly to the extreme debility of many animals at the time of its first administration, and to the large and sometimes poisonous doses required. Its effects, nevertheless, are so remarkable as to give good ground for hoping that, when the limits of utility and safety of the drug, especially as a preventive, or in the early stages of disease, are determined, the trivial addition of a supply of arsenic to the traveller's outfit will free the African colonist of, perhaps, his greatest source of anxiety.

In Surra attempts have been made to treat the disease by inoculation or injection of filtered serum from affected animals. They have not proved successful, nor, while admitting the importance of the fact that the range of forms attacked by it and Nagana is limited, is there any *à priori* reason why they should succeed. The class of diseases here noticed, of which malaria may be taken as the type, is not caused by bacteria; and though it is known that the vitality of hæmatozoa is affected by alterations in the medium in which they live, as by the administration of quinine or arsenic, the ordinary methods of research and antitoxic treatment employed in bacteriology do not appear to be applicable to them.

In view of a tendency in the reports, both of Dr. Bruce and Dr. Lingard, to dwell in detail upon the clinical features of the respective diseases, it cannot be too strongly urged that, when once the pathogenic nature of the hæmatozoon has been established, these inquiries, in order to progress to a fruitful issue, must be conducted on zoological lines. The mode of reproduction, distribution and general bionomics of the hæmatozoon, and, in the event of its possessing more than an accidental connection with the Tsetse, the economy of that insect, these are the essential subjects of research: and little light will be thrown on them by any amount of laboriously-compiled clinical and pathological details.

It is to be desired that Surgeon-Major Bruce's further and more complete reports shall be republished in England, or at least made easily accessible to the many persons interested in African colonisation. WALTER F. H. BLANDFORD.

[1] *Ann. Rep. U.S. Sec. Agric.*, 1889, pp. 88-91: 1890, pp. 92, 93, and 105-110; and following year.

THE ACTION OF LIGHT ON THE IRIS, DEMONSTRATED BY A NEW PUPILOMETER.

BROWN-SÉQUARD observed that, in the iris of batrachians and fishes, separated from the rest of the eye, the pupil contracts at the approach of a candle, a fact which he attributed to the direct action of the light on the muscular tissues of the iris, the nervous elements having already lost, as he thought, at the times of his experiment, all irritability. We may also ask if the iris of the living eye responds to the direct action of light.

This problem cannot be approached directly, because of the mobility of the eye and the extreme variability of the pupil.

My new pupilometer, constructed by the well-known engineer, Mr. Ph. Pellin, consists of a series of three tubes of increasing diameter, commencing with the ocular tube; the first is provided with a screen perforated by a very small hole, and with an adjustable frame which may be removed or brought near in a manner to fix the eye at the required distance (12·8 mm.), of the anterior focus of the eye. The last tube is closed by a ground glass, 10 cm. in diameter; on the surface of this glass appear black and white circles with numerical graduations. All the peripheric zones of the ground glass which are not perceived by the retina illuminate the iris. In this manner I am able to distinguish the effect produced upon the pupil by suppressing the illumination of a portion of the iris by means of opaque rings of blackened copper successively arranged upon the glass, the apertures of which are precisely equal to the apparent surfaces of the pupil, and then suddenly removed. For the retina nothing is changed by changing these rings, since the opening of each ring equals precisely the apparent surface of the luminous admission; for the iris, on the contrary, all is changed, since the opacity of the interposed rings prevents the luminous rays from reaching it.

The experiment made under these conditions proves that there is almost always a dilatation of the pupil when the iris is withdrawn from the light. The process may be described as follows. The subject is requested to indicate the largest concentric circle that he is able to distinguish on the luminous background, whereupon I place against the background an opaque ring, the opening of which equals precisely the said concentric circle; after a few moments I remove the ring, and then the subject generally remarks the coincidence of the apparent surface of his pupil with a concentric circle of much greater diameter. I have noticed but two exceptions to this rule where the result was a contraction instead of enlargement. The dilatation varies from $\frac{1}{8}$ to $\frac{1}{18}$ of 1 mmq. for 1 mmq. of iris withdrawn from the light, and such dilatation has generally been observed to be greater for the dark than for the light iris.

The great majority of dark eyes which prevails in southern latitudes is perhaps a provision of nature to thus protect the eye from the effect of too abrupt changes of luminous irritation.

In any case the variations of dimensions of the iris are much less when it is the iris alone which is subjected to light than when the iris and the retina are influenced together. It may be shown, for instance, that if 1 mmq. of the centre of the retina be withdrawn from the light, the iris is capable of increasing in size from 1 to 16 mmq.

If, with the pupilometer of Robert Houdin, we observe the pupil of one eye while the iris of the other is obscured, we remark on the said pupil a dilatation from half to quarter of a millimetre in diameter; this goes to prove that the action of light on the iris is due, in part at least, to a reflex of cerebral origin; but, on the other hand, we do not yet possess sufficient knowledge of the anatomy of the iris to enable us to say whether these variations are due to the direct action of light on muscular elements (as supposed by Brown-Séquard) or to the action of nervous centres yet unknown belonging to the iris.

I have studied the influence of a coloured disc on the pupil, allowing the coloured light to strike the retina, in which cases I remarked that the more luminous the colours the less the dilatation of the pupil: yellow and green, for instance, cause a greater dilatation than red or blue. Again, I have remarked just the contrary. The same contradictions, which may be explained by the fatigue of the eye, are manifest when we examine the isolated action upon the iris of rings cut from the same block as the aforesaid coloured disc.

I have also endeavoured to find with the new pupilometer the

relation existing between the pupillary contraction and the illumination of the retina.

The discovery of the direct action of light upon the iris leads to a number of curious deductions.

1. We are now able to explain the cause of the intense photophobia which characterises the iritis, and it is probable that the examination of the iris by the new pupilometer from the point of view of its proper excitability will be very useful in the diagnosis of diseases of the eye.

2. It shows that our photometric measurements must involve a systematic error, although slight. When the eye is directed towards the most luminous of two lights of different intensities the iris contracts, tending thus to equalise for the retina the two lights. It is in this movement of the iris perhaps that we should seek an explanation of the contradictions which we meet continually between the data of our photometric processes and the data furnished by sensitive plants employed in the measurement of light. We know, for instance, that a branch of *vitia sativa* placed between two lights equal for our eye and equidistant from each other tends invariably to incline towards one of them. CHARLES HENRY.

IMMUNISATION AGAINST SERPENTS' VENOM, AND THE TREATMENT OF SNAKE-BITE WITH ANTIVENENE.[1]

I.

FROM a remote period of antiquity, there has been enmity between the human race and serpents, and, in a literal sense, man has bruised the head of the serpent, and the serpent has bruised the heel of man. This long-continued feud has not yet resulted in victory for either side. Venomous serpents still annually destroy the lives of tens of thousands of human beings, and, in self-defence, tens of thousands of serpents are annually slain by man.

The progress of knowledge has greatly increased the means for protecting mankind against the death-producing effects of many diseases; and, although these means have been liberally employed in the contest against venomous serpents, none of them has hitherto been found sufficient.

The reality of the contest is appreciated when we find pervading medical literature from its earliest beginnings—from the time of Pliny and Celsus—to the present time, disquisitions on the treatment of the bites of venomous serpents, and lengthy descriptions of the numerous remedies, organic and inorganic, that have been used for this purpose. Although extended experience and the application of the scientific methods of the present day, have resulted in showing that each of these remedies had been recommended on insufficient grounds, we may hesitate in pronouncing their recommendation to have been premature, in view of the impossibility of waiting, in the presence of imminent dangers, until accurate demonstration has been obtained by the usually tardy and laborious processes of science.

Let me pause here for a few minutes to indicate the practical importance of a scientific demonstration of the value of any remedy that is used in the treatment of snake-poisoning.

