THURSDAY, JANUARY 19, 1893.

HEREDITY.

Das Keimplasma. Eine Theorie der Vererbung. By August Weismann, Professor in Freiburg i. B. (Jena: Gustav Fischer, 1892.)

IN the substantial volume whose title stands at the head of this article Prof. Weismann has gathered together the results of the essays and researches which he has given to the world during the last eleven years, and he now presents us with a theory of heredity, for which his previous writings have been but preparatory.

Those who have followed the German philosopher since the appearance of "Die Dauer des Lebens" in 1882 have traversed a wide territory. They have seen many theories and hypotheses come into view and attain a certain degree of definiteness. Some of these are now lost to sight, others have changed their outline and altered the relative proportion of their parts, but, whatever was the standpoint, the central feature of Prof. Weismann's theory of heredity—the continuity of the germ-plasma—remained unchanged.

The work before us consists of an introduction, partly historical, and of four books, in which the theory and its application to various biological problems are set forth in the fullest possible manner, and in language for the most part free of technical phrases, so that a non-scientific reader can easily follow the argument. At the close of the volume are a summary of the four books and an index. The latter is a novelty in a German book of this kind, for which we cannot be too grateful to its compiler, Fräulein Diestel.

The title of the work strikes the key-note of Prof. Weismann's theory. Heredity, according to his view, is brought about by the transference from one generation to another of a substance with a definite and very complex constitution, the germ-plasma. This substance is the material basis of heredity; and it is supposed that a part of it in each reproductive cell is not used up in the construction of the offspring, but is transmitted unchanged to form part of the reproductive cells of the following generation. As the author points out, his theory might be termed "Blastogenesis," or the origin from the germ-plasma, as opposed to Darwin's Pangenesis, or the origin from all parts.

This germ-plasma is necessarily a most complicated substance; it cannot arise anew, but can grow and increase. Its ultimate constituents, according to the latest view of the Freiburg professor, are certain units termed biophores, which possess the properties of assimilation, growth, and multiplication by means of fission. So long as the organic world consisted of biophores living either singly or united in colonies, heredity and multiplication with subsequent growth were one, since each division resulted in two similar halves, which by growth gave rise to organisms exactly like the parent.

But, when the principle of the division of labour made itself felt, the biophores became differentiated, and simple division no longer sufficed to give rise to two similar organisms, each exactly like their parent. A special mechanism was needed to bring about heredity, and according to our author this was found in the nucleus. This differentiated part of the cell was originally a collection of reserve biophores. After the division of the nucleus the biophores in each half multiplied, and so replaced those which had separated from them, and thus rendered possible the completion of the new organism. The structure of the nucleus became still more complicated when amphimixis, the mingling of the hereditary substance of two individuals, made its appearance. Amongst multicellular organisms, with their endless variety of cells, the same mechanism exists, but in a still more complicated form. Sexual reproduction has arisen; that is, the "Anlagen" for the whole organism are collected into a single reproductive cell, two such cells come together, and the resulting fertilized egg cell contains the hereditary substance of two individuals.

According to Prof. Weismann's present view, this hereditary substance or germ-plasma consists ultimately of biophores. These units are built up in a definite order and arrangement into units of the second degree, which are termed "cell determinants," or simply "determinants." Every cell of a multicellular organism is dominated in its histological character, and in the rhythm and nature of its division by one of the determinants. Each cell has not, however, a corresponding determinant in the germ-plasma, but cells of the same sort, as, for instance, blood corpuscles, may be represented in the hereditary substance by the same determinant. In the germ-plasma of any species there must be as many determinants as there are variable cells or cell groups in the organism. The determinants are arranged in a definite order in units of the third degree termed "ids."

These ids, which will be familiar to readers of Prof. Weismann's latest essay, that on Amphimixis, are again built up into idants, and these last probably correspond with the chromatosomes, or nuclear rods of the nucleus. Thus the germ-plasma consists of idants; the idants are composed of ids; the ids are built up in a definite manner of determinants; and the determinants are formed of the final units, the biophores.

It is assumed that the biophores can pass out of the nucleus and divide and multiply in the surrounding cell protoplasm. Amphimixis brings about the mingling of a certain number of biophores from one parent with a similar number from the other, and the organism whose body is dominated by this mixed assemblage of biophores partakes of the nature of both parents.

In the reproductive cells of the higher plants and animals the nucleus must contain not only those determinants which dominate the structure, rate of division, &c., &c., of the cell itself, but also those which will dominate the various cells and systems of cells which will eventually arise from the reproductive cell; and furthermore these must be definitely arranged in a given order, so that they may not be all called into activity at once, but may become functional successively, in accord with the origin of the cells they control.

It is not possible within the limits of a short article to describe the many ingenious applications of his theory, by means of which Prof. Weismann attempts to explain such phenomena as the Regeneration of lost parts, Reversion, Budding, Alternation of Generations, &c.: all

these are brought into line, and are shown to be capable of an explanation in the theory of germ plasma. Dimorphism and seasonal dimorphism are explained by the assumed existence of double determinants, one corresponding with each form, and remaining inactive during the life-time of the organism controlled by the other.

Such changes as affect the cell body cannot be transmitted according to this view, since alterations in the cell have no effect upon the biophore which in the next generation will dominate the corresponding cell of the offspring. But, since variation must be ultimately dependent on external circumstances, influences such as climate, change of food, &c., are considered to have in the course of time some effect upon the determinants, and a corresponding change in the organism results. In this lies one of the chief differences between the germ-plasma theory of Prof. Weismann and the Pangenesis of Darwin. They both give a possible explanation of heredity; but in the latter case the gemmules, coming from every cell of the body, afford an explanation of the transmission of acquired somatic changes; in the former case the biophores, arising only from other biophores, would be uninfluenced by any such change. A. E. S.

THE BASIS OF ALGEBRA.

The Algebra of Co-planar Vectors and Trigonometry. By R. Baldwin Hayward, M.A., F.R.S., Senior Mathematical Master in Harrow School, formerly Fellow of St. John's College, Cambridge. (London: Macmillan & Co., 1892.)

THIS work is constructed on the methods of the school of mathematicians who derived their inspiration from the teaching of De Morgan, a school which is represented by many of the most influential of our recent writers on mathematical subjects. It is intended to occupy the place of the "Trigonometry and Double Algebra," published in 1849 and now a long time out of print, at the same time incorporating such improvements in elementary treatment as have been evolved out of half a century's discussion of the foundations of Algebra. Those who are acquainted with Mr. Hayward's other writings, such as his "Elements of Solid Geometry," will expect a fresh and interesting treatment of his subject; and they will not be disappointed. On turning over the pages we constantly come across elegant touches and happy turns of expression, and historical appreciations—the stuff which constitutes the basis of literary excellence in mathematical writings.

The treatise is primarily concerned with the logical exposition and illustration of the principles on which Algebraic Analysis, including Analytical Trigonometry, is founded. The utility of this subject in its practical applications renders it a necessary part of even an elementary course of reading; while a very refined treatment of it may lead so far into the notions of the Theory of Functions and algebraic continuity in general, as to somewhat overlay the really simple matters with which it is concerned. In this country the tendency in elementary books has, until recently, been rather to take the fundamental formulæ on credit, and to make the subject consist of the development of their analytical and practical consequences. The philosophical principles which bind them into an organic whole have retained so much the aspect of *à posteriori* developments, that there is some temptation to proceed in the view that Mathematical Analysis is an inductive science like Natural Philosophy; that it is one part of the science to invent and verify the formulæ, while the logical calculus which gives them precision and limitation is quite another department. The great majority of readers of the elements of Algebra have no time for an exhaustive discussion of the nature of continuous quantity and all the types of singularity to which it is liable; while on the other hand complete neglect of the logical basis of Analysis deprives it both of a main source of its interest, and of a large part of its value as an intellectual training. Hence arises the importance, even in presence of the complete theory with which a specialist must be acquainted, of the simplification and improvement of methods of exact treatment within the domain of elementary ideas.

The author's method starts off from an *à priori* discussion of the Algebra of Co-planar Vectors, which leads him to the two modes of specification of a vector, as a power of the fundamental vector, and as a sum of components. The identification of these two expressions leads to the analytical definitions of the *sine* and *cosine*, and by way of certain theorems in algebraic limits [whose explicit enunciation is by the way not essential] to the orderly development of the subject. The theorems concerning series which involve the complex variable are strikingly illustrated by corresponding vector chains, and geometrical interpretations are throughout very copious. The treatment is here so full and many-sided, that it would form an interesting occupation for the reader to take up the other aspect of the matter, and try to pick out the simplest and briefest analytical foundation on which the formulæ required for practical applications may be built.

The remarkable formula of p. 115, $(4{\cdot}810475\ldots.)^{\iota} = \iota$, if removed from the context in which it is set, might be propounded as a puzzle in interpretation. The author introduces us straight off to an expression with a complex index, and proceeds to ascertain whether any meaning can be assigned to it, which will allow the inclusion of such expressions in the algebraic calculus. The geometrical method gives him very neatly and definitely an expression for the values of A^B, where A and B are both complex, by means of the vector ribs of a fan of equiangular spiral form. But when the conception of logometers (analytical logarithms) to a vector base comes up for interpretation, the answer proves to be some one of an infinito-infinite series of vectors related to one another in a manner so complicated as to elude definite grasp; and we have arrived at a case in which the inclusion of the function in our calculus would, in the absence of special machinery of representation like a Riemann's surface, be best avoided.

The origin of all difficulty in the treatment of complex algebra lies in fact in the multiplicity of values of the functions with which it deals. If each function can be defined as spread out in a multiple sheet so as to be single-valued at each point on each leaf of the sheet, a great part of the trouble disappears. We can then if we

please make explicit use of the Principle of the Permanence of Equivalent Forms, which, after having been expounded at length and defended by Peacock (appendix to "Algebra"), has been summarily rejected as misleading and unmeaning by many recent authors. To the formal reintroduction of this principle Mr. Hayward's language exhibits a tendency to return. Outside the domain of elementary Algebra, its strict employment in the prolongation of an analytical function into a new region is indeed of common occurrence in Analysis; while its tentative application in unrestricted form, as an instrument of suggestion and discovery in the Theory of Operations, is fundamental. To the effort to widen the limits of interpretation in connexion with it, has been due most of the advances in Analysis.

It is a fundamental question in mathematical logic how far, after having carried the stream of our analysis through regions of uninterpreted symbols, and having at length arrived at a stage in which these symbols have disappeared, we are entitled to claim this procedure to be demonstrative. It is of course of the very essence of Algebra that the intermediate steps of its analysis remain uninterpreted; though in the Algebra of real quantities we have a tacit assurance that an interpretation can be supplied if necessary. Why then was there an objection to a similar procedure in the Algebra of complex quantities; and what is the source of the timidity and doubt which characterized the use of complex analysis before its geometrical interpretation was developed? Simply that complex quantities turned out to be multiple-valued, and that the selection of the proper value under given circumstances had to be settled by tracing the continuity of the quantities in a way that was to the mind practically impossible until a visual geometric representation was discovered. The Argand diagram is not essential to the logic of the matter; it rather makes Analysis possible by bringing its scope within our grasp. It simply forms a more extensive and systematic example of the method which has been in use since the time of Descartes for studying functions and approximating to their roots, by aid of their graphical representation.

The Principle of Permanence of Equivalent Forms thus lies at the very root of Algebra, but it is rendered ineffective by indeterminateness of interpretation. Its strict use, when most needed, is subject also to another hitch. It requires that the forms be expressed in exact terms; an infinite series must be expressed in the sum of n terms together with a residue R. These residues must be retained throughout the analysis until we arrive at a point where interpretation comes in; and it must then be settled how far they can be neglected in the circumstances of the actual interpretation. In the language of Mr. Hayward, it cannot be asserted about series that are not absolutely convergent, that the fundamental laws of Algebra hold without limitation.

It is perhaps a question how far the idea, thus restricted and safeguarded, is worth being expressly retained as a working principle of ordinary Algebra. In subjects like the Calculus of Operations and Finite Differences, which are still in an unsytematized stage, it cannot be dispensed with; and the extent to which its use is boldly pushed, by De Morgan and Boole, even to the discussion in an operational manner of divergent series without their residues, contrasts with the more exact processes of recent Analysis. How far this boldness arises from the profound logical studies of these writers, and their appreciation of the imperfect character of inference at the best, may be a subject open to discussion.

In connexion with the doctrine of convergence of series, the author gives a very clear account, from Sir G. Stokes, of how it is that, on approaching certain critical points, the convergence may gradually fall off and finally disappear. The illustrations employed are algebraic series of an exceptional character; and the whole circumstances may possibly suggest to the uninitiated that it is a phenomenon of exceptional rarity. The most natural context is, of course, in connexion with the wonderful and far-reaching theory initiated by Fourier, by means of which functions arbitrarily discontinuous are expressed by seemingly continuous series. In that connexion, the necessity of explanation is so obvious that it is interesting to examine the previous attempts at elucidation. Thus De Morgan, in 1839, is able to conclude ("Diff. and Int. Calc.," pp. 233, 239) that such discontinuity cannot occur in series proceeding by powers of a real variable; that in other cases it occurs only through the series becoming divergent at the point of discontinuity. It is, however, an important question how far it would be allowable to avoid burdening an elementary exposition by complete precautions against the existence of anomalies like this, which would hardly have originally occurred to any one in that early stage.

The book ends with a wider survey, including a clear and interesting account of Cauchy's theory of the radical points of a rational function. The graphs of the cubic $z^3 + az$, which are given as an illustration, would also form excellent and rapid examples of the Rankine-Maxwell method of graphical addition, applied to the separate graphs of z^3 and az. J. L.

FOSSIL PLANTS AS TESTS OF CLIMATE.

Fossil Plants as Tests of Climate, being the Sedgwick Prize Essay for the Year 1892. By A. C. Seward, M.A., F.G.S., Lecturer in Botany in the University of Cambridge. (London: C. J. Clay and Sons, Cambridge University Press, 1892.)

THIS admirable essay is really a digest of the opinions of the principal writers on fossil plants, so far as they throw light on geological climates, and a critical *résumé* of the subject up to date. It should be read by all who prefer to deduce the relative temperatures of various latitudes in the past from such solid data as assemblages of ferns, cycads, and conifers, the ancestors of living genera and species, rather than from utterly extinct belemnites, ammonites, and saurians, of whose habits little can ever be known, and which might have drifted far out of their temperature zones by warm and cold sea-currents.