When a serpent inflicts a wound, I need scarcely say that it is not the wound, but the venom introduced into it which causes the symptoms of poisoning, and the death that may result. This venom is now known to be a complex mixture, containing several non-poisonous as well as poisonous substances. The latter are not ferments and have no power of reproducing themselves in the body, but they are substances that produce effects having a direct relationship to the quantity introduced into the body. This quantity in the case of each serpent varies with its size and bodily and mental condition; with the nature of the bite—whether both fangs or only one have been introduced, whether they have penetrated deeply or only scratched the surface; and with other circumstances related to the serpent, such as whether it had recently bitten an animal or not, and thus parted with a portion or retained the whole of the venom stored in the poison glands.

A bite may, therefore, result in very little danger, or it may be rapidly fatal; but, in order to produce death, there must have been introduced into the tissues at least a certain quantity of venom, which is spoken of as the minimum-lethal quantity or dose. The minimum-lethal quantity for the animal bitten, again, is different for different species of animals, and different also for different individuals of the same species, the chief cause of difference between animals of the same species being the body weight of the individual, the quantity required to produce death being very exactly related to each pound or kilogramme of weight.

If even a minute fraction below the minimum-lethal has been introduced into the tissues by an effective bite, death will not follow, although serious and alarming symptoms will be produced of exactly the same kind as those which follow a bite which terminates fatally.

How then can we be assured, in any case of snake-bite in man, that a quantity of venom sufficient to produce death has been introduced? It is impossible to answer this question except by the result. If a quantity less than the minimum-lethal has been introduced, although the gravest symptoms may be produced, the patient will recover whatever remedies are administered, provided, obviously, that the remedies have not been so injudiciously selected or used that they themselves, and not the insufficient quantity of venom, produce a fatal termination. The recovery of a patient after the introduction of less than the smallest quantity of venom capable of producing death, has thus too often been attributed to the remedies that have been administered; and consequently, as, indeed, is exemplified in the treatment of many diseases, a large number of substances have acquired an unjust reputation as antidotes. The list of antidotes has, accordingly, become a very large one; but when their pretensions have been subjected to sufficient tests, the verdict is that all of them are valueless to prevent death when even the smallest quantity of venom required to produce death has been received by an animal.

Without entering into details, I will content myself with reproducing the opinion of Sir Joseph Fayrer, that, "after long and repeated observations in India, and subsequently in England, I am forced to the conclusion that all the remedies hitherto regarded as antidotes are absolutely without any specific effect on the condition produced by the poison."

But while medical practice and science, in each period of its development, has thus failed to protect man against this ancient enemy, legendary traditions, the tales of travellers and of residents among nations and tribes existing outside of the civilisation of the time, at least suggest that, by means apart from the use of remedies, some measure of success may actually have been obtained.

Many of these legends and statements are probably of great significance, and, in connection with facts derived from experiment, which to-night I have to describe, they possess a deep interest.

We learn from these legends that from a remote period of time the belief has existed that a power may be acquired by man of freely handling venomous serpents, and even of successfully resisting the poisonous effects of their bites.

The Psylli of Africa, the Marsi of Italy, the Gouni of India, and other ancient tribes and sects, were stated to have been immune against serpents' bites, and this immunity has been explained on the supposition that serpents' blood was present in the veins of the members of these tribes and sects.

In more modern times and, indeed, at the present day, the same belief is expressed in the writings of many travellers. In "A New and Accurate Description of the Coast of Guinea," by William Bosman, published in 1705, an account is given of the great "reverence and respect" of the negroes for snakes, worshipped by them as gods; in connection with which the following statements are made. "But what is best of all is that these idolatrous snakes don't do the least mischief in the world to mankind; for if by chance in the dark one treads upon them, and they bite or sting him, it is not more prejudicial than the sting of millipedes. Wherefore the natives would fain persuade us that it is good to be bitten or stung by these snakes, upon the plea that one is thereby secured and protected from the sting of any poisonous snake" (p. 379).

At Southern Africa, the Rev. John Campbell, in 1813, observed that it was "very common among the Hottentots to catch a serpent, squeeze out the poison from under his teeth, and drink it. They say it only makes them a little giddy, and imagine that it preserves them afterwards from receiving any injury from the sting of that reptile" (p. 401).

Drummond Hay, in his work on Western Barbary, pub-

[1] An address delivered at the Royal Institution of Great Britain, on Friday, March 20, by Prof. Thomas R. Fraser, F.R.S.

lished in 1844, gives a description of the performances by members of a sect of snake-charmers, called the Eisowy, who freely handled, and allowed themselves to be bitten by serpents proved to be venomous by a rapidly fatal experiment performed on a fowl. At the termination of the exhibition, the Eisowy, apparently as a usual part of the performance, "commenced eating or rather chewing" a poisonous snake, "which, writhing with pain (to quote Mr. Hay's words), bit him in the neck and hands until it was actually destroyed by the Eisowy's teeth." He states that, on another occasion, at Tangier, a young Moor, who was witnessing the performances of a snake-charmer, ridiculed his exhibition as an imposture, and having been dared by the Eisowy to touch one of the serpents, the lad did so, was bitten by one of them, and shortly afterwards expired. In connection with my subject, a special interest is attached to the account given by Mr. Drummond Hay, and repeated in its main features by Quedenfeldt in the *Zeitschrift für Ethnologie* of 1886, of the origin of this Eisowy sect, and of the immunity which they claim. The founder, Seedna Eiser, was being followed through the desert of Soos by a great multitude, who, becoming hungry, clamoured for bread. On this, Seedna Eiser became enraged, and turning upon them he uttered a common Arabic curse, "Kool sim," which means "eat poison." So great was their faith in the teaching of the saint, that they acted upon the literal interpretation of his words, and thereafter ate venomous snakes and reptiles; and from that time they themselves and their descendants have been immune against serpents' bites (p. 65).

Dr. Honigberger, in his "Thirty-five Years in the East," published in 1852, relates the incident of a faqueer who was bitten by a serpent, and to whom he at once sent medicines which he judged likely to prevent the ill-effects of the venom. "On the same afternoon," he writes, "I visited him and found him in good spirits. I at first attributed the circumstance to the effect produced by the remedies I had sent him, but was surprised on hearing that he had not taken them, he being of opinion that the venom of the serpent was incapable of affecting him, inasmuch as he had often been bitten by serpents without having sustained any injury." On the suggestion of the faqueer, the same serpent, which had been caught and retained, was allowed to bite him again, and afterwards to bite a fowl. This fowl was taken home by Dr. Honigberger, and he found it dead on the following morning, "although the faqueer, who was bitten first, was quite well" (p. 135).

Nicholson, in his work on "Indian Snakes" (1875), and Richardson, in his "Landmarks of Snake-poison Literature" (1885), also narrate instances, the latter with obvious disbelief in their reality, suggesting that snake-charmers may possess some means for protecting themselves against the bites of venomous serpents.

Many other examples might be quoted in which this suggestion is made. The attention which has been drawn to the subject during the last twelve months has prompted the publication of other instances, such as that related by Dr. Bawa, of a Tamil snake-charmer who, in the course of his performances, was bitten by a cobra without any effect, while an onlooker, foolishly repeating the performance, was bitten by the same cobra, and died in three hours; and the description given by M. D'Abbadie, in a recent issue of the *Comptes rendus*, of the custom, recently prevailing at Mozambique, of inoculating with serpents' venom, under the firm conviction that protection is thereby produced against the effects of serpents' bites.

It may be instructive to associate with these statements the belief that venomous serpents are themselves protected against the effects of bites inflicted upon them by individuals both of their own and of other species. On mere anatomical grounds, it is difficult to understand how serpents could escape the absorption of their own venom through mucous surfaces, even admitting that absorption of venom does not occur in normal conditions of these surfaces. Venom must, however, be so frequently introduced into their bodies, in situations where absorption could not fail to occur, by the bites inflicted upon them by other serpents, that the conclusion seems inevitable that they possess some protective quality, without which, probably, no venomous serpents would now be in existence. Not only have many general observations been made in favour of this belief, but it has been supported by direct experiments, such as those made by Fontana of Tuscany more than a century ago, and by Guyon, Lacerda, Waddell, Kaufmann, and Sir Joseph Fayrer.

This, and other evidence, pointing to the existence of protection against venom, not only in serpents themselves, but also, in certain exceptional circumstances, in human beings, several years ago originated a wish to investigate the matter. It was obviously suggested that if protection occurs, it must be caused by some direct result of the absorption of venom; and, therefore, that its existence could be proved or disproved by experiment. In the former event, the first steps would already have been taken to obtain, by further experiments, results likely to be of value in the treatment of poisoning by serpents' venom, and, indeed, likely to be of suggestive importance in even the wider field of general therapeutics.

The general plan to be followed in the first stages of the investigation was obviously suggested by some of the statements I have reproduced; for they indicate that individuals might become accustomed to, or protected against the effects of serpents' bites, by the introduction into their bodies of a succession of doses of venom, no one of which, necessarily, at the beginning of the process was so large as the minimum-lethal. A consideration also of the facts, proving the possession of protection on the part of venomous serpents themselves, indicated the same plan of procedure; for, equally obviously, these serpents, from an early period of their existence, must absorb venom from their own gradually-developing poison-glands, until, in the course of time, they had acquired sufficient protection to remain unaffected by the larger quantities which the now fully-developed glands would introduce into their bodies.

My first supplies of cobra venom were obtained in 1869, from the late Dr. Shortt, of Madras, and in 1879 from Surgeon-Colonel Moir, of Meerut. They were in very small quantity, but with them I was able to satisfy myself that, by a succession of minute doses, animals became able to receive the minimum-lethal dose without any distinct injury. At this point, however, the supply of venom failed, and the observations could not then be carried further. It became evident that until large quantities of venom had been obtained, definite results could not be hoped for.

It was not until several years afterwards that a sufficient supply had been gradually accumulated, by further small quantities received from Sir Joseph Fayrer, the Thakore of Gondal, and Dr. Phillips; and by larger quantities from Sir William Mackinnon, Director-General of the Army Medical Department, and especially from Surgeon-Colonel Cunningham, of Calcutta, who for many years has been engaged with much success in the study of venoms and their antidotes. Within the last few months, and subsequently to the publication of some of the experimental results which had by this time been obtained, the India Office has also placed at my disposal a considerable quantity of venom, which had been collected by Dr. Hankin, of Agra, at the request of Dr. Cleghoorn, Surgeon-General with the Government of India.

But, besides these specimens of the venom of the cobra of India, I have also been fortunate in obtaining specimens of venoms from other parts of the world.

From America, Dr. Weir Mitchell, of Philadelphia—whose work on the chemistry and physiology of serpents' venom constitutes the great advance of the century on the venom of viperine serpents—has supplied me with the venom of three species of rattlesnakes, viz. *Crotalus horridus*, *C. adamanteus*, and *C. durrisus*, and also with a specimen of the venom of the Copper Head (*Trigonocephalus contortrix*).

From Australia, Dr. Thomas Bancroft, of Brisbane, has at various times sent specimens of the venoms of the black snake (*Pseudechis porphyriacus*), the brown snake (*Diemenia superciliosa*), and of a large unidentified snake of the Diamantina district of Queensland (probably a new species of Diemenia).

From Africa, the kindness of Mr. Andrew Smith, a distinguished naturalist of Cape Town, of Dr. Brook, of the Orange Free States, and of Dr. John Murray and Mr. Van Putten, of Cape Colony, has placed at my disposal small quantities of the venom of the puff adder (*Vipera arietans*), the night adder (*Aspidelaps lubricus*), the yellow cobra (*Naja haie*), and the "Ring Hals Slang" or "Rinkas" (*Sepedon hæmachates*).

In the meantime, however, the results of experiments on the inoculation of the toxines of diseases, as well as of proteid toxines of vegetable origin, had suggested to several observers that serpents' venom, because of its chemical analogies with several of these substances, might possibly be found capable, like them, of producing immunity against the effects of poisonous doses; and

further important evidence has thus been obtained in favour of the reality of the protection to which I have referred.

Sewall, in 1886, undertook an investigation with the object of determining if immunity against the fatal effects of rattlesnake venom could be produced by the inoculation of repeated doses, each too small to produce ill-effects. The experiments were made on pigeons, and he succeeded in proving that immunity could be secured to the extent, at least, of protection against seven times the minimum-lethal dose. Kanthack made a similar series of experiments in 1891, which allowed him to conclude that rabbits may be accustomed to resist lethal doses of cobra venom. Working with the venom of vipers, Kaufmann in 1891, and Phisalix and Bertrand in 1893, obtained experimental evidence of the possibility of producing a definite, though not high degree of resistance against the toxic effects of this venom. In the following year, Calmette, continuing some earlier observations which had led him to express the opinion that protection against snake venom could not be produced, published evidence confirming the results of previous investigators, but also showing that a higher degree of protection could be secured than they had obtained, for he succeeded in administering to each of several rabbits, within a period of eight months, a total quantity of from 30 to 35 milligrammes of venom.

In 1894, also, both Phisalix and Bertrand and Calmette obtained evidence of the power of the blood-serum of protected animals to counteract the effects of venom. Calmette at the same time claimed that hypochlorite and chloride of calcium were antidotes of considerable value; and in a later publication, he showed that the blood-serum of animals immunised by the administration of venom possesses a certain degree of antidotal efficacy against the toxines of several diseases.

In the case of many of the venoms which I have had the good fortune to obtain, the quantity at my disposal was not sufficient for experimental examination on the plan that seemed desirable, and, besides, the examination of each of them would require several months of work. The venoms that have as yet been used are four in number, those, namely, of the cobra of India (*Naja tripudians*), of the *Crotalus horridus* of America, of a large colubrine snake, probably a species of *Diemenia* from Queensland, Australia, and of the *Sepedon hæmachates* of Africa. They are, therefore, those of the most deadly of the poisonous serpents of Asia, America, Australia, and Africa, respectively; and, further, they are representative of the chief differences that occur in the composition and action of venoms, for they are derived from members af the two great groups of the colubrine and viperine serpents. My supply of cobra venom, however, being much larger than that of any of the others, this venom was chiefly used in the experiments.

An essential preliminary to exact investigations with active substances must always be the determination of the activity of the substances. The only convenient method for doing this is to define the smallest dose capable of producing death for any given weight of animal—that is, the minimum-lethal dose. The venoms in their natural liquid state are unstable, and they are also inconstant in activity, mainly because of variations in the quantity of the water which they contain. Dried venoms have therefore been used in all the experiments. The cobra venom has, however, nearly always been received in the form of a dry solid; but when this was not so, it has been dried *in vacuo* over sulphuric acid.

Experiments were made with it on several animals—as the frog, guinea-pig, rabbit, white rat, cat, and the innocuous grass snake of Italy (*Tropedonotus natrix*). Very considerable differences were found to occur in the minimum-lethal dose for each of these animals. For the guinea-pig, the minimum-lethal dose per kilogramme was ·00018 grm.; for the frog, ·0002 grm.; for the rabbit, ·000245 grm.; for the white rat, 00025 grm.; for the cat, somewhat less than ·005 grm.; and for the grass snake, the relatively large dose of ·03 grm.[1] Cobra venom thus takes a position among the most active of known substances, rivalling in its lethal power the most potent of the vegetable active principles, such as aconitine, strophanthin or acokantherin.

These facts having been ascertained, attempts were next made to render animals proof against lethal doses, by administering to them a succession of gradually increasing non-lethal doses. These were, for the first few doses, in some of the experiments, one-tenth of the minimum-lethal, in others one-fifth, in others one-half of the minimum-lethal, and in others almost as great as the minimum-lethal. At varying intervals, the doses were repeated, and by-and-by gradually increased, until the actual minimum-lethal had been attained. The subsequent doses, by gradual increments, exceeded the minimum-lethal, and after five or six times the minimum-lethal had been reached, it was found that the increments could be increased so that each became twice, four times, and latterly even five times the minimum-lethal, and still the animal suffered little, and, in many cases, no appreciable injury.

This brief statement, however, does not represent the experimental difficulties that were encountered. It describes the course of events in the altogether successful experiments. Non-success, however, was frequent, and many failures occurred before experience indicated the precautions and conditions that are necessary for success.