Perhaps if any criticism can be made, it is that too little has been said by the author as to what is known of the Mesozoic floras, which, if scanty, are extremely interesting. In fact only the widely-separated Palæozoic and Cenozoic floras are fully dealt with. Owing to the magnitude, difficulty, and freshness

of the problems presented by the former, they have received the larger share of attention and have ever attracted some of the most acute and philosophic of scientific workers. But while the researches of such investigators as Williamson and Renault into the actual structures and affinities of the carboniferous plants have been rewarded with the most brilliant successes, attempts to speculate and theorize have only been productive of barren controversy. All inferences as to the temperatures in which they flourished have merely been inductions from unknown data: their affinities with existing plants are so remote that they can tell us of little beyond moist climates and spongy, marshy soils, liable to inundation, with possibly an atmosphere more highly charged with carbonic acid than at present. But that neither the flora nor identical conditions were uniformly present over the whole land during the deposition of the carboniferous, becomes every year more apparent; and perhaps few would now maintain that fossil floras met with in widely-different latitudes must necessarily be contemporary because similar, or reject as impossible the correlation of the Glossopteris floras of the southern hemisphere simply because they are so dissimilar.

Tertiary floras, however, have to be approached from almost totally different standpoints, for here minute investigations into vegetable structure can only exceptionally lead to important results. On the other hand it may be possible to predicate the climate that any group among them would have required, with almost perfect accuracy. Allowing that even most closely-allied species may have had different habits, enough remain that are practically identical with living species. These not only prove to us that in every land in our hemisphere the temperatures remained warmer throughout the Tertiary period than at present, but also that the temperatures were far from equable during Eocene time. Thus it is impossible to hesitate as to the evidence of the flora in the lower stages of our Eocene, which exhibits an abundance of planes, poplars, and alders and an absence of all approach to sub-tropical essences; nor as to that of the London Clay, with its tropical nipas, sabals, and a host of others almost indistinguishable from species existing at the present day. There is scarcely need of the corroborative evidence of the Mollusca as to cooler seas in the Thanets, nor of tropical conditions in the large turtles, crocodiles, snakes, and nautili of Sheppey. In fact, the temperature of the spots occupied by Reading, Bournemouth, or Mull at a particular stage of the Eocene could be predicated from the fossil floras almost as accurately as from living plants. If the same cannot be said of the Arctic regions it is simply that the specimens brought home are, perhaps from the exigences of travel and inexperience of the collectors, for the most part so imperfectly preserved and fragmentary, that few of the determinations can carry the smallest weight. It may suit quidnuncs to accept indeterminable fragments as evidence of the growth of palms and cycads in the Greenland Eocene—it is time the Miocene age of these beds was relegated to the limbo of Coal-measure palms and yuccas—and to become excited over the presence of a sub-tropical flora within the Arctic circle; but as a fact it is doubtful whether anything has been discovered there which might not have grown in our own temperature, if slightly modified, a state of things which it is conceivable the damming back of the Arctic seas by the land connection which then existed between Europe and America, aided by an active Gulf Stream, might have brought about. When we come to the Miocene, worked out as that of Switzerland was by Heer, or still more the Quaternary, with such data as those laboriously amassed by Clement Reid, the inferences as to climate are still more irresistible.

As to evidence of the age of rocks, plants are less trustworthy, because they have neither been so perfectly studied nor are their zones as yet at all properly defined. All we can say is that certain assemblages are found in association at the beginning of the Tertiary, and that changing temperatures have since compelled them not to disperse, but to migrate far and wide. Fewer probably of the species are extinct than is generally supposed, and the primitive associations have held together perhaps to the present day, with many gaps from extinction and desertion and a large infusion of recruits through the ordinary causes of evolution, stimulated by the increase in browsing mammalia. Whether, on the other hand, the marine deposit zones are really entitled to the weight attached to them as evidences of age, except locally, is not so clear. They are usually the littoral deposits of a limited area, where some changes of level or current have apparently suddenly driven out the fauna and introduced new colonies more adapted to the changed conditions. If we could follow the subsequent wanderings of these assemblages under the sea our faith in their sudden extinction and consequently in their chronological value might be greatly modified. At all events, many of the less conspicuous groups of mollusca, when critically examined, prove to have surprisingly near relatives in distant seas at much later periods, and even at the present day.

J. STARKIE GARDNER.

OUR BOOK SHELF.

Pioneers of Science. By Oliver Lodge, F.R.S. (London and New York: Macmillan and Co., 1893.)

THIS book consists of eighteen lectures on the history and progress of astronomy, which were delivered by Dr. Lodge in 1887. "The lectures having been found interesting," he thought it "*natural* to write them out in full and publish," and, although this can scarcely be considered a sufficient excuse, the intrinsic merits of the work are abundant justification for its existence. In Part I., "From Dusk to Daylight," the progress of astronomy from Copernicus to Newton is traced in a series of vivid pictures of Copernicus, Tycho Brahe, Kepler, Galileo, Descartes, and Newton; while Part II., "A Couple of Centuries' Progress," brings the history of gravitational astronomy from Newton down to the present time. In these latter lectures Roemer and Bradley are associated with the velocity of light and aberration; Legrange and Laplace with the solar system and the nebular hypothesis; Herschel with the motion of "fixed" stars; Bessel with the distances of stars; Adams and Leverrier with the discovery of Neptune; and Lord Kelvin and George H. Darwin with tides. Dr. Lodge has been able, by judiciously combining clear statements of scientific facts and laws with interesting personal details, to give his lectures all the charm of a romance. The book is an admirable introduction to the study of astronomy, and no better gift for a beginner could well be chosen; while to those to whom many of

its details are already familiar, the picturesque clearness with which they are presented will make their knowledge more real and more complete. The standard of excellence maintained in the lectures makes distinction difficult and invidious, or we would distinguish the lectures on Newton and those on tides as models of what such popular scientific expositions should be. The book is copiously, and, on the whole, well illustrated, but some of the illustrations—notably those of clusters and nebulæ—are very familiar and somewhat out of date. A curious mistake occurs on page 291, where a well-known drawing of a comet appears as an "old drawing of the Andromeda nebula." The illustration on page 326, showing the paths of Uranus and Neptune and their relative positions from 1781 to 1840, and professing "to illustrate the *direction* of their *mutual* perturbing forces," is partly misleading; but in introducing this Dr. Lodge has erred in good company, for the diagram, originally due to Dr. Houghton, appears in many of our recent astronomical text-books. A. T.

Electric Lighting and Power Distribution. Part I. By W. Perren Maycock, M.I.E.E. (London: Whittaker and Co., 1892.)

THIS cheap and useful little text-book has been written for the author's junior students, as he is of opinion that no trustworthy elementary work on the subject is to be obtained. The scope of the work has been limited to the syllabus of the ordinary grade examination of the City and Guilds of London Institute. We find, however, much information on subjects not usually found in other manuals. The book is freely illustrated, and the descriptions are clear.

It is very important for the junior student to understand clearly what is meant by a line of force, and to grasp the fact that lines of force are only *assumed* to exist, because, by such an assumption it is possible to explain many, otherwise inexplicable, phenomena. On page 47 we find the following statement:—"The power which any magnet possesses, of picking up pieces of iron, and of acting upon another magnet, depends upon the existence of lines of magnetic force." This quotation is vague; a junior student might easily imagine that the lines of force really existed, whereas they are purely assumptions, to elucidate the phenomena of magnetic attraction. The illustrations of simple bar magnets, solenoids, and electro-magnets, in which the lines of force are delineated, should have the assumed directions of the lines of force clearly shown by arrow-heads. This might be done with advantage in Figs. 17 to 20.

Chapter IV. deals with induction of currents, electromagnetic induction, Faraday's Law, and concludes with a clear description of magneto-motive force, magnetic resistance, magnetizing force, induction and permeability. These latter are very difficult for a junior student to understand thoroughly, and the author should have devoted more space to the discussion of these important points in dynamo construction. One particularly good feature in this text-book is the large number of questions arranged at the end of each chapter. These are well suited to test the knowledge of a student. Chapter V. deals generally with electrical testing, measuring instruments used in installations, and meters for measuring the current, such as Teague's, Elihu Thomson's, and the Wright-Ferrauti. Chapter VI. concludes the book, describing the principle of the dynamo, different types of machines, and the construction of the various parts.

Taken as a whole this book attempts too much. The matter described has suffered considerably by condensation, a serious thing where junior students are concerned. Most of the illustrations are good; some are indistinct, and Fig. 98 is decidedly wrong, showing the brushes set for one direction of rotation, and the arrow indicating the reverse.

On the other hand the sequence of matter is good, and a student should learn much from the work. The author takes great pains to describe clearly the many units involved, particularly the applications of Ohm's law. The book would last much longer in the hands of the average student if the present paper binding were replaced by something stronger.

The Naturalist on the River Amazons. By Henry Walter Bates, F.R.S. With a memoir of the author by Edward Clodd. Reprint of the Unabridged Edition. With Map and Numerous Illustrations. (London: John Murray, 1892.)

THIS work is so well known, and has long held so high a place among scientific books of travel, that it is unnecessary to do more than note the appearance of a new edition. It is clearly printed on good paper, and the illustrations are well reproduced. The introductory memoir by Mr. Clodd is a most welcome record of the main facts of Mr. Bates's career. The materials for this interesting sketch were enriched by letters placed at the author's disposal by Sir Joseph Hooker and Mr. Francis Darwin. An excellent portrait of Mr. Bates is included in the volume.

LETTERS TO THE EDITOR.

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

A Proposed Handbook of the British Marine Fauna.

SUCH a handbook as Prof. Herdman suggests is so much wanted that many naturalists must from time to time have felt tempted to essay it. But the difficulties are very formidable. Prof. Herdman seems to contemplate the preparation of such a work mainly as a labour of compilation. But the groups where compilation would nearly suffice are just those where the handbook is least required. On the other hand, such a group as the Amphipoda, in spite of Canon Norman and Mr. Stebbing's many papers, is still in great need of revision; it was only the other day that Canon Norman opened our eyes to our rich fauna of Mysidæ, before which time no search among published records would have told us anything worth the having; we are in just the same position as to our British Cumacea, until Canon Norman again reveals the treasures of his cabinet; our Pycnogrns are almost as little known. In every one of these groups, and in many others like them, the preparation of a hand-list would need the experience of a specialist, just as much as the Tunicata would require Prof. Herdman's own special knowledge. The area to be embraced is another difficulty. Prof. Herdman proposes to take the British area as defined by "Canon Norman's" B.A. Committee in 1887, on which he himself served. But the committee's report was repudiated by Canon Norman himself, who afterwards suggested a wider "British area," whose boundaries I fancied had since been recognized as more suitable by everybody. However the British area be defined, there will long remain a difficulty in the numerous forms not yet recorded from within it, but which are likely, or certain, to turn up when sought for. Such things as the parasitic and other Crustacea described of late years by Giard and his pupils from Wimereux form a case in point. I am inclined to think that to make in the first instance a hand-list of the whole fauna of the North Atlantic basin would be not a bit more difficult, but in some respects easier, than to restrict the list to the British area alone. That it would be incomparably more useful is certain. It would make a book not more than three times (perhaps little more than twice) as big as Carus's "Fauna Mediterranea." And it would be a very important step towards that new *systema naturæ* of which the Germans are already beginning to talk, and which it is high time were begun.

But Prof. Herdman both asks discussion of his plan, and also invites criticism on his execution of it. Take his very first illustrative genus, which he tabulates as follows:—

ANTENNULARIA.—Stems simple or branched; pinnæ verticillate; nematophores along the stems; gonothecæ axillary, unilateral.

A. antennina, L., stems clustered, usually simple ; hydrothecæ separated by 2 joints. 6 to 9 in. high. Gen. distr. deep w.

A. ramosa, Lamk., stems single, usually branched ; hydrothecæ separated by 1 joint only. 6 to 9 in. high. Gen. distr. deep w.

Now there are *no* nematophores along the stem, but only on the pinnæ ; *A. ramosa* may sometimes grow up unbranched, but I for one never saw it so, and *A. antennina* is always simple, save by the rarest individual abnormality ; the dimensions are quite inaccurate, for we have *A. antennina* here of all sizes up to 24 inches high. The distribution given is too vague. In the report of the B.A. Committee, which Prof. Herdman goes by, deep water is defined as that below 100 fathoms ; but these two are not deep-water species, either in that or any other common use of the phrase. The authorities are very loosely given. *A. antennina*, L., should be (L.), and if the bracketed authority, *i.e.* the original user of the specific name, is to be the one quoted, then for *A. ramosa*, I think Lamk. should give place to (Lamx.). And why is the authority for the genus left out altogether?

Moreover, even if these definitions were verbally accurate so far as they go, they would only suffice to exclude one another, with no reference to other non-British species. They are rather definitions of groups of species or sub-genera, than of these two particular forms. It would not matter very much, perhaps, in this case, where other species are not likely to turn up upon our coasts ; but such definitions, drawn with reference only to known British forms, would soon lead to hopeless confusion in the case of less-known groups. D'ARCY W. THOMPSON.

Dundee, January 11.

On an Abnormality in the Veins of the Rabbit.

AMONGST a number of rabbits dissected in my laboratory last term, one specimen exhibited a peculiarity in the venous system which is especially interesting in connection with Hochstetter's and Macalister's accounts of the development of the veins. Unfortunately the specimen had been too far dissected before the abnormality was noticed to follow out every detail.

The blood from the hinder extremities, urinogenital organs, and abdominal walls, passed into a large vessel having the position and relations of a postcaval posteriorly. Instead, however, of passing through the dorsal border of the liver to penetrate the diaphragm, it was seen at the anterior part of the abdomen to correspond to the azygos, receiving the superior intercostal veins, and opening into the right precaval. This vessel evidently, then, corresponded to the persistent right posterior cardinal. The portal system was apparently normal, and the hepatic veins opened into a postcaval, which extended through the diaphragm to the heart in the usual manner.

Thus the independently-formed section of the postcaval (*Leberabschnitt*) had taken on no connection with the part developed from the cardinals (*Urnierenabschnitt*), but had remained as a separate vein, bringing back the blood from the alimentary organs (and ? diaphragm) only.

I have not thought it necessary to do more than mention these facts, as the whole question has recently been fully discussed by Dr. A. Robinson ("Abnormalities of the Venous System and their relation to the Development of Veins," "Studies in Anatomy from the Anatomical Department of the Owens College," vol. i. p. 197, Manchester, 1891). The above case, however, supports the view that the renal veins are direct tributaries of the right cardinal, and not of the postcaval ; while the reverse conclusion is derived from Dr. Robinson's observations. W. N. PARKER.