Serpents' venom exerts what may broadly be described as a duplex action. It produces functional disturbances unassociated with visible structural changes, and it also produces obvious structural changes. The latter are of a highly irritative character, causing intense visceral congestions in the lungs, kidneys, and other organs, and when the venom is given by subcutaneous injection, on all the structures of the skin and subjacent parts. There are apparently also some definite changes produced in the blood, with regard to which several important facts have been discovered by Dr. Martin, of the University of Sydney, and by Surgeon-Colonel Cunningham, of Calcutta. Irritative effects are obviously produced by cobra venom, even in non-lethal doses, and with greatly increased virulence by doses that exceed the minimum-lethal; but, in respect to this action, the other three venoms used are greatly more active than the venom of the cobra. Evidence was obtained to indicate that in the process of immunisation a diminution occurs in the intensity of these local actions; but this diminution does not proceed so rapidly as that in the unseen functional or other changes which are the more direct causes of death; and, further, the local irritative changes, after having been produced, are slower to disappear than the unseen functional disturbances. Until these facts had been appreciated, and, indeed, even with the adoption of precautions suggested by them, frequent failures occurred. The apparently contradictory results, accordingly, were obtained of the production, by gradually increasing doses, on the one hand, of a protection against quantities much above the minimum-lethal, so perfect that no apparent injury was caused; and, on the other hand, when the intervals of time separating successive doses had been too brief, of an intolerance so decided that death was produced by the last of a succession of gradually increasing doses, no one of which was so great as the minimum-lethal. The latter unfortunate event was frequently displayed in frogs and guinea-pigs, and attempts to carry immunisation in them to a high point usually resulted in failure.

Notwithstanding these difficulties, however, such gratifying results have been obtained as that rabbits could at last receive, by subcutaneous injection, so much as ten, twenty, thirty, and even the remarkable quantity of fifty times the minimum-lethal dose, without manifesting any obvious symptoms of poisoning.

Almost the only observable phenomena were a rise in the body temperature, which continued for a few hours after the injection, and which contrasts with the fall that occurs after the administration of even non-lethal doses, in non-protected animals; and a loss of appetite, which usually, though not invariably, occurred, and was probably the cause of a temporary fall in weight during the day or two days succeeding each injection. On the other hand, during the process of successful immunisation, the animals increased in weight, fed well, and appeared to acquire increased vigour and liveliness (Fig. 1).

It is marvellous to observe these evidences of the absence of injurious effects, and even of the production of benefit in an animal which, for instance, has received in one single dose a quantity of venom sufficient to kill, in less than six hours, fifty animals of the same weight, and in the course of five or six months a total quantity of venom sufficient to destroy the lives of 370 animals of the same species and weight.

With the cobra venom, I have also immunised cats and white rats, both by subcutaneous and by stomach administration; but the significance of the latter method of administration will be afterwards considered. A horse has also been immunised; and I have to express my obligations to Principal Williams and Prof. W. Owen Williams for granting me the accommodation of their

[1] Guinea-pig, nearly ½ millig. | Kitten (6 weeks), 2 millig.
Frog, ½ ,, | Cat, 5 ,,
Rabbit, nearly ¼ ,, | Grass snake, 3 centig.
White rat, ¼ ,,

establishment, and to Mr. Davis, also of the New Veterinary College, for much valuable assistance.

Following the same plan of research with the three other venoms, it was found that for rabbits the minimum-lethal dose per kilogramme of the Diamantina venom is ·0015 grm. ; of the venom of *Sepedon hæmachates*, ·0025 grm. ; and of the venom of Crotalus ·004 grm.[1] The Crotalus venom is, in its purity, altogether comparable with the cobra venom ; and the determinations, therefore, show that cobra venom is sixteen times more powerful than Crotalus or rattlesnake venom. This venom, as well as the two others, however, much exceed cobra venom in the intensity of their local action. When death is produced by Crotalus venom, the subcutaneous tissues become extensively infiltrated with a large quantity of blood and of blood-stained serum, the underlying muscles are reduced to an almost pulpy blood-stained substance, and post-mortem decomposition occurs very soon after death. Similar changes in the subcutaneous tissues, but to a rather less degree, are caused by the Diamantina

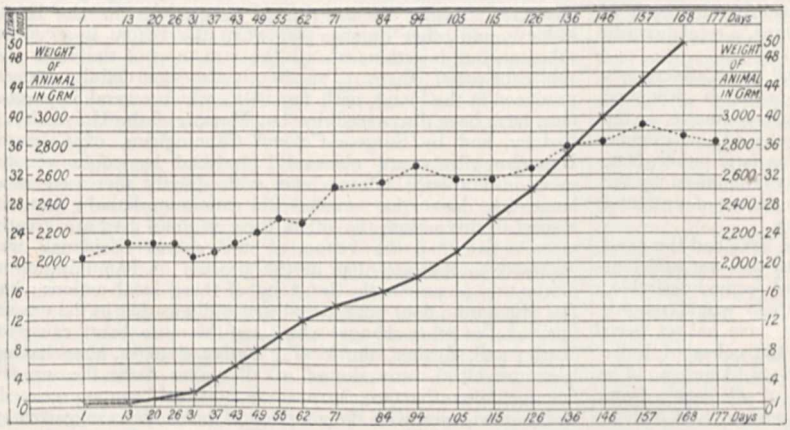


FIG. 1.—Immunisation of a rabbit against 50 times the minimum-lethal dose of cobra venom. The crosses connected by the continuous line represent administrations of venom. The dots connected by the interrupted line represent the weights of the animal.

venom, and in addition, hæmaturia, or more probably hæmoglobinuria, was invariably produced by lethal and by large non-lethal doses. I mention these circumstances to indicate the perfection of the protection which is produced by the administration of successive gradually increasing doses ; for they can be so adjusted that a dose of the Diamantina venom, even fifteen times larger than the minimum-lethal, may be administered without producing more than an inconsiderable degree of local destructive effect.

Experiments have also been made by which it has been demonstrated that when an animal has acquired a resistant power over the minimum-lethal dose of one venom, that animal is also able successfully to resist the lethal action of a dose above the minimum-lethal of other venoms. To a rabbit protected against cobra venom, a dose above the minimum-lethal of Sepedon venom has been administered ; to rabbits protected against Crotalus venom, doses above the minimum-lethal of Diamantina and of cobra venoms have been given ; to rabbits protected against the Diamantina venom, doses above the minimum-lethal of Crotalus and Sepedon venoms have been given, and in each case the animal has recovered, and but few symptoms of injury were produced. At the same time, in other experiments, indications were obtained that animals protected against a given venom are capable of resisting the toxic effect of that venom more effectually than the toxic effect of other venoms.

The experiments have not yet proceeded sufficiently far to show for what length of time the protection conferred by any final lethal dose may last. It has been discovered, however, that protection lasts for at least a considerable period of time, even when the last protective dose has not been a large one. For example, to a rabbit which had last received four times the minimum-lethal dose of cobra venom, twice the minimum-lethal dose was administered thirty-four days subsequently ; while to another rabbit, which had last received twice the minimum-lethal dose of Crotalus venom, the same dose of this venom was administered twenty days subsequently, and in each case the second dose failed to produce any toxic symptom.

Having thus succeeded in producing a high degree of protection in animals against the toxic effects of serpents' venom, the blood-serum of these animals was, in the next place, collected for the purpose of testing its antidotal properties. In this portion of the investigation, the method followed was essentially the same as that described in a communication made by me to the Royal Society of Edinburgh in 1871, on "The Antagonism between the Actions of Physostigma and Atropia," as it appeared to be the most direct method for obtaining accurate knowledge of the value of an antidote.

A few preliminary experiments were, however, early made with the serum of animals in whom the protection had not been carried to a high degree, and they were sufficient to show that antidotal properties are possessed even by this serum. It soon became apparent that in order to obtain some reasonable approximation to constancy in the conditions of the experiments, it was necessary that the serum should be in such a state that it would remain unchanged during at least several weeks. It was found that this could be insured, without any appreciable loss of antidotal power, by drying the freshly-separated serum in the receiver of an air-pump, over sulphuric acid.

A perfectly dry and easily pulverisable solid is thus obtained from which a normal serum can readily be prepared as required, by dissolving a definite quantity of the dry serum in a definite quantity of water. The dry substance is on the average equivalent to about one-tenth of the weight of the liquid serum. I have found that, without any special precautions, it retains its antidotal power unimpaired for at least a year, and it is probable that it may be kept unchanged for an unlimited period of time.

To this antidotal serum, whether in the dry form or in solution, I have given the name "Antivenene," a name which, notwithstanding etymological objections, has the advantages of brevity and freedom from ambiguity.

(*To be continued.*)

[1] Diamantina venom, 1½ milligramme.
Sepedon hæmachates, 2½ ,,
Crotalus horridus, 4 ,,

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

AT the graduation ceremony of the University of Glasgow on Tuesday, the honorary degree of LL.D. was conferred upon Mr. Thiselton-Dyer, F.R.S., and Prof. Andrew Gray.

PROF. J. PERRY, F.R.S., Professor of Applied Mathematics and Mechanical Engineering at the Finsbury Technical College, has been appointed to the vacant chair of Mechanics and Mathematics at the Royal College of Science, London.

AT a meeting of the Court of Edinburgh University on Tuesday, it was announced that the trustees of the late Earl of Moray have allocated the sum of £20,000 as a capital endowment fund for the promotion of original research in that university. The Court resolved to record their deep sense of the munificence of the gift and their cordial approval of the purpose towards which it is to be applied.

IN the House of Commons on Thursday last, Sir A. Rollit asked the Vice-President of the Committee of Council of Education whether it was intended to introduce a Bill in pursuance of the recommendations, with or without modifications, of the Gresham Commission for the reorganisation of the University of London ; and, if so, when and in which House. In reply, Sir J. Gorst said he could not give any definite answer to the question. The matter is however under consideration, and we are informed that Lord Playfair's Bill will be reintroduced shortly with small changes.

THE *Calendar* for 1895–96 of the Queen's College, Galway, contains an alteration in the statutes referring to scholarships. We notice that from the beginning of the Session 1896–97, all scholarships and prizes will be open to students of either sex; junior scholarships in arts of the second year will be tenable for one year only. After the close of the Session 1897–98, the third year's scholarship in law and the senior scholarship or exhibition in the same subject will be abolished.

THE tenth summer meeting of the Edinburgh University Extension Movement will be held at University Hall, Edinburgh, from August 3 to August 29. Among the courses of lectures which have been arranged are philosophy and social science, by Prof. Patrick Geddes; the relation between science and philosophy, by Dr. R. M. Wenley; African scenery as influenced by climate, by Mr. Scott Elliot; psychology, education and physiology, hygiene, biology, geography and geology. There will also be several conferences for the discussion of educational problems of the present day. The comprehensive character of the programme should attract a large number to the meeting.

IN the House of Commons on Tuesday, Mr. Carvell Williams asked the First Lord of the Treasury whether the Parliamentary grant to King's College would not only be restored, but considerably increased; and, if so, whether provision was made for such increase in the present Estimates or whether it would be otherwise provided. In reply, Mr. Balfour said no increase was proposed this Session in regard to King's College. In accordance with an undertaking given by the Chancellor of the Exchequer to a deputation which waited upon him, he has appointed three gentlemen, Mr. T. H. Warren, President of Magdalen College, Oxford, Prof. D. G. Liveing, and Mr. Chalmers, of the Treasury, to visit the colleges sharing in the grant made to universities and colleges in Great Britain, and to investigate the character and quality of the university work done, and to inquire generally into the position which each college occupies both financially and in other respects. When their report is received, which the Chancellor of the Exchequer expects will be some time in the autumn, he will be in a position to judge whether a case has been made out for recommending Parliament to increase the sum to each of the colleges sharing in the grant.

FROM *Science* comes news of a notable extension of the University of Pennsylvania, by the establishment of a large number of graduate scholarships and fellowships. Provost Harrison gave 500,000 dols. to the university last June, "for the encouragement of liberal studies and the advancement of knowledge." The specific purposes of the fund are as follows: (1) The establishment of scholarships and fellowships intended solely for men of exceptional ability. (2) The increasing of the library of the university, particularly by the acquisition of works of permanent use and of lasting reference to and by the scholar. (3) The temporary relief from routine work of professors of ability in order that they may devote themselves to some special and graduate work. (4) The securing of men of distinction to lecture, and for a time to reside at the university. Our contemporary states that in pursuance of the end in view in the foundation, definite action has been taken in the establishment of a considerable number of graduate scholarships and fellowships. The recommendations which were made regarding these have been approved and will now go into force. There are eight graduate scholarships giving free tuition and 100 dols. open to those coming from the liberal courses in the college of the university; and there are, with the Hector Tyndale Fellowship in Physics, now fifteen fellowships, fourteen of which, coming from this foundation, are open to students of any university. The amount of the tuition deducted from the full value of the fellowship (600 dols.) does not go into the general funds of the university, but may be used for the purchase of books or apparatus which will aid the student in his work, or may be used in the publication of theses. A somewhat unusual feature is the establishment of senior fellowships, open only to those who have taken the Doctor's degree in the University of Pennsylvania. This amounts to the introduction, in a modified form, of the "Docent" system of German universities, the object being not at all to use the Senior Fellow as a teacher for the sake of the value he may be to the university, but to test him and give him an opportunity to do a little teaching in the direct line of his special work. From the Senior Fellowships there is no reduction for tuition. This gives eight Graduate Scholarships, fifteen Fellowships, and five Senior Fellowships, making twenty Fellowships in all. Fourteen of the Fellowships are open to men from other institutions, but the Senior Fellowships are limited to those having taken the Doctor's degree from the university in order that some of the best men may be kept in residence there as long as possible, and their influence felt among the students.

SCIENTIFIC SERIALS.

American Journal of Science, March.—Trinidad pitch, by S. F. Peckham and Laura A. Linton. This paper gives an account of the physical and chemical properties of pitch from the Pitch Lake of Trinidad, together with a map of the lake itself. A dry sample of the true lake pitch contained 34·2 per cent. petrolene, 18·8 per cent. asphaltene, 11·4 per cent. of other organic matter, and 35·6 per cent. of inorganic matter. The pitch as it occurs is a unique substance found nowhere else in nature. It consists of a mixture of bitumen, water, sand, decayed vegetation, and gas in such definite proportions that within certain limits the composition of the entire mass is uniform.—Proofs of the rising of the land round Hudson Bay, by Robert Bell. The old shorelines in the provinces of Ontario and Quebec slope upward in a north-easterly direction at rates varying in different regions from a few inches to a foot and even two feet per mile. Many former landing-places about the bay are now high and dry. The rising is apparently still in progress.—Experiments upon the kathode rays and their effects, by A. W. Wright. In developing "shadowgraphs," it is better not to use any alkaline accelerator at all until just at the end of the process. Röntgen rays passing through glass walls do not show magnetic deflection or mutual repulsion; but when they are made to pass through gold-leaf instead, they show traces of these phenomena, probably owing to the fact that they carry with them small portions of volatilised and electrified metal.—Triangulation by means of kathode photography, by John Trowbridge. The principle of triangulation may be applied to kathode photography when determining the situation of metallic particles in the body. By using two vacuum tubes in different positions, two pictures of, say, a bullet embedded in a hand may be obtained, and their distance apart gives the depth at which the bullet may be sought.—Notes of observations on the Röntgen rays, by H. A. Rowland, N. R. Carmichael, and L. J. Briggs. Some photographs of a coin obtained by Röntgen's method showed no penumbra when the coin was 2 cm. from the plate. In a very high vacuum tube the source of the active rays was distinctly traced to the *anode*.