University College, Cardiff, January 14.

Difficulties of Pliocene Geology.

YOU were good enough to print a letter from me a week or two ago, in which I called attention to some of the difficulties in explaining the distribution of the so-called Pliocene beds. I should like to prosecute the subject a little further.

The geographical distribution of the mastodon is assuredly one of the greatest paradoxes in natural science.

As is well known, it occurs both in North and South America, and on both sides of the Rocky Mountains and the Andes. It has not occurred, however, so far as I know, north of the great lakes in the east, nor of Oregon in the west, nor has it ever been reported from Alaska, where mammoth remains are so abundant. I do not know any evidence that it has been found anywhere in Asia, north of the Himalayas, neither in China, nor Manchuria, nor Mongolia, nor Turkestan, nor in Siberia ; nor has it occurred in European Russia, except close to the Black Sea, nor in Poland, nor in Scandinavia, nor in North Germany.

In the Old World its zone of distribution extended from India to the Pyrenees, including the Mediterranean borders, the valleys of the Danube, and the Middle Rhine, Eastern England, and perhaps Iceland, whence some teeth are said to have been sent to the royal collection at Copenhagen. This distribution of a very highly specialized beast is certainly most extraordinary. Granted that the mastodons of Western Europe and those of America are slightly different, the difference is so slight that, as Falconer says, Cuvier treated them as the same species, and they cannot have been very long isolated. Yet how are we to explain the facts, and do justice to the widespread view that the ocean areas are very old?

It seems to me as clear as anything can be that when the mastodon was distributed over Western Europe and America, there must have been a land communication between the two areas, and I cannot see how, with the facts before us, we can escape the conclusion that this connection must have been across either the Atlantic or the Pacific, not in high but in low latitudes, perhaps across both.

The mastodon is not the only animal which points the same lesson. The machairodus, a very highly specialized feline, has been found both in the Old and the New World, but did not inhabit the great palæarctic province of Europasia, east of the Rhine, nor America north of the great lakes. The American jaguar, a mere variety of the Old World leopard, is another animal with the same abnormal distribution, so are the American and the Old World tapirs.

Now this connection between the Old and the New World cannot, so far as we can judge, have been in high latitudes, for the forms in question have not occurred in high latitudes. If the connection had been across the Northern Pacific, we should have had some remains of these animals in Japan, where more than one fossil elephant has occurred ; or in the Sandwich islands, which are, to all appearances, a very old land-surface.

The connection must, therefore, if it was across the Pacific, have been across its more equatorial part. It seems similarly to follow from the absence of these animals in the high latitudes of America and Europe, save the doubtful case of Iceland, that in the case of the Atlantic also the land-bridge must have been further south, and perhaps where the Atlantic islands still remain. One more inference. If there was a penannular or circular belt of land about the earth in the tropical or subtropical zone over which these beasts could travel, it would possibly account for the tertiary climate of high latitudes having been a warm one, as we know it was. A zone of land in the tropics would act as a furnace, whose heat would be widely distributed by the ocean currents in contact with it.

The views here urged, it will be said, are like those of the advocates of a Miocene Atlantis. They are in essence very different, and meant to explain a very different phenomenon, namely the aberrant and abnormal distribution of the mastodon and its companions. The mention of the Miocene Atlantis, however, suggests another and more critical difficulty in explaining the Pliocene beds, but this must be postponed to another letter. HENRY H. HOWORTH.

The Athenæum Club, January 13.

Earthquake Shocks.

A SERIES of slight earthquake shocks have lately occurred in this district, viz. January 3, 2.15 p.m. at Severn Junction (E.J.L.) January 4, 11 a.m., Itton Court, Chepstow (a heavy plant; in a greenhouse was seen to move four times by Mr. J. Curr and the Rev. N. S. Barthropp) ; January 5, between 2 and p.m., and again on the 6th (a little earlier), Llanthony Monastery (a rumbling noise on the Black Mountains near the monastery Mr. P. E. Hill) ; January 14, 6.55 p.m., a shock lasting mo r than a second, Bigswear House, Coleford, Mr. J. V. Newbery (Mr. Newbery has had experience of earthquakes, from a long residence in Japan). E. J. LOWE.

Shirenewton Hall, Chepstow.

The Weather of Summer.

I REGRET to find that, in making a quotation at the end of my letter last week (p. 246), I erred in supposing Mr. Symons to be the writer. I beg to apologize for the slip. A. B. M.

ON THE ORIGIN OF THE ELECTRIC NERVES IN THE TORPEDO, GYMNOTUS, MORMYRUS AND MALAPTERURUS.

THE subject of this communication may seem remote and uninteresting, but it will not be difficult to show that questions of the highest importance for physiology, anatomy, and the Darwinian theory are closely related to those touching the structure of the electric organs of certain fishes and the laws of their functions.

The fact that the body of an animal should become a complete electrical apparatus acting at the will of its owner induces us to inquire how this extraordinary result has been attained; that is, to investigate the origin of the electric organs of fishes, and the manner in which the animal throws them into action. We shall see that in pursuing both lines of enquiry we open far-reaching views into regions as yet unknown.

According to the present state of our knowledge there can be no doubt that most of the electric organs hitherto discovered are of muscular origin. It is not my intention to dwell on this transformation of muscular tissue, but it may nevertheless prove interesting to cite an example of the completeness with which such transformation can take place; I refer to the Mormyrus—the so-called pike of the Nile—a fish which has only of late been sufficiently known to possess electric power. A transverse section of the tail of any ordinary fish shows scarcely anything more than the vertebral column, muscles and their tendons, attached to the bones. On the other hand, a transverse section of the tail of Mormyrus (Fig. 1) shows no conspicuous muscles, but in place of them electric tissue filling up the entire space occupied by muscles in ordinary fishes. Of the muscular apparatus there is nothing left except the longitudinal tendons passing outside the electric organs from muscles placed anteriorly. If these tendons were cut across the Mormyrus would be unable to move its tail.

Omitting the complicated arrangement of histological elements in this modified muscular tissue in the different electrical fishes—which could not be sufficiently explained without a large number of illustrations—it may be sufficient to state that a kind of swelling loosens the molecular elements of the muscles and allows them to be settled again in a very regular but quite new form.

The well-known electric eel of America, *Gymnotus electricus*, has only the external shape of an eel, and is in reality a very short fish, carrying very powerful electric organs in a long tail springing from a very short rump. A transverse section of the tail shows that a part of the muscle is changed into electric organs, while another remains unchanged.

In the different kinds of electric skates—Torpedinidæ—the electric organs are developed from muscles, which originally belong to the branchial arches and the arch of the lower jaw.

When we look to the nerve apparatus which enables the fish to throw the electric organs into action by a voluntary impulse, we find in every case wonderfully developed ganglion cells from which the impulse is transmitted directly to the electric batteries. Such a coincidence certainly cannot be the result of mere chance. But beyond the invariable presence of large ganglion cells as the starting points of electric nerve fibres there is very little uniformity in the arrangement of these elements in the different sorts of electrical fishes; on the contrary, there are most remarkable and striking differences not only in the position but also in the number and in the appearance of these nerve centres. It is to be hoped therefore, that some important views regarding the character and functions of ganglion cells in general may be suggested by their study.

FIG. 1.—Transverse section of the tail of *Mormyrus cyprinoides*.

FIG. 2.—Ganglion cells from roots of electric nerves of Torpedo.

In the Torpedo the electric ganglion cells—being in vast numbers—form a bean-shaped mass in the medulla constituting the well-known electric lobe. It represents modified motor centres of the vagus nerve; anteriorly it is covered by the cerebellum, but emerging from beneath that organ, the lobe increases rapidly where the largest electric nerve leaves the medulla. Lower down its size again diminishes, where it gives rise to the fourth electric nerve and terminates quite free in a blunt point on each side. On counting the ganglion cells in a complete series of sections one finds the number to be about 54,000—a number that can be found to nearly correspond with the fibres in the electric nerves that arise from them. A transverse section of the medulla, close to the spot where the roots of the electric nerves are gathering, shows the so-called axis cylinder processes of the cells entering the roots to form the nerves. This is seen in Fig. 2—a photogram taken from nature like all the other illustrations of this paper.

Even the first and smallest of the electric nerves shows a great number of nerve fibres collected into bundles which on transverse section appear as if perforated by numerous small openings—each apparent aperture being a nerve fibre. I counted about 8039 fibres in the first electric nerve, in the second or largest about 23,770; in all four nerves about 58,318 fibres. This total exceeds that of the ganglion cells by at least 4000, but the disparity of number is probably to be accounted for by the impossibility of getting an exact total from a series of sections where the cells are very often dragged away by the knife.

The ganglion cells of the Gymnotus, or electric eel, are disposed in a different manner. Behind a short portion at the anterior end of the spinal cord where ordinary cells are found, the grey substance contains large rounded ganglion cells, the most anterior of them forming a semicircle around the central canal of the cord. Since these first cells extend in front of the most anterior electric nerves, a transverse section of this region shows no axis cylinders leaving the grey substance, all being directed

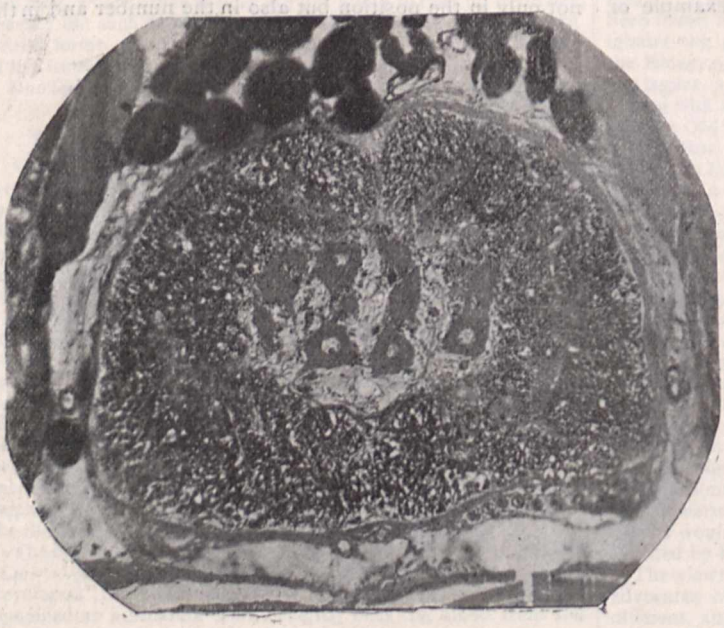

FIG. 3.—Communicating Electric Cells in the Spinal Cord of Mormyrus

downwards to the gathering place of the first electric nerve roots, and therefore must be cut off. If, however, a transverse section be made in the middle portion of the cord the whole grey matter is seen to be packed with electric cells and their axis cylinders are seen passing very straight and undivided to join the electric nerve roots at once. The other processes of the cells are so pale and fine that it is impossible to recognize them sufficiently well in a complete section. Since the electric batteries extend along both sides of the tail to its very end, the electric nerves and their ganglionic centres have a similar extension. The electric cells form a continuous column in the spinal cord, but it is very slender, therefore, notwithstanding the great longitudinal extent of the electric centre, the number of cells is not so very great. I estimated the total number of cells to be about 60,000—not many more than the estimated number in the Torpedo.

The genus Mormyrus, whose electric power was doubted until quite recently, resembles the Gymnotus in the structural arrangement of its electric apparatus. I was fortunate enough to find the ganglion cells for the electric nerves in the spinal cord, where the tail is endowed with the electric batteries, as seen in Fig. 1. The cells are very soft, and must be very carefully preserved to show all their details. Their regular undivided axis cylinders leave the cord-like motor roots, and form a sort of plexus before leaving the vertebral canal. It is to be considered as a very important fact, that broad processes of the cells regularly intercommunicate on so large a scale that their union into a complete system for simultaneous action cannot be doubted.

Fig. 3 shows such cells in the grey substance of the spinal cord; the intercommunicating processes can be seen much more distinctly in the microscopic slide and even in a photogram, than they appear in that figure.

The axis cylinder of each cell being a well-defined undivided process, the intercommunicating processes must be regarded as protoplasmic in the sense expressed by Deiters. Their general intercommunication cannot have any other significance than to insure equality of action in giving the impulse to the electric batteries. If that statement be admitted *the protoplasmic processes of the cells must have a conducting function.* If that be true in the Mormyrus there is no reason whatever why it should be otherwise in other vertebrates. Yet Golgi maintains that the protoplasmic processes of nerve cells are to be regarded as having a simply nutritive and therefore a non-nervous function.

There is another most remarkable fact in the organization of the Mormyrus having reference to the combined action of the electric organs on both sides. The upper as well as the lower electric nerves form a decussation outside the vertebral canal resembling the chiasma of the optic nerves. I am not acquainted with any other instance of motor nerves crossing the median plane to the other side of the body outside the cerebrospinal axis. In all other cases they are outside the brain and the spinal cord confined to their own side of the body to insure the isolated action of each muscle or group of muscles on that side. It is therefore stated that in changing the motor into an electric function these nerves at the same time became liberated from the strict rules of their predecessors. Certainly the case of Mormyrus gives a very good idea of the extraordinary power of adaptation to function with which Nature is endowed; but who can say how this particular anatomical arrangement could come about by gradual variation? I consider this difficulty far greater than that relating to the first development of electric organs in general which is so frequently the subject of reference.

Since the celebrated investigations of Prof. E. du Bois-Reymond have shown that the function of the muscular system is intimately associated with electric currents it is permissible to take them into account where muscle and their derivatives are under consideration.

I have shown elsewhere that most of the electric fishes are liable to a degeneration of the muscular system, seemingly caused—in part, at all events—by a certain lazy mode of life (disuse of organs). We therefore find along with fully developed electric tissue in the Gymnotus, nests of muscles which have not arrived at perfection. In the Mormyrus degenerating muscles in the forepart of the electric organ suggest the impression that the process of transformation is still going on. Still more is this the case in the common Raja.

Moreover, we know that the peculiar degeneration of muscular tissue into electric tissue destroys the contractile power of the muscles, but does not interfere with their

electromotor properties; on the contrary the loosened and differently arranged elements of the changed muscles are more capable of producing electric currents. In that

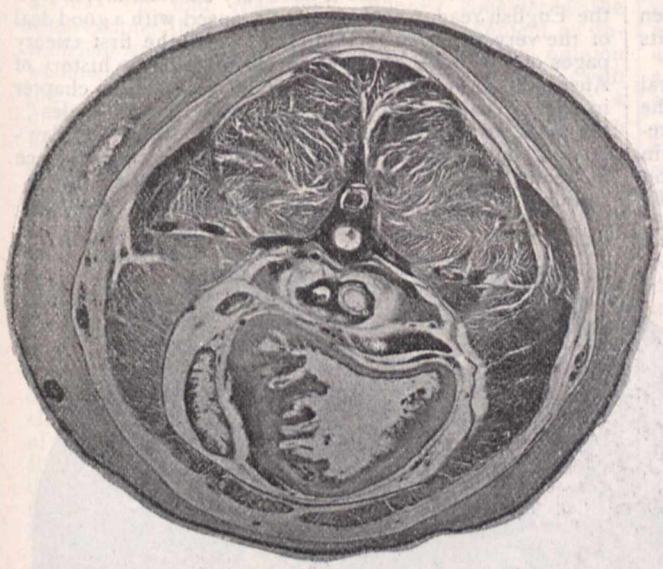

FIG. 4.—Transverse section through the body of Malapterurus with a parasite in the electric organ.

state of development which has still quite an occasional character, it seems only necessary to assume that under certain favourable circumstances the fish while trying to catch a prey or to defend itself against an enemy in the sudden excitement becomes aware of its electric power hitherto unknown to itself. On perceiving the advantage of the electric power in the struggle of life the fish might begin to use it regularly and to develop it gradually to perfection in its descendants; just as a man might one day perceive that he is endowed with the power of hypnotism, consequently learns to use it and gradually improves it.

But now it is necessary to consider also the electric Shadfish of the Nile, the *Malapterurus electricus*, a powerful fish of very peculiar structure, which places it in quite a different category from the electric fishes already mentioned. A transverse section of the whole fish (Fig. 4) shows the difference at once. The body of the animal is enveloped in a very thick electric skin, constituting one electric organ. Muscular tissue is nowhere deficient, other histological elements must therefore have furnished the material for the electric plates, which are packed very close in lozenge-shaped compartments of the skin.

In my opinion the plates are nothing else than modified cells of the cutaneous glands which are plentiful in the remainder of the skin. The precise proof of that statement ought to be furnished by a complete investigation of the development of the animal, which as yet is quite unknown. But the differences between the two kinds of electric organs are so great that we are surely entitled to separate the *muscular* from the *cutaneous* electric organs.

Assuming that the origin of these cutaneous batteries differs from those developed from muscle, we cannot wonder that their functions also differ in most important points. The electric current passes through the body in a direction the opposite of that in other electric fishes. There are *only two* electric nerve fibres, one on each side, which divide and subdivide until they give off more than two million branches. We shall see that these two nerve fibres are not true axis cylinder processes of ganglion cells. Before making a more detailed reference to these interesting elements it may not be amiss to point out in the section shown in Fig. 4 the existence of an intruder, a specimen of the so-called *Filaria piscium*, which had taken up its abode in the electric organ itself. This proves that animals can become accustomed to strong electric currents without receiving injury, and it suggests that the immunity of electric fishes against their own currents and that of their young *in utero* (Torpedo) is a faculty acquired by gradual training.

The construction of the single electric nerve fibre in Malapterurus resembles to a surprising extent that of an electric cable on a minute scale. We see the tiny nerve fibre like the central wire of the cable surrounded by a little non-conducting material and held *in situ* by a sort of network; the whole being enveloped in an enormous mass of connective tissue sheaths just like a cable protected externally by numerous layers of strong material. Fig. 5 shows a transverse section of the central part only to render the details of the round fibre and supporting network more distinct. If we follow this single fibre inwards to its origin in the central nervous system we are led to *a single ganglion cell* from which the single fibre arises. There is one cell on each side of the cord, therefore just two cells in all; whereas in Mormyrus, which has the smallest number of electric cells in the fishes with electric organs of muscular origin, the cells must be estimated at more than 1500. The position of the two cells in the spinal cord of Malapterurus reminds one of Clarke's column in the cord of higher vertebrates where the cells differ in certain particulars from the motor cells. As already stated there is only one cell on each side, but

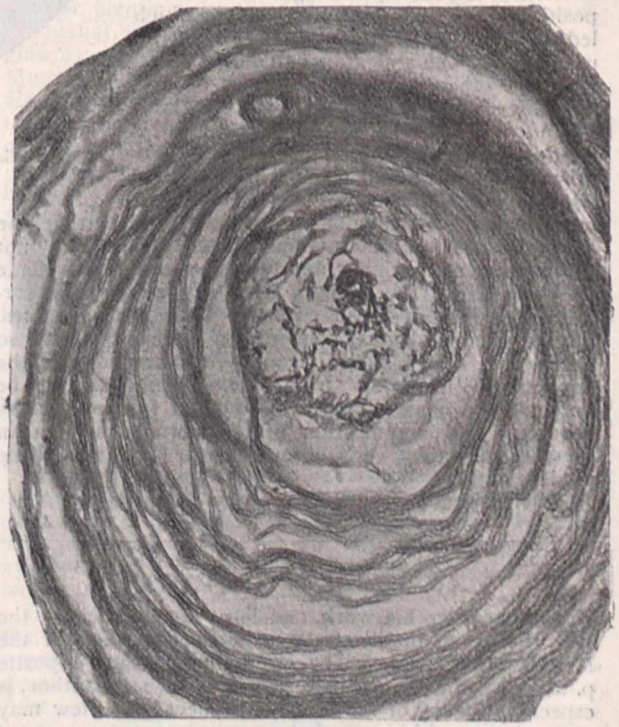

FIG. 5.—Transverse section of the central part of the electric nerve of Malapterurus.

that is a giant of its race. There is no real axis cylinder arising from the cell, but in place of it branched protoplasmic processes join and form a kind of perforated

plate beneath the cell, from which the nerve fibre starts with a broad base (Fig. 6). I consider this a chief point of difference between this peculiar cell and all the other afore-mentioned cells of a motor character. Fig. 6 gives a good idea of this magnificent histological specimen with its elegant nucleus showing its network and its nucleolus on one side.

Reviewing from a physiological standpoint the several facts stated above, we must feel convinced that the peculiar ganglion cells which are invariably found in relation to electric organs must play an essential part in bringing the electric organ into action. In my opinion that is tantamount to proof that other ganglion cells must be essential for sending nerve impulses to peripheral organs, and that the idea lately suggested by Nansen that ganglion cells have only a trophic influence on nerve tissue cannot be reasonably maintained in the face of these and similar facts. I may here refer to the well-known peculiar ganglion cells found in the motor region of the brain of higher animals, including man. Betz, who discovered them, searched for them for the purpose of stating anatomically the laws of localization found by Prof. Hitzig and myself.

It may not be out of place to adduce here another piece of evidence taken from the department of pathology. My friend and collaborator Hitzig has lately published the case of a man who died from tetanic cramp of the head. He observed that in the ganglion cells of the motor centre of the fifth nerve presiding the affected muscles there was a very singular change to be observed *in these cells only*. It appears that the bacteria of tetanus caused a granular decomposition of the protoplasm in the cells, which led to a further state of degeneration characterized by the appearance of large holes, while the other ganglion cells and the remainder of the organ appeared quite healthy. I am convinced the case shows that the cramps in the combined muscles resulted from the irritation and gradual disorganization of the ganglion cells.

The above statements may suffice to show that the electric fishes and their nervous elements are really not such outsiders in science, and that the observations made on them should be brought into comparison and correspondence with those gathered from other sources. Indeed the histological elements in their organs are so instructive, that I would strongly recommend that the conclusions deducible from their study should be employed in maintaining well-founded former notions regarding the organization of the nervous system in vertebrates against certain revolutionary ideas of some modern authors.

GUSTAV FRITSCH.
Physiological Institute, University of Berlin.

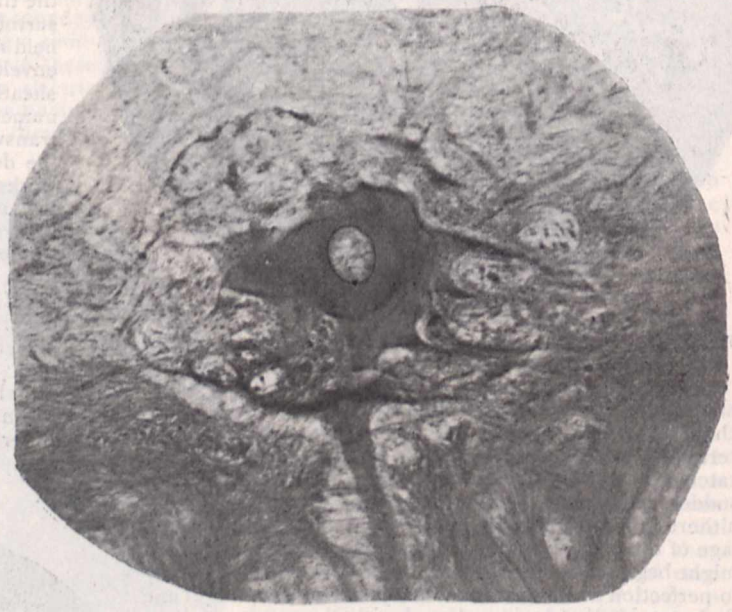

FIG. 6.—The right giant ganglion cell with the origin of its electric nerve from spinal cord of Malapterurus.

AUSTRALIAN TRAVELS.[1]

ON opening this work, one is at once struck by the beauty of the illustrations, particularly those of the New Zealand Alps. The double-page plate opposite p. 248, drawn from a photograph taken by the author, is especially worthy of remark. For effect this view may well compare with some of the most picturesque parts of Switzerland. Some of the photographs, however, have a familiar appearance to the travelled reader; one recognizes in the beautiful picture "Off the West Coast of Ceylon" (p. 300) an old friend, none the less worthy of reproduction.

The work makes no pretensions to a virgin freshness its professed object being to gather together the already published observations of the author, and to present them in a popular form. This it does very successfully, though the English reader could have dispensed with a good deal of the very apparent "padding." Thus the first twenty pages of this book of travel are devoted to the history of Australia, and remind one of Coghlan's opening chapter in the "Wealth and Progress of New South Wales": the next twelve pages on gold differ from Coghlan's second chapter, particularly in giving greater prominence to Count Strzelezki's discovery, and one regrets that n mention is made of James McBrian, who certainly ha prior claims. The author is candid in his criticisms and condemns both the theatres and University of Sydney, as being, from the German standpoint, decidedly bad. On p. 34 we come to a "Journey into New South Wales," and here commences an interesting medley of natural history, traveller's tales, and geographical investigation. In this vacation ramble Von Lendenfeld claims to have discovered the culminating point of the Australian continent in Mount Townsend, to which he assigns (by aneroid) the height of 2241 metres. The doggerel verse on p. 82, in which a red sunset is taken to indicate approaching rain, must be wrong in its meteorology, so at least it proved, a red sunset being followed, much to Lendenfeld's surprise, by a fine day. It is satisfactory to find that the signs of the weather are not inverted at the Antipodes.

The author's familiarity with glaciers and ice-action in Europe served him in good stead in the southern hemisphere. Several interesting pages are devoted to his discovery of the former existence of glaciers in the Australian Alps; though there seem to have been contemporaries in this matter, for while Von Lendenfeld's observations proved the existence of *moutonnéed* and striated surfaces down to a level of 1500 metres above the sea—Mr. James Stirling claimed to have found signs of ice-action at lower levels still, as in the neighbourhood of Omao, where they occur at 800 metres above sea-level. The historical conscience is strong in the author, or he would scarcely have troubled to recall the

[1] "Australische Reise," by R. von Lendenfeld, pp. 325, with Illustrations. (Innsbruch: Wagner, 1892.)

fact, that when his communication on the discovery of glacial markings was read before the Geological Society of London, it was received with scepticism by Prof. Bonney (and, let us add, though the author does not, by Dr. Blandford also). On turning to the *Journal* of the Society we find that Prof. Bonney considered the observations then adduced by Von Lendenfeld as insufficient to establish his conclusions, and in this opinion we fancy most geologists will be inclined to agree with him. That the conclusions were right after all is a different matter. It is to be regretted that even in this, his latest published summary, Von Lendenfeld does not always supply us with facts on which we can base an independent judgment. The personal opinion of an observer, however skilled, can be no sufficient substitute for these. A single instance will suffice. An important joint expedition was undertaken by the author and Mr. Stirling to examine into the accuracy of the latter's statements as to the downward extension of the ice. After several pages of interesting traveller's gossip we reach the result in words much to the following effect:—"After three-quarters of an hour's ride in the valley bottom we reached an old moraine, which we investigated closely. A dam 35 metres high and 200 broad composed of various (*verschieden*) great blocks of rocks with sharp angles stretched across the valley. A brook flowed through the middle. We are here at a height of from 900 to 1000 metres, and since it is a veritable moraine Stirling is right and our dispute is ended."

We will not offend the susceptibilities of the author by questioning whether this is really a moraine: probably it is; but no convincing proof of the fact appears in the description. One would like to know whether other signs of ice-action were observed in the immediate neighbourhood, in what respects the fragments differed from each other and from those of the adjacent valley slopes, and especially what evidence existed to show that they had been carried down the valley, and how far they are removed from their source. This information could have been conveyed in a few words, and would have been welcomed by inquiring minds, who now may wonder whether after all this dam could by any chance be merely the remains of an ancient landslip. New Zealand is introduced to us on p. 161, and after a short historical account we pass on to the New Zealand Alps and fjords. With regard to the latter the author stoutly maintains their glacial origin: one of his chief arguments resting on their great epth as compared with the sea into which they open. They are apparently submerged rock basins, but although the author may be right in his contention that they are not merely moraine-dammed valleys, yet he altogether overlooks another more probable explanation, depending on unequal subsidence: submergence of the land has certainly taken place, and one has only to concede that the central mountain masses have sunk to a greater extent than the adjacent sea-floor to understand how the previously existing valleys would be converted into fjords. The greatest depth of Milford Sound is 360 metres, and one must travel (so our author tells us) at least 100 kilometres from the coast before this depth is reached at sea; now as the watershed is distant only 30 kilometres from the coast, it is at least as probable, considering the gradient, that we have to do here with differential movements of the land, as with locally concentrated erosive action.

An ingenious attempt to explain the last glacial episode leads to several bold generalizations. The author commences with the assertion that the whole of the southern hemisphere is at present much more severely glaciated than the northern, indeed he goes so far as to state that the northern hemisphere in the middle of the ice period was not much more severely glaciated than the southern is now. Since the mean temperature of the southern is not lower than that of the northern hemisphere the reason for its excessive glaciation must lie in a more uniform climate and a damper atmosphere; and these again are a direct consequence of the greater extent of the oceanic surface.