THE *Meteorologische Zeitschrift* for March contains some interesting results of meteorological observations made at Boroma, on the Zambesi, lat. 16° S., long. 33° 12′ E., in the years 1891–92. The most prominent feature of the climate is the contrast between the dry and the wet seasons. The approach of the rainy season is announced by lightning in the north and north-east during October; rain commences in November, and continues, on and off, for about five months; hail also occasionally occurs during thunderstorms. The dry season commences in April, and until the following November no measurable quantity of rain falls. It is noteworthy that during seven dry months, under a tropical sun, vegetation is not arrested, although even slight dew is very rarely observed. The daily barometric range is very regular, and amounts to about 0·15 inch. The atmospheric waves are so similar that the barometric curves overlie each other as nearly as possible; depressions such as are frequent in our latitudes do not occur at any part of the year; even the passage of thunderstorms is not shown upon the barograph traces. The absolute maximum temperature recorded was 109°·9, in November, and the minimum 54°·5, in August. The annual rainfall amounted to 29·6 inches, of which 10 inches fell in December. The greatest amount observed in twenty-four hours was only 1·9 inch.

THE last fascicule of the Memoirs (*Travaux*) of the St. Petersburg Society of Naturalists (vol. xxv. livr. 2), which is entirely given to the works done in the zootomical laboratory of the St. Petersburg University, contains an interesting monograph, by B. Sukatchoff, on some new forms of sponges from Lake Baikal. The dredgings were made in the south-western part of the lake, near the issue of the Angara, by means of an apparatus similar to the one used by the *Challenger* expedition, the greatest depth reached being 492 feet. The greatest depth at which sponges were found was 273 feet. Most of the sponges obtained belong to already known species of *Lubomirskia*, described by

Dybowski in 1880; but some of them must be considered as new varieties, or as new species of the same genus. Thus the author describes and figures the new varieties: *Lubomirskia baicalensis*, Pall., var. ε, and *Lubomirskia intermedia*, Dyb., var. β, and the new species, *L. Tcherskii* and *L. fusifera*. The paper is fully summed up in French. The same number contains a note on *Polyzonium germanicum*, Brandt, by M. Rimsky Korsakoff; a paper, by W. Schimkevitch, on some new species and varieties of *Pantopoda* from the Arctic Ocean (Barents's Sea), in which the new forms *Ammothea borealis*, *Nymphon rubrum*, var. *intermedium*, *Nyphon grossipes*, var. *armatum*, *Tanystylum hœkianum*, *Phoxihilus bœhmii*, are described and figured. The author also gives the plates which are intended to show that the two species, *Phoxihilus vulgaris* and *Ph. charybdæus*, are different. M. Eugéne Schultz describes the new species *Loxosoma harmeri*; and A. Yaschenko gives a catalogue of the fishes in the museum of the St. Petersburg University.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 27.—"A Method for rapidly producing Diphtheria Antitoxines." Preliminary note. By Dr. G. E. Cartwright Wood.

In this preliminary communication[1] a method was described by means of which, firstly, an animal can be rendered immune towards large quantities of diphtheria poison; secondly, such animals can be made to produce powerful diphtheria antitoxines. The distinctive feature of the method consists in the use of the products produced by the growth of the diphtheria bacillus in albuminous fluids made by the addition of serum to ordinary peptone broth. This fluid is, after three or four weeks' growth at 37° C., filtered through a Chamberland candle and heated for an hour at 65° C. This liquid, which is described as "serum" toxine, probably depends for its action on the presence of the diphtheria albumoses described by Sidney Martin. It gives rise on injection to little or no local reaction, but to a marked rise of temperature, which is still more pronounced when the injection is repeated. The ordinary toxine obtained by the growth of the diphtheria bacillus in fresh peptone broth, or in putrid broth (Spronck's method), was also made use of, and this is referred to in the paper as "broth" toxine.

In the first experiment (Horse No. 1) 380 c.c. of serum toxine was injected during the first fourteen days for the purpose of immunising the animal, and thus protecting it against the subsequent introduction of the much more irritating and deadly broth toxine. During the next fortnight it then received 310 c.c. of broth toxine in three injections without being markedly affected, and was then bled at the end of this period. The antitoxic value of the serum was then found to be ten normal units, 1-100th of a c.c. protecting against ten lethal doses of broth toxine, a result obtained by the ordinary method only after ten weeks treatment.

In the second experiment (Horse No. 2), the animal received 1350 c.c. of serum toxine mixed with 51 c.c. of antitoxine during the first fortnight. During the next two weeks it received 950 c.c. of broth toxine mixed with 350 c.c. of serum toxine. When the animal was bled at the end of a month, 1/1000th c.c. was found to protect a guinea-pig against ten lethal doses of broth toxine.

In the third experiment (Horse No. 3), the horse received the serum toxine without the addition of antitoxine, and, as will be seen from the following table, the results were even more striking.

	Antitoxic value of serum.	Amount of toxines injected.
7th day ...	$\frac{1}{300}$ c.c. ...	1200 c.c. serum toxine.
14th day ...	$\frac{1}{500}$ c.c. ...	980 c.c. serum toxine.
21st day ...	$\frac{1}{850}$ c.c. ...	650 c.c. serum toxine and 1050 c.c. weak broth toxine.
28th day ...	$\frac{1}{1250}$ c.c....	1100 c.c. serum toxine and 1200 c.c. stronger broth toxine.

The high antitoxic value of the serum obtained from horses Nos. 2 and 3 suggested that the serum toxine might be made use of at a later stage, as well as for the purpose of rapidly immunising the animals. When mixed with the ordinary toxine, and injected as usual, although the results obtained were better, they were not so striking as one might have expected. On examining more in detail the protocols of the horses in which the best results had been obtained, it was observed that these had been under more or less continuous treatment with the toxines, both toxines being injected in as large amounts, and as frequently as possible, so that the animal was kept in a chronic condition of local and constitutional reaction. For the purpose of determining whether the favourable result was due to this "cumulative" action of the toxines, four horses, which had been under the ordinary treatment for periods varying from nine months to a year, were treated in the following way. They received one evening each 300 c.c. of serum toxine prepared by Spronck's method, and on the following morning an injection of weak broth toxine, the latter being usually repeated daily during the rest of the week. This treatment was continued during the following week, and the serum then tested for its antitoxic value. The results are seen in the following table.

	Strength of serum before treatment.	Strength of serum after 16 days' treatment.	Amounts of toxines injected during the 16 days.
Horse No. 4 ...	$\frac{1}{600}$ c.c. ...	$\frac{1}{20000}$ c.c. ...	650 c.c. serum toxine and 2350 c.c. weak broth toxine.
Horse No. 5 ...	$\frac{1}{400}$ c.c. ...	$\frac{1}{15000}$ c.c. ...	600 c.c. serum toxine and 1800 c.c. weak broth toxine.
Horse No. 6 ...	$\frac{1}{300}$ c.c. ...	$\frac{1}{7500}$ c.c. ...	650 c.c. serum toxine and 2350 c.c. weak broth toxine.
Horse No. 7 ...	$\frac{1}{400}$ c.c. ...	$\frac{1}{7500}$ c.c. ...	650 c.c. serum toxine and 2350 c.c. weak broth toxine.

These results indicate clearly that the rapid productions of anti-toxine depended on the increased sensitiveness of the animal, owing to the injections being repeated before the previous ones had had time to pass off. Some preliminary experiments have indicated that this cumulative action may be produced in an even more marked degree by the use of other toxines than those produced by the diphtheria bacillus.

It is claimed for this method that powerful diphtheria antitoxines can be easily produced in a shorter space of time than has hitherto been possible, and that, as a consequence, the amount of serum necessary to be injected is greatly reduced, while its greater strength will permit of the patient receiving at the beginning of treatment a sufficient quantity of the serum at one injection, when, as is universally recognised both by animal experiment and clinical experience, its curative action is exerted most markedly.

March 19.—"On the Relations of Turacin and Turacoporphyrin to the Colouring Matter of the Blood." By Prof. Arthur Gamgee, F.R.S.

In a recent paper read before the Royal Society, the author has shown that the intense absorption band in the extreme violet, which is observed in the spectrum of highly diluted solutions of hæmoglobin and its compounds, is (with slight changes in its position) exhibited by certain of the derivatives of the blood colouring matter, *e.g.* by hæmochromogen and the compounds of hæmatin, and by that remarkably interesting coloured but iron-free derivative of the latter body, hæmatoporphyrin.