Let us now suppose the sea-level in the northern hemisphere to rise 100 metres, the lowlands will become submerged (as during the last glacial episode they apparently were) the climatal conditions will then approach those now prevailing in the southern hemisphere, and excessive glaciation will result.

But in the southern hemisphere also, the ice was formerly of much greater extent, and this is not susceptible of the same explanation, since a depression of the land would not greatly affect the existing climate. What, however, would be the effect of a depression of the sea level? The submarine slopes of most of the land in the southern hemisphere are so steep that the present distribution of land and sea would not be largely modified, though the latter should sink 300 metres; on the other hand, the increase in the height of mountains (300 metres) would lead to a descent of the snow line, the growth of snow fields, and a corresponding enlargement of glaciers. Thus the glacial episode in the northern hemisphere might be attributed to an elevation of the sea-level, that in the southern to its depression: and these changes of level may have been produced by a bodily movement of the ocean waters from one hemisphere to the other, a result itself possibly due to a shifting of the centre of gravity of the earth. The author does not explain how to shift the centre of gravity of the earth.

We notice that the author speaks with disrespect of the maps of the Tasman glacier by Mr. W. S. Green, stating that they are nothing like so good as Von Haast's; since however, later explorers prefer them to Von Lendenfeld's own, it would appear that we have here a descending scale of excellence.

After pointing out the failure of Mr. Green to reach the actual summit of Mount Cook, the author gives a glowing account of a successful ascent of his own, not of Mount Cook however, but of the Hochstetter Dome! He therefore claims to be the first who has set foot on the top of a high mountain in New Zealand. We offer him our congratulations.

In commenting on the author's style, which in its lucidity is far more English than German, we must offer a serious protest against his manner of using what he terms our "transcendentally intense adjective." Bob Acres' remark that, "The best terms will grow obsolete. Damns have had their day," does not appear to apply to Australia, where, to judge from our author, they flourish along with other survivors of a Mesozoic age.

AMERICAN FORESTRY.[1]

COMPETENT English authorities on forestry are so rare that no apology is needed for presenting some extracts from a translation from the German, of an important paper by Sir D. Brandis on American forestry. This is in continuation of a similar translation which appeared about a year ago in the columns of NATURE (vol. xliv. p. 60).

Upwards of 1,000,000 acres of forest are required for the annual supply of wooden sleepers for European railways. These forests are properly managed so as to yield a steady return, whilst nothing of the kind can be said of American forests. This explains why German foresters are interested in watching the progress of forest destruction in America, where it is now merely a question of ten or

[1] "The Silva of North America." By C. S. Sergent, vols. i.–iv. (Boston and New York. Houghton, Mifflin and Co., 1891–92). Notes on the above by Sir D. Brandis, K.C.I.E., F.R.S., in *Zeitschrift für Forst und Jagdwesen*, October, 1892.

fifteen years before a timber famine must occur, which will greatly enhance the value of European forests.

Brandis explains the present lamentable state of affairs in the United States, as follows:—The Timber Culture Act, which was in force in certain of the States, provided that settlers should plant up with trees one quarter of the area allotted to them, and it was thus hoped to obtain forests in the treeless regions between the Rocky Mountains and the Mississippi river. Large tracts of land have been occupied under this Act, but very little progress has been made in afforestation. It is not difficult in the Republic for people to neglect engagements they have made with the State. It has been recognized for some time past that this law has been practically of little use, and it was therefore abrogated in March, 1891. The law abrogating it, in section 24, empowered the President to demarcate and reserve certain tracts of State forest. Great hopes were therefore entertained, and soon afterwards a proclamation was issued largely extending the Yellowstone Park, in Montana, on the borders of Canada.

This measure had been strongly supported for some time past by the American Forestry Association. The Park is a mountain forest tract on the water-parting between the Rivers Columbia and Missouri, and its preservation and proper management is of immense importance. In October, 1891, the extensive forest tract in Colorado in the Rocky Mountains, in which several large tributaries of the Colorado river have their rise, and containing 1,365,000 acres, was proclaimed as the White River Forest Reserve. It was also expected that a portion of the western slopes of the Sierra Nevada, bordering on the Yosemite National Park, and other localities where the *Sequoia gigantea* flourishes, would be proclaimed as State reserves. These two national parks were previously reserved under older laws. The numerous intelligent friends of forestry in America confidently expected that a beginning would now be made in the demarcation of extensive State forest reserves, and in their scientific management.

The most recent news from America, however, has thoroughly upset these expectations. A Bill has been introduced into Congress, to hand over most of the Yellowstone forest reserve to a railway company. It is considered certain that this Bill will pass the Lower House, and it is not expected that the Senate will refuse to sanction it. Wood merchants, mining speculators, and sheep owners are vigorously agitating against the proposed reserve in the Sierra Nevada, and it is feared that their agitation will carry the day.

The American Forestry Association, which held its tenth annual meeting last January, has "memorialized" the President that instead of making a few reserves here and there, he should proclaim the reservation of all State forests still left to the Union, and arrange for their proper management. Friends of the forest are numerous in America, and insight into the essential necessity of forest protection is spreading, owing to the numbers of Americans who travel in Europe, but in a land where the dollar rules, and where an individual who will not recognize its authority is considered a fool, any steady progress towards State forest management cannot be expected.

Bernhard Fernow, the chief of the Forestry Branch of the Ministry of Agriculture at Washington, still hopes for action in this direction on the part of Congress and the State Executive. At the last meeting of the Forestry Association he rightly urged that æsthetic and sentimental grounds for improving American forests must be left entirely in the background. Only where important material interests are concerned, such as securing a continuous supply of wood, or a supply of water, or climatic considerations, should the State limit the freedom of its citizens in dealing with forests. If, however, for urgent reasons of public utility, it should be necessary to reserve a forest, the State should not be contented with merely demarcating and protecting it, but should introduce scientific management, so that the neighbouring populations may be able to utilize the forest produce; and in any case, all pre-existing rights acquired by the people in the forests should be strictly protected. Fernow concludes with the strongly-expressed advice that a law should be passed reserving the relics of the forests of the Union, and preventing any fresh alienations. He firmly believes that such a law is most urgently required. It is, however, quite a different matter for Congress to pass any such law, though more may perhaps be expected from the separate States in the Union, and in those of New York and California some rather halting steps have been taken in the right direction.

As matters stand at present in the United States, it is pretty obvious that a time will come when landowners will look upon their private forests as a good investment, for prices of wood and other forest produce are steadily rising. Little progress has, however, yet been made in this direction, and recent attempts made by some rich men to manage their forests properly with advantage have failed.

Sir Dietrich Brandis then turns to the progress made in the study of American forest trees, and states that literature on the subject is pretty abundant, but is after all merely thrashing straw. What is wanted in America is a practical proof that in forests of the Weymouth pine, of Minnesota, or of Californian red wood, or of Douglas fir in Washington and Oregon, or in the splendid mixed broad-leaved forests of the Alleghany mountains, good forest management will prove more remunerative than wasteful pillage (*Raubbau*).

The remainder of Brandis's paper is chiefly of botanical interest, and greatly praises Sergent's magnificent work. One other passage is too interesting to be omitted. It refers to the mesquit tree, *Prosopis juliflora*, which belongs to the dry zone in the south-west of the United States, and is also found in Mexico, and in the Andes as far as Chili and Argentina. In the river valleys of Arizona, where, although the air is dry, yet subsoil water is near the surface of the ground, this species forms extensive forests. On drier soils the aerial parts of the tree are reduced, but the root system is greatly extended. Sergent states that while the stem may be only a few inches high, and may only bear a few leaves, yet the tap root goes straight down to the subsoil water, and the aerial growth of the tree furnishes a clear indication of the depth at which the latter may be found.

Wherever the mesquit is a tree the subsoil water is forty to fifty feet down, where it is a small shrub it is from fifty to sixty feet down, and wherever the roots descend over sixty feet, the plant is not more than two or three feet high. In the scantily-wooded districts, where the mesquit tree grows, its roots yield most of the firewood, and are dug up, or dragged by oxen from the ground. *Prosopis spicigera* in the drier parts of India similarly furnishes fuel and cattle fodder in the Punjab, Sindh, and parts of Berar. This tree, there termed the *Jhand*, sends down its roots to a depth of fifty feet and more, to the subsoil water, and thus produces wood in a dry country, providing the peasant with fuel and wood for his plough.

W. R. FISHER.

JOHN STRONG NEWBERRY.

IT is not only in the United States that the death of this veteran of scientific research will bring widespread regret. To many geologists and palæontologists in this country and on the Continent he was personally known, and those whom he honoured with his friendship will feel keenly the loss they now sustain. He was born at New Windsor, Connecticut, on December 22, 1822,

and took the degree of M.D. from the Cleveland Medical College, Ohio, in 1848. Before beginning the practice of medicine, which he intended to be his occupation in life, he spent two years in Europe. During his stay at that time in Paris he acquired a good knowledge of the French language, and had many opportunities of cultivating a love of science, which soon manifested itself as one of his distinguishing characteristics. Returning to his native country, he began practice as a medical man at Cleveland in 1851. Even at the outset of his professional work he contrived to find time also for scientific enquiry. His first published paper appeared in the same year in which he started in his medical profession. It is devoted to the geographical distribution of land and fresh-water shells.

But he soon entered upon the two branches of geological investigation in which he was to make his name familiar all over the civilized world—the study of fossil botany and of fossil fishes. As early as the year 1853 he made his first contribution to the history of Carboniferous plants, and three years later his earliest memoir on fossil fishes was published. By this time his scientific acquirements and enthusiasm were widely known. Hence when an expedition under Lieutenant Ives was organized for the exploration of the Colorado River of the West, Newberry was selected to accompany it, and to take charge of the observations to be made in natural history. His geological contribution to the famous Report at once placed him in the very front rank of American geology. His account of the geological structure of the region traversed by the expedition, and of the marvellous denudation of the cañons, will always remain as one of the landmarks of geological progress.

He had now been touched by the fascination of exploration in the far west. The drudgery of medical practice became irksome to him, so that when in the year following his return from Colorado the offer was made to him to take part in another expedition, he gladly availed himself of the opportunity. He accordingly accompanied Captain Macomb in an exploring expedition in the summer of 1859, from Santa Fé, New Mexico, to the junction of the Grand and Green Rivers of the Grand Colorado. This journey forms the subject of another masterly report by him, which, however, was not published for some sixteen years.

The shadows of the coming great Civil War were already falling on the United States, when Newberry was at work on the preparation of the record of the results of his western journeys. The storm at last burst in 1861, the same year in which his Colorado report was issued. Among the many scientific men who placed their services at the disposal of the North, Newberry took a foremost place. His medical skill and wide general scientific knowledge enabled him to be of great use to the army. He specially distinguished himself in the organization and administration of the hospital department. Among the reminiscences of his not uneventful life he had many graphic tales to tell of his experiences during that momentous epoch in the history of the United States. After the close of the war in 1865 he returned with renewed ardour to his scientific labours, and specially devoted his energies to the study of the ancient floras and fish-faunas of North America. Among his numerous memoirs on these subjects the two large monographs forming vols. xiv. and xvi. of the series published by the United States Geological Survey are specially worthy of notice. But they represent only a part of the enormous mass of material which he had worked over.

Prof. Newberry early in his career saw how great was the aid which geology could afford in the development of the mineral industries of his native country, and he gave himself with great energy to the practical applications of the science. He became one of the highest authorities on mining matters in the country, and he was mainly instrumental in the equipment of the great mining school of Columbia College, New York. He occupied the Chair of Geology in that establishment, and threw himself heart and soul into its duties. At last, in the midst of his work and honours, a stroke of paralysis disabled him from active duties, and he grew gradually feebler until his death. With him American science loses one of its most honoured and distinguished cultivators. His piercing eyes and well-cut features made him a marked figure in any assembly, while his courtesy and gentleness, and his unfailing helpfulness and serenity, gave him a charm which will endear his memory to a wide circle of friends. A. G.

NOTES.

ALL entomologists in the country will learn with great satisfaction that the Treasury has consented, on the recommendation of the Trustees of the British Museum, to make provision in the estimates for the coming financial year for the purchase of Mr. Pascoe's well-known collection of insects. The importance of the acquisition of this collection by the nation is very great, as it contains an immense number of types, especially of the families Longicornes and Curculiones, to which Mr. Pascoe devoted so much attention for a period of more than forty years. Its dispersal or removal to a foreign country would have been an irreparable loss to British entomologists.

THE medals and funds to be given at the anniversary meeting of the Geological Society of London on February 17 next have been awarded as follows: The Wollaston Medal to Prof. N. S. Maskelyne, F.R.S.; the Murchison Medal to the Rev. O. Fisher, the Lyell Medal to Mr. E. T. Newton; and the Bigsby Medal to Prof. W. J. Sollas, F.R.S.; the balance of the proceeds of the Wollaston fund to Mr. J. G. Goodchild; that of the Murchison fund to Mr. G. J. Williams; and that of the Lyell fund to Miss C. A. Raisin and Mr. A. Leeds.

BETWEEN June 10 and 18 the University of Montpellier will celebrate the third centenary of the foundation of its Botanic Garden, on which occasion it is intended to invite a general congress of the botanists of all nations.

A MEETING of the Association for the Improvement o Geometrical Teaching was held on January 14, at University College, Gower Street, the chair being taken by the Master of St. John's College, Cambridge. The reports of the Council and treasurer having been read and adopted, Dr. Wormell was elected President for 1893, the hon. secretaries (Mr. E. M. Langley, 16, Adelaide Square, Bedford, and Mr. C. Pendelbury, 4, Glazbury Road, W. Kensington), and the other members of the Council being re-elected. Dr. Wormell having taken the chair, Mrs. Bryant gave a model lesson on geometry to a class of about twenty ladies. After an adjournment papers were read by Mr. G. Heppel on the use of history in teaching mathematics, and by Mr. F. E. Marshall on the teaching of elementary arithmetic. The attendance was larger than usual, and interesting discussions followed the lesson and the papers.

A DEPARTMENTAL committee, consisting of officers of the Charity Commission, the Education Department, and the Department of Science and Art has been appointed by Mr. Acland, Vice-President of the Committee of Council on Education, to consider the question of the organization of secondary education in England and Wales, and the relation of the Departments among themselves in connection with this subject. The Committee consists of the following members:—The Vice-President of the Council (chairman), Sir H. Longley, K.C.B., Chief Charity Commissioner, Mr. T. E. Ellis, M.P., Parliamentary Charity Commissioner, and Mr. Fearon, Secretary to the

Charity Commissioners, representing the Charity Commission; Mr. Kekewich, C.B., Secretary to the Committee of Council on Education, and the Rev. T. W. Sharpe, her Majesty's Senior Chief Inspector of Schools, representing the Education Department; and Major-General Donnelly, C.B., Secretary of the Department of Science and Art, Captain Abney, C.B., F.R.S., Assistant-Director for Science, and Mr. Armstrong, Director for Art, representing the Department of Science and Art, Mr. H. W. Simpkinson, Examiner in the Education Department, acts as Secretary to the Committee.

ON the 25th inst. an influential deputation will wait upon the President of the Board of Trade to urge the adoption of the decimal system of coinage and weights and measures in Great Britain. Among those who propose to form part of the deputation are the Agents-General for Victoria, Queensland, and the Cape, and several prominent members of the various chambers of commerce.

THE Infant University of Chicago seems to be resolved to arrange its staff of teachers on a scale commensurate with the size of the North American Continent. Thus, the Department of Geology is placed in the hands of no fewer than seven distinct professors and two assistant professors, each taking some special branch of this wide science under the competent leadership of Prof. T. C. Chamberlin. Three of the professors are non-resident, but they will probably give occasional lectures, and will at least direct the studies in their own branches of research.

MR. JOHN D. ROCKEFELLER, who had already presented the University of Chicago with 2,600,000 dollars, has now given it another million. The university owns land, buildings, and other property valued at £1,400,000 sterling, and the principal is ambitious enough to hope that in course of time it may have "such an array of magnificent buildings as one sees at Oxford or Cambridge."

A BOTANICAL laboratory has been established at Eustis, Lake co., Florida, chiefly for the investigation of diseases of the orange and other species of *Citrus*, under the direction of Prof. W. T. Swingle. The anatomy, physiology, and pathology of other sub-tropical economic plants will also be investigated.

ON Saturday last Prof. Flinders Petrie delivered his first lecture as professor of Egyptology at University College, Gower Street. In the course of the lecture he said that, besides more than a thousand photographs and various impressions or "squeezes" of sculpture, a collection of original objects would be exhibited for the close examination of students. Miss Edwards had formed a collection with much care—as complete and typical as possible. He hoped also to place on loan his own collection, and to have a series of annual loan exhibitions drawn from the many valuable private collections in England. There would thus be found a collection of deities, the most complete collection of scarabs, the only chronological collection of beads, a dated series of pottery, the largest collection of funeral cones, and also of Egyptian weights. In certain lines of study their museum would not be merely supplemental, but would be in advance of any historical museums. He proposed to give a series of lectures in the autumn and spring, and would prepare students who might wish to undertake practical work in Egypt, where he would spend the time before Christmas to Easter.

MR. ROWLAND WARD is exhibiting in his studio a valuable collection of African trophies and curiosities, most of which have been brought to England by Captain Lugard and Mr. F. C. Selous. Besides natural history specimens, the collection includes many weapons and products of native art.

ANOTHER severe loss has been sustained by science in Russia through the death of the well-known mineralogist, Nikolai Ivanovitch Koksharoff. He died at St. Petersburg on January 2. He was born on December 2, 1818, in West Siberia, in a village near which at that time was the fort of Ust-Kamenogorsk, and he made his studies in the Mining Institute at St. Petersburg. In 1841, when he was a mining engineer in the Urals, he accompanied Murchison on his journey to Russia and to the Urals, and the intercourse with the great geologist led him to adopt a scientific career. He spent the next three years studying in Western Europe, and on his return he devoted himself entirely to minerology, and especially to goniometric measurements of minerals, in which he was so much aided by his wife that his numerous writings on this subject are as much her work as his. He lectured in his early years on geology and physical geography, but later on devoted himself almost entirely to the description of Russian minerals, of which he discovered and described many new ones. His chief works are embodied in eleven large quarto volumes of "Beiträge zur Mineralogie Russlands," illustrated with numerous plates. The twelfth volume was in type when he died. In 1866 he was made a member of the St. Petersburg Academy of Sciences, and many scientific bodies of Western Europe elected him corresponding or honorary member.

DURING the past week the weather has been of a very unsettled character; at first an anticyclone lay over the greater part of these islands, while areas of low pressure were situated over the North Sea and to the west of Norway. With these conditions the weather became warmer in this country, the daily maxima varying from 40° to 46°, but over the Continent very low temperatures continued to be registered, the minima in Sweden varying from 60° to 65° below the freezing point, while exceptionally severe weather also prevailed over France and Germany. On Sunday a depression was passing to the southward of these islands, and under its influence north-easterly gales were experienced in the eastern and southern parts of England; a sharp frost occurred over this country, accompanied by snow in most parts, while a thaw set in over Scotland and rapdidly spread southwards, accompanied by rain, the maximum temperatures reaching from 45° to 50°. Subsequently the conditions were again becoming anti-cyclonic, accompanied by a return of colder weather, but they were not at all settled; snow was falling on Tuesday in the south of England. For the week ending the 14th instant the temperature was everywhere below the mean, the deficit ranging from 2° to 5°. The amount of bright sunshine exceeded the average in the north and west of Scotland and in the south-west of England; elsewhere the amount recorded was very small, being only 3 per cent. in the north-west of England.

Das Wetter of December last contains an account of a heavy thunderstorm which occurred at Paderborn on August 9, 1892, in which a number of living pond mussels were mixed with the rain. The observer who is in connection with the Berlin Metereological Office sent a detailed account of the strange occurrence, and a specimen was forwarded to the Museum at Berlin, which stated that it was the *Anodonta anatina* (L.). A yellowish cloud attracted the attention of several people, both from its colour and the rapidity of its motion, when suddenly it burst, a torrential rain fell with a rattling sound, and immediately afterwards the pavement was found to be covered with hundreds of the mussels. Further details will be published in the reports of the Berlin Office, but the only possible explanation seems to be that the water of a river in the neighbourhood was drawn up by a passing tornado, and afterwards deposited its living burden at the place in question.

Mr. C. F. MAXWELL writes to *Science* from Dublin, Texas, that on the night of November 29, about 8 o'clock, a very large meteor was seen passing westward, a little to the south of that place. Just as it seemed to be passing the body exploded, producing a sound that was distinctly heard, resembling that of a rocket explosion or a pistol-shot. After the explosion a body half as large as a full moon moved away to the westward, making a hissing or frying sound. Mr. Maxwell has seen no one who saw the meteor before the explosion. The whole country was brilliantly lighted for a moment as if by a continued electric discharge, but at the time of the explosion the light was red and blue, or perhaps violet. The sound of the explosion was heard by parties five miles west and seven miles east of Dublin, who could not have been less than ten miles apart on an air-line, and they report the sound together with the other phenomena to have been about the same as they were at Dublin.

WHEN commanding the *Naiade* during the cyclone of November 6, 1891, Rear Admiral Cavelier de Cuverville had the opportunity of testing the efficiency of oil in calming the troubled waves of the North Atlantic. The last number of the *Revue Maritime* contains an account of his experiences and conclusions. When the waves threatened to become dangerous he gave orders to fill two coal sacks with tow steeped in oil, one of them to be suspended freely at the extremity of a spar spanned to the cat-head, the other near the bridge. The effect was excellent. No seas were shipped, and the vessel escaped without breaking a spar. It appears that the oil takes effect upon the "breakers" due to horizontal translation produced by the wind, leaving the orbital motion or "swell" unaffected. The former is the only element of danger in a rough sea. It was found that two sacks, filled with 5 kgr. of tow, holding 5 litres of colza or machine oil each, were sufficient to protect a vessel 75 m. long. The oil had to be renewed every six hours. Too much oil has the disadvantage of spreading more slowly, and theoretically the best system of distribution would be one in which the oil would reach the surface from below in a large number of small drops.

HERR J. NAUE has been fortunate enough to discover at a prehistoric station near Schaffhausen a piece of limestone, on both sides of which are drawings like those which have been found in caves in France and in the cave at Thayngen. It was found in the lowest part of the yellow "Kulturschicht" among bones and teeth of reindeer, horses, and other animals. On one side are a horse, a foal, and a reindeer, while several horses appear on the other. The style is not so fine as that of the Thayngen drawings, but, according to Herr Naue, they display a power of keen observation, and he points out that it was more difficult to work on stone than on a bone still fresh.

THE remarkable address delivered by Prof. Virchow on his assumption of the office of Rector of the University of Berlin has been issued by the German publisher, August Hirschwald, of that city. The title is "Lernen und Forschen."

THE *Pharmaceutical Journal* of the present week prints the first of what promises to be a good series of papers, which are intended to make bacteriology intelligible and interesting to students, and to be of some practical value to pharmacists in business. The *Journal* rightly thinks that the time has come when pharmacists ought to make themselves familiar with the principles of "this newest department of experimental science."

LAST week Lord Kelvin delivered an interesting speech at a dinner given to the members of the new watch factory at Prescot. He said it was something to be proud of that the article they were making was a triumph of mechanism. There was nothing in the whole of scientific art, nothing in the results of mechanics applied to the useful purposes for mankind, that was a more splendid success than the science of watchmaking. He had been all his life engaged more or less with scientific experiments, with measurements, and with instruments which their French friends would call instruments of precision. They knew something of instruments of precision in electricity, and they were thankful if they could make a measurement which was accurate to one-tenth or one-twentieth per cent. But what did watchmaking do? The commonest cheap watch—cheap but good—which would issue from the Prescot works would keep time to a minute a week. Now a minute a week, if they made a little calculation, was something like one-hundredth per cent. of accuracy, or just about ten times as accurate as they considered exceedingly good work in electrical measurements.

AT a recent meeting of the College of Preceptors, Mr. Foster Watson read a remarkably interesting paper on Richard Mulcaster, who was head-master of St. Paul's School from 1596 to 1598. The paper is printed in the current number of the *Educational Times*. Mulcaster's ideas were in some respects far ahead of those of his time. The following, according to Mr. Watson, were his "main educational contentions":—(1) Culture and learning for those who have the wit to profit by it, whether rich or poor. Adequate knowledge for those who go into trade. (2) Education for girls and women, as well as boys and men. Higher education for girls who have good abilities. (3) Training colleges for teachers. (4) Physical training for all—boys and girls, teachers and pupils, and this to be continued in after-life. (5) Liberal education, with disinterested aims for the elementary schools. (6) The best masters to take the lowest classes. (7) Drawing and music to be taught in every school, not as "extras," but as essentials. "You will notice," says Mr. Watson, "that the last-named five aims are only within the field of discussion even yet; they are not *faits accomplis*. All this time they have been in Mulcaster's book, and Mulcaster's book—a few copies of it, very few—have been gathering dust."

THE Association of Officers of Colleges in New England have recommended the gradual adoption of the following changes in the curriculum of New England grammar schools:—(1) The introduction of elementary natural history into the earlier years of the programme as a substantial subject, to be taught by demonstrations and practical exercises rather than from books. (2) The introduction of elementary physics into the later years of the programme as a substantial subject, to be taught by the experimental or laboratory method, and to include exact weighing and measuring by the pupils themselves. (3) The introduction of elementary algebra at an age not later than twelve years. (4) The introduction of elementary plane geometry at an age not later than thirteen years. (5) The offering of opportunity to study French, or German, or Latin, or any two of these languages from and after the age of ten years. (6) The increase of attention in all class-room exercises in every study to the correct and facile use of the English language. In order to make room in the programme for these new subjects, the association recommends that the time allotted to arithmetic, geography, and English grammar be reduced to whatever extent may be necessary. The association explains that it makes these recommendations in the interest of the public school system as a whole, but that most of them are offered more particularly in the interest of those children whose education is not to be continued beyond the grammar school.

MR. WALDO DENNIS gives in *Science* a minute and very interesting account of a snake which he watched for an hour in the woods one morning in July last. It went straight up a tree "without crook or turn," and by-and-by lay still for a while,

basking in the sun. Mr. Dennis notes that while in this position it lifted up its head four or five inches and gaped. Its mouth opened very wide; and when the mouth was closing, the nervous spasm, only half expended, again seized upon the jaws, whereupon they went wider than before, the spasm exhausting itself at last in a parting wriggle or two to the head. "So natural," says Mr. Dennis, "was this novel performance, that I involuntarily listened for that characteristic accompaniment, the little agonizing whine so common with the dog, and and not uncommon with us."

FEW things are more frequently said than that diseases of the nervous system, especially those of a hysterical character, have increased with the growth of civilization. Dr. de la Tourette has been trying to show, in the *Journal de Médecine*, that this is an error, and Dr. D. G. Brinton, in *Science*, expresses cordial agreement with him. Travellers who give the soundest information on the subject, says Dr. Brinton, report that in uncultivated nations violent and epidemic nervous seizures are very common. Castren describes them among the Sibiric tribes. An unexpected blow on the outside of a tent will throw its occupants into spasms. The early Jesuit missionaries paint extraordinary pictures of epidemic nervous maladies among the Iroquois and Hurons. During the Middle Ages there were scenes of this kind which are impossible to-day.

THE question as to whether electrification is produced by the friction of gases has been exhaustively dealt with by Mr. Wesendonck, who gives an account of his results in *Wiedemann's Annalen*. The apparatus resembled that employed by Faraday with negative results, in the case of dry air. Mr. Wesendonck used air compressed to 100 atmospheres in Elkan steel bombs of 1000 litre capacity. This was passed through a brass tube widening out into a cone into which a similar cone could be screwed from the opposite direction, so as to leave a conical path for the air issuing from the bomb. The second cone was connected to a delicate electrometer, which indicated any electrification produced by the impact of the air. Ordinary air was thus found to give considerable negative charges, up to 1½ volt, if the cones were far apart, and positive charges if they were screwed up close. But no electrification was produced when the air had been previously freed from dust and moisture. Oxygen behaved in the same way. Carbonic acid, evaporated from the liquid state, imparted a strong positive charge to the brass, which was, however, reversed as soon as the cold led to the precipitation of water vapour. Ordinary atmospheric dust was found to electrify the brass negatively, the charge being increased by previous drying. It seems, therefore, that pure gases are incapable of producing electrification by friction, and that the effects observed are conditioned by the presence of minute solid or liquid particles.