Having found that no organic body which he had examined exhibits an absorption band occupying the position, or possessed of the remarkable intensity, of the extreme violet band under discussion, it seemed as if the latter owed its origin to a group of atoms existing in, and perhaps characteristic of, the blood colouring matter, which group remains intact in certain of the products of decomposition of the complex hæmoglobin molecule, whereas it does not exist in certain other of the derivatives of the hæmochromogen or hæmatin moiety of the molecule, such as bilirubin and urobilin. It appeared interesting to determine whether turacin, which, as Prof. Church first showed in 1869,[1] presents two absorption bands in the visible spectrum, which have a remarkable resemblance to those of oxy-hæmoglobin,

[1] The investigation has been carried out in the laboratories of the Royal Colleges of Physicians and Surgeons, and I should like here to express my great indebtedness to the Laboratories Committee for the facilities there afforded to me. I must also thank them and, through them, the Honourable Goldsmiths' Company, from whose Research Fund a grant was placed at my disposal.—G. E. C. W.

[1] A. H. Church, "Researches on Turacin, an Animal Pigment containing Copper," *Roy. Soc. Proc.*, vol. xvii. (1869) p. 436; *Phil. Trans.*, vol. clix. (1869) pp. 627-636.

would exhibit in the extreme violet or the ultra-violet, an absorption band similar to that of the compounds and certain of the derivatives of the blood colouring matter. It was found that solutions of turacin in caustic soda or ammonia, so dilute as to be almost colourless, and to exhibit, when a stratum 10 mm. thick was examined, only a faint shading in the position of the stronger of the two turacin bands in the green, absorbed the extreme violet and ultra-violet rays of the spectrum *precisely as* highly diluted solutions of the acid compounds of hæmatin (*e.g.* hæmatin hydrochloride dissolved in glacial acetic acid). The earlier observations were made by allowing the spectrum of a beam of sunlight reflected into the dark room from the mirror of the heliostat, and which had passed through the solution of turacin, to fall upon a fluorescent screen of the double cyanide of platinum and barium, when an intense absorption band at the commencement of the ultra-violet was visible to the naked eye. This observation was subsequently confirmed by taking a series of photographs of the spectrum, employing solutions of turacin of various degrees of concentration.

It thus appears that turacin, like the acid compounds of hæmatin, exhibits an absorption band, which is exactly on the boundary of the ultra-violet proper, and which extends further and further into the ultra-violet, as the concentration of the solution increases.

The identity of the spectrum of turacin with that of the hæmatin compounds was so complete that it led the author to surmise the existence of a close relationship between the copper-containing body and the iron-containing colouring matter of the blood. Without any knowledge of Prof. Church's second investigation, published in 1892,[1] in making an oral preliminary communication of his first results to the International Physiological Congress at Berne, in September, 1895, the author expressed his conviction that turacin contains the same atomic group which is the cause of the extreme violet and ultra-violet absorption band in the spectrum of highly dilute solutions of hæmoglobin and its derivatives, and predicted that by removing the copper from turacin, it would be possible to obtain a turaco-porphyrin similar to the body (hæmato-porphyrin) which results from the removal of the iron from hæmatin. It was only after the completion of the experiments necessary for the elucidation of this point, that the fact of his having been anticipated in this matter by Prof. Church was brought under the notice of the author.

The results of the present work offer, however, an independent and additional confirmation of Prof. Church's results.

The facts placed on record in this paper point to the essential identity of turaco-porphyrin and hæmatoporphyrin, and when taken in connection with the identity of the ultra-violet spectrum of turacin, and of the acid hæmatin compounds, appear to establish that turacin contains the atomic group, which is the cause of the characteristic extreme violet and ultra-violet absorption exerted by hæmoglobin, its compounds, and principal derivatives.

Entomological Society, April 1.—Prof. Meldola, F.R.S., President, in the chair.—Mr. Champion exhibited, on behalf of Mr. Blatch, specimens of *Quedius riparius*, Kellner, captured in February last on the banks of running streams at Porlock, Somerset. He remarked that the insect was an interesting and unexpected addition to the British list, and the second recent novelty from the west country, the other being *Ochthebius lejolisi*, Muls. and Rey, found at Ilfracombe in June last by Mr. Bennett. He added that Mr. Waterhouse had informed him that he had seen specimens of the Quedius from Wales and Scotland. Mr. Champion also exhibited a small collection of Coleoptera made by Mr. O. V. Aplin in Southern Tunis during various expeditions inland from Gabes. The collection included some interesting Tenebrionidæ of the genera *Pimelia* and *Adesmia*. Mr. Aplin noticed specimens of these insects impaled by shrikes.—Mr. Goss exhibited, for Mr. Cameron, an apterous male of *Mutilla contracta* taken at Barrackpore, India. The specimen was stated to be the first recorded instance in this species of a wingless male, and was also abnormal in having the thorax incised laterally.—Dr. Sharp, F.R.S., called attention to the fact that at a recent meeting of the Society (March 20, 1895) a specimen of a supposed dimorphic form of one of the species of *Dytiscus* was examined, and Prof. Stewart inquired whether any anatomical examination had been made of the sexual organs. He said that in the *Comptes rendus* Soc. Bordeaux, 1894, there was an account of the examination of the sexual organs of the supposed second form of *D. marginalis* by M. Peytoureau, who came to the conclusion that it was really a distinct species.—Prof. Poulton, F.R.S., exhibited examples of the type labels now in use in the Hope Collection at Oxford, and illustrated their employment by projecting on the screen, by the lantern, a photograph of the Westwood types of African *Eusemiæ* described in F. Bates' "Matabele Land" (London, 1881). He said that such labels, having been once set up in type, could be reproduced in electrotype very cheaply and efficiently. Mr. Verrall said he was of opinion that no species should be described from a single type, but from many specimens, and he wished every so-called "type" could be destroyed as soon as a species had been described from it. Mr. Blandford explained the system of labelling types in the Brussels Museum. Dr. Sharp, Prof. Meldola, Mr. McLachlan, and Prof Poulton continued the discussion.—Mr. Blandford exhibited a series of lantern slides showing the uses to which photography could be put in entomological illustration. The photographs shown included various *Saturniidæ*, *Vanessidæ*, species of *Mamestra*, *Tipula*, *Ophion*, *Carabus*, *Lucanus*, *Sitones*, &c., as well as one or two examples of insect-injury, and a view in Windsor Park showing oaks defoliated by *Tortrix viridana*. Prof. Meldola expressed surprise that photography had hitherto been so little employed in the illustration of works on entomology.—Prof. Poulton read a paper entitled "On the Courtship of certain European Acridiidæ." He said that these observations upon the courtship of Swiss Acridiidæ were made in exceedingly favourable weather at the end of August and beginning of September last year. He was much indebted to Mr. F. Jenkinson and Mr. V. F. Dickins for many independent observations and valuable confirmation. The observations were almost all made in the neighbourhood of the Weisshorn Hotel, high above Vissoye, in the Val d'Anniviers. Prof. Meldola expressed great interest in the paper, and said that the observation of the habits of insects in the field seemed to be much neglected by many entomologists. Dr. Sharp remarked that there was a greater variety in the organs capable of producing sound in the Orthoptera than was generally supposed.—Mr. G. F. Hampson read a paper entitled "On the Classification of Three Subfamilies of Moths of the Family Pyralidæ: the *Epipaschiinæ*, *Endotrichinæ*, and *Pyralinæ*."

PARIS.