FISHES in badly-ventilated aquaria give various signs of oppression, such as restlessness, frequent gasping, mounting to the surface, leaping into the air, &c. Experiments have been recently made by Messrs. Duncan and Hoppe-Seyler (*Zeitschrift für Phys. Chemie*) to ascertain to what point the oxygen-content of the water may be lowered before fishes indicate uneasiness. They were made with tench, trout, and crayfish in an elliptical glass vessel, with pipes for injecting and removing water and air, &c., in one case a pipe communicating with a chamber in which was a live rabbit, conveyed to the fishes air impoverished by the latter's breathing, while the behaviour of rabbits and fishes in the same air could be compared. With 4 to 3 cubic centimetres O in the litre of water, the fishes seemed well and content, and with the corresponding O tension in the air (8 to 11 volume-percentage) the rabbit was in no difficulty. With 1·7 to 0·8 cubic centimetres O in the water, the trout were evidently ill at ease, and, if it continued, they died. The tench and crayfish, however, stood still further reductions, the former finding relief at the surface. Reduction of the O to zero soon produced the worst symptoms.

IT was long ago shown by Sir J. B. Lawes that plants on ground that has been long without manure evaporate more water than those on good ground. Further research has proved that transpiration is not proportional to leafy development, for it largely depends on the activity of the roots, as well as evaporative surface. M. Dehérain has lately (*Ann. Agr.*) been led to investigate the influence of manure on the development of roots; and he finds that roots in unmanured ground have a much larger growth than in manured, having to spread more in search of the scanty nutriment. If, then, a plant with small leafy growth, evaporates more water relatively than one with large, it is probably due to large root-growth procuring more water. The observation of Volkens is cited, that desert plants have extraordinarily long roots. Further, M. Dehérain points out, the solar rays falling on a plant have a twofold work to do, viz. assimilation and transpiration. And these are complementary. In strong leafy plants there is vigorous assimilation, so that transpiration is limited; while in the leaves (with little chlorophyll) of an "anæmic" plant a larger fraction of the solar energy is given to transpiration.

IN the *American Geologist* an account is given of a preliminary examination of some specimens of a coaly mineral, having the general properties of a cannel, from the Kootanie and Lower Cretaceous of British Columbia. Their examination was of more than ordinary interest on account of their peculiar physical constitution and the great difficulty of ascertaining their connection with any of the materials ordinarily known to contribute to coal formation. The main characteristics of the mineral are the total absence of structure, and the presence of tubular ramuli resembling fungus mycelia, as well as rounded cavities. Angular fragments of material of the same nature as the larger rod-like bodies appear in the sections, and an amorphous substance either occurring in distinct flakes or acting as a cement to unite the rods. Mr. Penhallow's examination has made it probable that the origin of these coals must be sought in some other direction than modified vegetable structure. It is suggested that they represent a form of fossil resin accumulated during a period when resin-bearing trees were very abundant, and possessed a structure favouring the rapid disintegration of organic tissue.

A YOUNG lady in America seems to have the power of awakening not only the intelligence but the affections of insects. Her experiences are recorded in *Science* by a friend of hers, who signs himself "B." In September some one gave her a beetle, which is described as a specimen of *Pelidnota punctata* Linn. At first she kept it in a small box, feeding it with grass, leaves, and small pieces of fruits, such as peaches, pears, &c. Occasionally she would give it a drop of water to sip. It would sometimes bite a little out of a leaf, would eat the fruits, and would take water eagerly. From the first she would take the insect in her fingers several times a day and stroke or caress it, also putting it to her lips and talking to it all the while she handled it. When she put it to her lips it would brush its antennæ over them with a gentle, caressing motion. When she left her room she would shut it up in its box. One day, about two weeks after she received it, she was called out suddenly and neglected this precaution. She was absent for some time, and when she returned the insect was not in its box nor anywhere to be seen. Fearing that she might injure it, she stood still and called "Buggie, buggie," when it came crawling from its retreat towards her. "After this," says "B.," "she would frequently leave it free in the room when she went out, and when she returned, if the insect was not in sight, she would

call it, and it would crawl or fly to her. As this was continued, it would more and more frequently fly to her instead of crawling, until at last it flew nearly every time it was called. When it came in this way she would put it to her lips or to her nose, and the insect would appear to be pleased, moving its antennæ gently over her lips, or taking the end of her nose between them and touching it with a patting motion." Unfortunately this interesting beetle lost its liveliness in winter. It was placed on a cloth above the kitchen boiler, where it revived to some extent; but in December it accidentally fell to the floor and soon afterwards died.

THE annual report of the U.S. Commission of Patents for the year 1891 has been issued. In addition to the usual statistical information there are added to this report two tables and two diagrams illustrative of the growth of patent-granting from 1790 to 1890, the first century of the existence of the American patent system. The first table gives the patents granted in that period by years and by States to American citizens. The second table does the same for patents granted to citizens of foreign countries. The first diagram has one line illustrating graphically the growth of patent-granting during the century, along with another line denoting the increase of population in the same period. The second diagram has one line illustrating the growth per capita of patent-granting as a whole during the century, and other lines illustrating the growth per capita of patent-granting in the States by groups of States. There is also a list of patentees and their improvements, by years, prior to the year 1800.

THE first volume of the *Irish Naturalist*, a monthly journal of general Irish natural history, has just been published, and a very interesting volume it is. The editors are Mr. G. H. Carpenter and Mr. R. Lloyd Praeger, and they have secured from able contributors many good articles on subjects which cannot fail to be attractive to Irish readers. The volume also records work done by some of the foremost of the Irish scientific societies.

THE Bureau des Longitudes has issued, through Messrs. Gauthier-Villars et Fils, its "Annuaire" for the year 1893. It contains, as usual, a great mass of scientific information, clearly arranged. Among its "notices" is an interesting paper upon the observatory of Mont Blanc, by M. J. Janssen.

THE Belgian Royal Academy of Science, Letters, and Art has also issued its "Annuaire." Among the contents is a rather elaborate memoir of Jean Servais Stas, accompanied by an excellent portrait.

MESSRS. CHARLES GRIFFIN AND CO. have published a ninth edition of "A Pocket Book of Electrical Rules and Tables for the Use of Electricians and Engineers," by John Munro and Andrew Jamieson. The authors state that the work has been carefully revised and enriched with fresh matter, including several important communications by leading authorities on electro-technics.

MESSRS. GEORGE BELL AND SONS have issued the first portion of a supplement to the third edition of "English Botany, or Coloured Figures of British Plants." This part has been prepared by Mr. N. E. Brown. The rest will be done by Mr. Arthur Bennett.

IN our review of "Modern Mechanism" last week (p. 242) a typical American express locomotive with 20 × 24 cylinders was said to be less powerful than an 18 × 26 cylinder British engine. This should, of course, be reversed, the American engine being the more powerful.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus* ♀) from India, presented by Mr. F. Skinner; eleven Tuatera Lizards (*Sphenodon punctatus*) from Stephen's Island, Cook's Straits, New Zealand, presented by Captain E. A. Findlay; a Puff Adder (*Vipera arietans*) from East Africa, presented by the Directors of the British East African Company; a Vulpine Phalanger (*Phalangista vulpina*), from Australia; a a Stanleyan Chevrotain (*Tragulus stanleyanus* ♂) from Java, deposited; a Sanderling (*Calidris arenaria*), European; two Brown Capuchins (*Cebus fatuellus*), an Azara's Fox (*Canis azaræ*), a Ring-tailed Coati (*Nasua rufa*), seven Glossy Ibises (*Plegadis falcinellus*), a Brown Milvago (*Milvago chimango*), four Barn Owls (*Strix flammea*), a Ypecaha Rail (*Aramides ypecaha*), a Chilian Pintail (*Dafila spinicanda*), a Geoffroy's Terrapin (*Platemys geoffroyana*) from South America, purchased; a Hog Deer (*Cervus porcinus*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

COMET HOLMES.—The following telegram was received from Dr. Copeland on Tuesday evening:—"Comet Holmes reported suddenly brighter. Stellar" (nucleus). We therefore continue the ephemeris. (Schulhof, for Paris, midnight.)

Date		R.A app. h. m. s.	Decl. app. ° ′
Jan.	19 ...	1 25 53·2 ...	+33 39
	20 ...	27 13·7 ...	39
	21 ...	28 35·1 ...	39
	22 ...	29 57·2 ...	39
	23 ...	31 20·1 ...	40
	24 ...	32 43·7 ...	40
	25 ...	34 8·0 ...	41
	26 ...	1 35 33·0 ...	+33 42

The comet is now almost midway between β Andromedæ and α Trianguli.

BURNHAM'S DOUBLE-STAR OBSERVATIONS.—Mr. Burnham's splendid series of double-star measures, made chiefly with the 3-foot refractor at the Lick Observatory during the first six months of 1892, are published in *Ast. Nach.* No. 3141. He states that the superiority of the great telescope for this work has been fully demonstrated. In the present list there are micrometric measures of eight new double stars, and additional measures of 170 old ones. χ Pegasi has completed more than one revolution since its discovery in 1880, the period being about eleven and a half years, which "is probably shorter than that of any other known pair in the heavens."

Mr. Burnham's connection with the Lick Observatory having permanently ended in June last, the present list of measures concludes his work on double stars. It is to be hoped that the field of work which he has so brilliantly occupied will not be neglected in the future.

EPHEMERIS OF COMET BROOKS.—The following is a continuation of Kreutz's ephemeris for Berlin, midnight:—

Date.	R.A. (app.) h. m. s.	Decl. (app.) ° ′	Log r.	Log Δ.
Jan. 19 ...	22 58 23 ...	+ 48 59·3 ...	0·0835 ...	9·9670
20 ...	23 5 14 ...	47 36·7 ...	0·0845 ...	9·9786
21 ...	11 26 ...	46 17·3 ...	0·0856 ...	9·9902
22 ...	17 4 ...	45 1·2 ...	0·0867 ...	0·0017
23 ...	22 13 ...	43 48·5 ...	0·0879 ...	0·0132
24 ...	26 56 ...	42 39·0 ...	0·0891 ...	0·0245
25 ...	31 16 ...	41 32·8 ...	0·0904 ...	0·0358
26 ...	23 35 17 ...	+ 40 29·6 ...	0·0917 ...	0·0468

THE ECLIPSE OF APRIL 16, 1893.—In a communication to the Astronomical Society of France, M. de la Baume Pluvinel indicates some of the points to which attention should be directed in the eclipse of the sun in April. In the first place, he does not think any of the precious moments of totality need be devoted to the study of prominences, as these can now be completely studied at any time. The investigation of the corona is all-important, and attempts should be made to obtain photographs showing its general aspect with various exposures, as well as photographs of its spectrum. The different parts of

the corona are of such varying brightness that it will be impossible to obtain all the details with a single exposure. For the spectroscopic work it is also recommended that isochromatic plates be employed, with special reference to the distribution of the material which gives the green line 1474 Kirchoff. Mr. Lockyer proposes to use an objective prism, so as to obtain monochromatic images of the corona, that is, rings corresponding to each elementary radiation of the coronal light. This method will not only give the spectrum of the corona, but the distribution of each spectrum line over the whole of it. The problem of the "reversing layer" is also wanting definite solution, and it is pointed out that instantaneous photographs may settle the question once for all. M. Pluvinel also points out the importance of noting the presence or absence of the hydrocarbon bands suspected by Tacchini in 1883, as this observation may throw further light on the analogy between the corona and the tails of comets.

Photometric observations should also be secured, and the polariscope should be employed to determine the proportion of polarized light in various parts of the corona.

NOVA AURIGÆ.—Prof. Barnard has recently made some measures of the position of Nova Aurigæ, with a view to detecting proper motion. The two comparison stars selected were the stars E and F in Mr. Burnham's previous list of comparison stars. The results are stated thus (*Ast. Nach.* No. 3143):—"The measures with F come out identical with Mr. Burnham's during February, but those with E seem to show some sort of motion in distance and possibly in angle. From the position of the comparison star this can hardly be due to parallax. It is possible, though, if the discrepancy is a real displacement, that it is due to orbital motion, the orbit being so situated as to show no motion with reference to F. The difference is not sufficiently great, considering the distance, to prove anything." Prof. Barnard further remarks that although the Nova presented no nebulosity at its first appearance, it has always appeared as an undoubted planetary nebula since he observed it on August 19. Estimates of magnitude in the present condition of the Nova will depend greatly upon the telescope and magnifying power employed. Since August the nucleus has become fainter, while the light as a whole has remained essentially constant.

"ASTRONOMICAL JOURNAL" PRIZES.—"A gentleman earnestly interested in the development and progress of astronomy in his native land has authorized the editor of the *Astronomical Journal* to offer two prizes, for resident citizens of the United States" (*Ast. Jour.* No. 284). The prizes will either take the form of money or of gold medals, one being of the value of two hundred dollars and the other of four hundred dollars. In the first instance the prizes will be awarded for observations tending to advance our knowledge of cometary orbits, one being for the best series of measurements of the positions of comets during the year ending March 31, 1894, and the other for the best discussion of the path of a periodic comet, with due regard to its perturbations. With regard to the first, astronomers who hope to gain the prize must frequently be at work until sunrise, as special value will be attached to observations made at inconvenient hours.

GEOGRAPHICAL NOTES.

THE name Ibea, contracted from the initials of the Imperial British East African Company to designate their territory on the east coast of Africa, has acquired a certain amount of currency, and although open to philological criticism is practically convenient. On the same principle the great Dutch possessions in the East Indies have been termed Noi (*Nederlandsch Ost Indie*), and Mr. Ravenstein has suggested a similar abbreviation for the German East African territory (*Deutsch Ost Afrika*), only he would combine the initials with a Swahili affix or suffix signifying "land," and make it either Udoa, or Doani. The cumbrousness of using many words to specify a well-defined region seems to justify a somewhat bolder coinage of new names in geography than has hitherto been customary.

THE *Mouvement Geographique* publishes a sketch map of the Stanley Falls district of the Congo, compiled from the compass-bearings of M. Page, one of the members of the disastrous Hodister expedition. Besides Stanley, Lieutenant Gleerup and Dr. Oscar Lenz are the only other authorities on this stretch of the river. Special information is given regarding the three groups of rapids which occur between Stanley Falls station and Kibonge. The cataract of Mandombe above Stanley Falls is composed of a succession of falls from six to ten feet high and numerous rapids, but local canoe-men are able to take boats through in four or five hours. Three hours of free navigation leads to the rapids of Mamanga, where the river is barred from bank to bank by a ridge of rock about twelve feet high, and followed by rapids and other smaller falls necessitating a portage. Three and a half hours of free navigation lead to Basundu, the last cataract, which canoes are able to pass in about three hours after being lightened.