Academy of Sciences, April 7.—M. A. Cornu in the chair.—Applications of the theory of divergent series capable of summation, by M. E. Borel.—Some remarks on the X-rays, by S. P. Thompson. An account of the phenomena observed with a fluorescent screen in a Crookes' tube during the gradual production of a vacuum. At a very high vacuum, the rays penetrate bones as well as flesh, and hence there is a certain degree of exhaustion for which the difference between the transparency of the bone and flesh is a maximum.—On electrified Röntgen rays, by M. A. Lafay.—A condition for the maximum power of Crookes' tubes, by MM. J. Chappuis and E. Nugues. The radiation of a Crookes' tube, as measured by the rate at which its rays discharged an electrometer, was found to vary with the rate of vibration of the commutator of the Ruhmkorff coil employed. For the coil used by the authors, ten breaks per second produced the maximum effect; rates higher or lower than this were less effective.—Thermal studies of some oxybromides, by M. Tassilly. Determinations of the heats of solution of the hydrated oxybromides of the alkaline earths.—Action of hydrobromic and hydriodic acids upon phosphoryl trichloride, by M. A. Besson.—At a temperature of 400°-500° in presence of pumice, hydrobromic acid acts upon phosphoryl trichloride giving the complete set of substitution derivatives $POCl_2Br$, $POClBr_2$, $POBr_3$, and PBr_5. Hydriodic acid acts somewhat differently, a solution of the gas in phosphoryl trichloride slowly reacting at the ordinary temperature giving phosphorus triiodide and metaphosphoric acid.—On a sample of rice over a century old, by M. Balland. The sample on analysis differed from ordinary rice only in a lower percentage of fat.—Elongation of the lower limbs due to castration, by M. Lortet.

BERLIN.

Meteorological Society, March 3.—Prof. Börnstein, President, in the chair.—Prof. Hellmann spoke on Indo-Germanic superstitions as to weather, which are still widespread among the people, and are based upon a belief in the importance of the twelve days from Christmas to Epiphany, or

[1] A. H. Church, "Researches on Turacin, an Animal Pigment containing Copper," *Phil. Trans.*, vol. 183 (1892), A, pp. 511-530.

from January 1 to 12, as determining the weather forecasts for the whole ensuing year. These rules are contained in a work, "Die Bauernpraktik," of which the first German edition appeared in 1508, and having attained a wide circulation over western and northern Europe, was translated into English, French, Danish, Swedish and Bohemian, and passed through numberless editions in the sixteenth and seventeenth centuries. There is no known author of this work, but the speaker had succeeded in tracing out manuscripts of the thirteenth century, and the writings of the Venerable Bede in the ninth, as the source of the book. From Bede's writings—which deal not only with weather forecasts, but contain also a "Thunder-book," which is still popular in Sweden—it is evident that the author had translated a Greek manuscript. Certain passages in Pliny refer to Democritus as the source of some of the forecasts, and of the significance of the twelve days mentioned above. But the superstition as to these days is of still older date, for statements which, although incomplete, are, on the whole, similar to those in the "Bauernpraktik," are found on the Babylonian tablets, and the speaker hence concluded that the superstition is of Babylonian origin.

Physiological Society, March 6.—Prof. du Bois Reymond, President, in the chair.—Prof. Zuntz read a communication by Messrs. Asher and Lüscher, in Bern, in which they describe the first results of an investigation of the electrical changes in the œsophagus during deglutition. Using german-silver wire electrodes and a capillary electrometer, they observed a movement of the mercury whenever a wave of contraction passed over the portion of the œsophagus included between the electrodes.—Dr. Rothmann spoke on secondary degenerations of the pyramidal tracts resulting from unilateral extirpation of the cortical centres for the extremities.—Prof. Zuntz spoke on the results of his investigations on metabolism, which had shown that the performance of 1 kgm. of work requires the consumption of 28 kgm. of chemically equivalent energy, whether it be derived from proteids, from fats, or from carbohydrates. Chauveau had recently come to the conclusion, based on experiments, that sugar alone is used up in a muscle doing work, and that when the animal is fed with fat the latter is preliminarily changed into sugar by the liver. The speaker showed that this assumption involves the occurrence of a very complicated chemical process, during which a large part of the energy of the food must be set free in the liver and remain unused. Chauveau had also stated that the same amount of energy is used up in positive as in negative work, and against this view the speaker advanced the results stated above for positive work, while, on the other hand, during the negative work of descending an incline with the lesser declivity, less chemical energy is consumed, thus corresponding to the lessened work. As the declivity becomes gradually greater, the amount of chemical energy increases, at a certain stage is equal to the work done, and then increases rapidly beyond the ratio given above for positive work.—Dr. Rawitz reported on an investigation of the well-known statement made by Darwin that imperfect albinos—animals with white hides and blue eyes—are deaf. Having become possessed of a white dog with blue eyes, he had found, by experiments lasting over three weeks, that this dog really was deaf. After killing the dog, he found that the cortical auditory centres of both sides were atrophied, being on one side reduced to half the normal amount, and on the other to one-third. The cochlea of the inner ear was also wasted away, and the auditory ossicles ankylosed.

March 20.—Prof. du Bois Reymond, President, in the chair.—Dr. René du Bois Reymond discussed Stieda's theory of the homology of the limbs, in detail with reference to the bones and muscles, and briefly as to the blood-vessels and nerves.—Dr. Epstein demonstrated a new turbine, a new perimeter, and a new kymograph constructed for the purpose of experimenting on the influence of colour-perception on blood-pressure.—Prof. Thierfelder reported on two further experiments, made in conjunction with Dr. Nuttall, on animals free from bacteria. In one of these, two guinea-pigs were fed for thirteen days, in the other for ten days, aseptically with milk and biscuit. The animals remained in every respect normal, and gained in weight to the same extent as others fed with ordinary milk and biscuit. Their urine contained ethereal sulphates, although the alimentary canal was free from bacteria.

Note.—In the report of the Physiological Society on p. 503 of NATURE, column 2, line 37 from the top, for "height of circulation" read "height of contraction."

PHILADELPHIA.

Academy of Natural Sciences, March 10.—A paper entitled "Summary of New Liberian Polydesmoidea," by O. F. Cook, was presented for publication.—General Isaac J. Wistar made a communication on the apparent capricious distribution of iron oxide as colouring matter in the rocks of the anthracite coal region. At several points, apparently, the accessible supply of iron was exhausted by complete distribution in the strata under process of deposit with intermediate and subsequent periods during which new supplies appear from some source not yet clearly explained. Prof. A. P. Brown stated that it had been suggested by Russell that the red colour of certain formations may have originated from the subaërial decay of iron-bearing rocks, and the subsequent deposit of this material as sediment forming the red rock. As far as the ash of coal is concerned, it is probable that the colour is due to the way in which pyrites is contained either in the coal itself or in the slate adjoining. Coal containing separable pyrites would give white ash, while if the pyrites is intimately mixed in the coal the ash will be red.—Mr. James Willcox and Prof. Angelo Heilprin commented on the evolutionary value of the large collection of fulgurs presented to the last meeting, the former claiming that about twenty-five species had been reduced by the presence of complete series of intermediate forms to three or four.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—The Heart of a Continent: Captain F. E. Younghusband, 2nd edition (Murray).—Argon and Newton: Lieut.-Colonel W. Sedgwick (Whittingham).—British Sea Birds: C. Dixon (Bliss).—Les Rayons X: Dr. C. E. Guillaume (Paris, Gauthier-Villars).—Report of the Commissioner of Education for the Year 1892-93, Vol. 2 (Washington).—Queen's College, Galway, Calendar for 1895-96 (Dublin, Ponsonby).

PAMPHLETS.—Prof. Röntgen's "X" Rays, and their Applications in the New Photography (Glasgow, Bauermeister).—Die Denkschöpfung, &c.: A. Bastian (Berlin, Dümmlers).—The Magnetic Circuit: Dr. H. du Bois, translated by Dr. Atkinson (Longmans).

SERIALS.—Journal of the Royal Statistical Society, March (Stanford).—Engineering Magazine, April (Tucker).—Journal of the Franklin Institute, April (Philadelphia).—Science Progress, April (Scientific Press).—Imperial University, College of Agriculture, Bulletin Vol. ii. No. 6 (Tōkyō).—Studies from the Yale Psychological Laboratory, Vol. 3, 1895 (New Haven).—Ethnologisches Notizblatt, Heft 3 (Berlin, Haack).—American Journal of Science, April (New Haven).—American Naturalist, April (Philadelphia).—Strand Magazine, April (Newnes).

CONTENTS.