THE Antarctic whaling fleet, the dispatch of which was noticed in vol. xlvi. p. 477, has been reported from the Falkland Islands. The *Balaena*, which has the most complete scientific equipment, arrived at Port Stanley at the end of November, the *Active* on December 8, the *Diana* on December 11. The fourth vessel, the *Polar Star*, was spoken off the Plate on November 16. The telegram from Monte Video reports all well, and a preliminary notice of the scientific observations will probably follow by mail.

IN a communication to the Paris Geographical Society, M. Venukoff calls attention to the fact that although the extensive Government drainage works have almost obliterated the Pinsk marshes from the valley of the Pripet, the most recent non-Russian atlases continue to represent these marshes as they were thirty years ago. Now their site is largely forest and meadow-land.

TRAVELS IN BORNEO.

MR. CHARLES HOSE'S paper on "A Journey up the Baram River to Mount Dulit and the Highlands of Borneo," read to the Royal Geographical Society on Monday evening, was a pleasant variety in the succession of African papers which has formed the staple of the Society's programme for the session.

The Baram River runs on the whole northward through eastern Sarawak, reaching the sea in 4° 37′ 15″ N. and 115° 59′ 30″ E. Its mouth is complicated by a series of sandbanks shifting with the change of the monsoons. The river is in parts very deep, and is navigated by a fleet of Government steamers. The bordering land is low and swampy or covered with jungle until Claudetown, about sixty miles from the mouth, is reached. There the ground rises, and a prosperous trading town has been established by Chinese merchants. At Long Mari, about fifty miles further up, there are great rapids which can only be passed with difficulty, and gorges of considerable depth occur at intervals further up the stream. The journey to Mount Dulit was made up the Linjar, a large tributary of the Baram. The people on the banks of this river have a peculiar custom of keeping dead bodies in their houses encased in ornamental coffins for three months before burial; and Mr. Hose gave some highly interesting particulars regarding their burial customs, their complicated subdivisions of the world of the dead, and their habit of interchanging messages with departed friends. At the head of canoe navigation the Sibop tribe hunt various species of monkeys with the blowpipe, the valuable commodity being the intestinal calculi known as Bezoar stones, which are greatly in demand by Chinese apothecaries.

The ascent of Mount Dulit was commenced on September 21, when a hut was built at the height of 2000 feet, and a path cut through the thorny scrub to 4000 feet, near which another hut was built. Several days were spent here collecting natural history specimens, many of which were species new to science; amongst the smaller quadrupeds *Hemigale hosei*, and amongst birds *Calyptomena hosei* and *Mesobucca eximius* may be mentioned. A cave some distance higher was found with wild tobacco growing at its mouth and several remarkable ferns, one with fronds 14 feet long; but except for bats and a solitary snake, the cave was untenanted. The fauna of Mount Dulit closely resembled that of Kina Balu, showing the widespread distribution in the highlands of Borneo of Himalayan forms. The flat moss-clad summit of Mount Dulit was found to be, by aneroid, 5090 feet; and there was a magnificent view of distant ranges, the position of a number of peaks in which was fixed. Some natives reported having heard a tiger roaring in the neighbourhood, but Mr. Hose found the sound to proceed from a gigantic toad, measuring 14½ inches round the body. At the close of the paper Dr. Bowdler Sharpe F.R.S., pointed out the great importance of Mr. Hose's results in their bearing on geographical distribution.

BACILLI IN BUTTER.

THE fact that milk affords a particularly suitable medium for the growth and multiplication of most micro-organisms, has rightly led to its being regarded as a dangerous vehicle for the propagation of disease. On the Continent the practice of boiling all milk before use, and so destroying any pathogenic microbes which may be present, is almost universal, and recently a number of special pieces of apparatus have been devised for household use, ensuring the efficient so-called "pasteurization" of milk. In England, however, we but rarely boil our milk in spite of outbreaks of diphtheria and typhoid fever having been not infrequently traced to a particular milk supply. In a paper by Cnopf on the bacterial contents of milk it is stated, that on one occasion out of every thirteen samples of milk supplied to Paris one was found to contain tubercle bacilli, whilst it is well known that the germs of typhoid, cholera, diphtheria, anthrax, &c., thrive readily in this medium. But although milk has been made the subject of much careful experimental investigation, comparatively little is known of the microbial condition of butter. Heim has shown that cholera bacilli purposely rubbed into butter could be demonstrated after thirty-two days, whilst typhoid bacilli similarly introduced were found after three weeks, and tubercle bacilli after the lapse of a month, although Gasperini discovered the latter in butter even after 120 days. Quite recently Lafar has published a paper, "Bacteriologische Studien über Butter" in the *Archiv für Hygiene*, in which he has recorded his investigations on the micro-organisms found in Munich butter. These experiments are instructive as exhibiting the fitness of butter to support a large number of bacteria, and thus furnish an interesting supplement to what is already known concerning the longevity of pathogenic microbes in this medium. The samples examined were prepared from fresh cream and were investigated as soon as possible after the butter was made. It was found that the number of microbes differed according as the portion for experiment was taken from the outside or from the interior of the piece of butter. Thus in one instance whilst one gram from the centre of the pat contained 2,465,555, on the outside in the same quantity as many as 47,250,000 micro-organisms were found. Taking the average of a number of examinations, it was estimated that the interior of a lump of butter possessed from 10 to 20 millions of bacteria in a single gram. Lafar is inclined to regard this as an under rather than an over-statement of the number, inasmuch as there are always probably present a certain proportion of microbes which will not develop at the ordinary temperature, or on the gelatine-peptone medium usually employed. He graphically puts it that, in some cases it is conceivable that the number of organisms swallowed with a moderately-sized slice of bread and butter may exceed that of the whole population of Europe! Lafar found that butter kept in a refrigerator, with a temperature of between 0° to + 1° C. at first (after five days) showed a marked reduction in the number of bacteria, but that no further diminution took place, although the sample was kept for a month at this temperature. Samples kept at from 12° to 15° C. exhibited a marked increase in the number of micro-organisms, a rise from 6 to 35 millions being observed in the course of nine days, whilst when placed in the incubator (35° C.) after four days the bacteria had fallen from 25 to 10 millions, and after thirty-four days only 5 per cent. of the original number present were discoverable. Experiments were also made to ascertain what was the bacterial effect of adding salt to butter kept in a refrigerator. It was found that although the numbers were thereby considerably reduced, that yet, even when as much as 10 per cent. of salt was added, the complete destruction of the bacteria was not accomplished. On examining, however, gelatine-plates prepared from these samples, it was ascertained that the organisms present consisted almost entirely of a pure cultivation of one particular microbe, which was apparently entirely unaffected by the addition of salt, and had grown and multiplied to the exclusion of nearly all the other bacteria originally present. When samples similarly salted were placed in the incubator (35° C.) the result was rather different, for whilst there was more apparent connection between the proportion of salt added and the diminution in the number of bacteria, more varieties of micro-organisms were found on the gelatine-plates. But in this case, also, the germicidal effect produced was not proportional to the increase in the amount of salt. Samples of artificial butter were also examined, and were invariably found to be much poorer in bacteria than ordinary butter. Thus, whilst the smallest number found in one gram was 747,059, in real butter considerably over two million microbes was the minimum. Two varieties of bacilli have been isolated and described, which were found very constantly present in butter throughout these investigations. They are beautifully illustrated and shown in coloured plates as individual organisms and colonies at the end of the paper. Lafar purposes continuing his investigations, and it is to be hoped that the examination of butter for pathogenic micro-organisms, about which so little is known, will form an important feature in any further researches he may undertake.

GRACE C. FRANKLAND.

THE OCCURRENCE OF NATIVE ZIRCONIA (*BADDELEYITE*).

THE discovery of native zirconia was first made public in my letter to NATURE (vol. xlvi. p. 620) in October last; at the same time I gave characters sufficient for the recognition of the new mineral, and suggested the name *Baddeleyite*, in honour of Mr. Joseph Baddeley who had brought the specimen with other dense minerals from Rakwana in Ceylon. As there was only a single fragment of what at first sight seemed a hopelessly imperfect crystal, the determination of all the important characters without appreciable injury of the specimen was a task of an attractive kind: the technical details of the investigation (including quantitative chemical analyses) and the line of argument by which definite results were evolved from the observations, were communicated to the Mineralogical Society at the meeting held on October 25 (NATURE, vol. xlvii. p. 70), and crystals of hydrous zirconium oxychloride prepared by identical methods from Baddeleyite and artificial zirconia, respectively, were exhibited for comparison. Having regard to the unexpected result of the chemical examination and the difference of the characters of Baddeleyite from those of artificially prepared crystals of zirconia, every care had been taken to get results as accurate as the material itself would admit of.

Of course it was hoped that the occurrence of native zirconia, once established, would soon be noticed elsewhere; and in fact, I hear this morning (January 3) from Dr. Hussak of the Geological Survey of Brazil, that flawless crystals of zirconia are actually met with in the south of São Paulo as an accessory constituent of an augitic rock described under the name of Jacupirangite by my friend Mr. O. A. Derby.

The Brazilian mineral had three or four years ago been regarded by Dr. Hussak (who had then only a small amount of material for examination) as probably orthite (silicate of cerium, iron, &c.), a mineral with which it agrees in its more obvious external characters, and it was mentioned later under that name in Mr. Derby's description of the Jacupirangite; but more recently Dr. Hussak, on isolating a score of flawless crystals from the decomposed rock, recognized the distinctness of the mineral from orthite, determined the geometrical and physical characters of the crystals, and decided from a chemical examination that the material was a tantalo-niobate of probably some member of the yttrium-cerium group: these results were published in the *Neues Jahrbuch für Mineralogie*, 1892, Band II. p. 142, immediately after my announcement of the occurrence of native zirconia in Ceylon had been sent for publication, but they had been forwarded from Brazil as early as the month of June. Dr. Hussak now informs me that the Brazilian mineral, which had been sent to Sweden for a complete quantitative examination, has been determined by Prof. Blömstrand to be almost pure zirconia.

As regards crystalline form, the parametral elements obtained by myself for Baddeleyite, and announced at the meeting of October 25, agree in a very satisfactory way with those determined by Dr. Hussak for the Brazilian mineral, while as regards optical characters, the two descriptions are practically identical. The only important deviation of external character is in the specific gravity; that of Baddeleyite is 6·025, that of selected crystals of the Brazilian mineral is 5·006.

Now it seems almost impossible that the specific gravity of crystals of a simple oxide presenting otherwise identical characters can vary to this extent, and the explanation of all the difficulty will probably be found to be that Dr. Hussak's specimens really belong to two distinct minerals; that while the crystalline form and optical characters were determined from the one (zirconia), the specific gravity and the chemical composition

were originally determined from the other (yttrium tantalate). In fact, it was stated in my former communication that the Baddeleyite of Ceylon is itself associated with such a chemical compound; and I may add that this associated mineral was there designated without the mention of a species-name because it had been found to have a specific gravity (4·9) far below the inferior limit (5·5) hitherto observed in the case of undoubted Yttrotantalite: it was intended to determine later whether or not the lowness of the specific gravity was accompanied by a difference in the proportion of the chemical constituents; further, the similarity of aspect of the zirconia and yttrium tantalate of Ceylon is such that a confusion of the two would be easy. In this way the discrepancy of the chemical results and the complete accuracy of the observations of Dr. Hussak, whose reputation stands so high in the annals of mineralogical science, would be found consistent with each other.

There remains the inconvenience that two names have been suggested for the same mineral; but according to the rules of nomenclature formulated by Dana (rule 13*d*) the name of *Baddeleyite* has the prior claim. I may add that the name *Brazilite* was in use eight years ago, commercially at least, for the specification of an oil-bearing rock found in the neighbourhood of Bahia. L. FLETCHER.

GAS POWER FOR ELECTRIC LIGHTING.

AT the ordinary meeting of the Institution of Civil Engineers on Tuesday, January 10, an interesting paper on "Gas-Power for Electric Lighting" was read by Mr. J. Emerson Dowson. The author stated that in Great Britain alone gas-engines had been sold for electric lighting, exceeding in the aggregate 7000 horse-power, and that in Germany engines were used for about 1100 arc- and 90,000 glow-lamps. It was, however, only within the last few years that gas-engines of large size had been before the world in a practical form. The varying load-factor in central stations was a serious trouble, and the author hoped to show that much of the present loss, due to fuel, water, and wages, would be avoided if gas-power were used instead of steam-power.

Special reference was made to the central-station at Dessau, belonging to the German Continental Gas Company. That station was opened in 1886 with two 60 horse-power, one 30 horse-power, and one 8 horse-power (effective) engines, worked with town-gas, and all the dynamos were driven by belting and counter-shafts. In 1891 considerable alterations were made. One 60 horse-power engine, with its belting and counter-shaft, was retained, and one of 120 horse-power introduced, coupled direct to its dynamo. The speed of the engine and coupled dynamo was 145 revolutions per minute, and the consumption of town-gas was equal to 39 cubic feet per kilowatt. Formerly, without accumulators, it was thought necessary to adjust the size of the engines to the supply, so that they should always be worked to their full extent. It had, however, been found that a limited supply could more advantageously be furnished entirely from accumulators. In spite of the loss of about 21 per cent. in the accumulators, large engines worked more profitably in parallel than smaller ones supplying direct without accumulators. Since February, 1889, the Municipality of Schwabing, a suburb of Munich, had used an Otto engine worked with Dowson gas for 10 arc- and 300 glow-lamps. The load was variable, but with an average output of 22·5 kilowatts per hour the fuel-consumption was 3·3 lbs. per kilowatt. The town of Morecambe was lighted by nine arc-lamps and glow-lamps, equal to 1600 of eight candle-power each, the dynamos being driven by Stockport gas-engines worked with Dowson gas. With an output of only 1155 kilowatts per week the consumption of fuel was 2·58 lbs., and the cost of the gas, including wages and fuel, was ½d. per kilowatt delivered. At the château of Mr. Say, at Longpont, in the South of France, there were 650 glow-lamps and one arc-lamp, supplied by a dynamo driven by a Crossley engine worked with Dowson gas. The consumption of fuel was 1·2 lb. per indicated horse-power, and 2·7 lbs. per kilowatt per hour.

It was believed that the late Sir William Siemens first drew attention to the fact, that when illuminating-gas was burnt in a gas-engine to drive a dynamo, much more light was produced electrically than could be produced by burning the same quantity of gas in burners in the usual way. Latterly the consumption of gas per horse power in gas-engines had been reduced, and the ratio was at the present time about 20 to 1 in favour of converting the gas into an arc-light, by means of a gas-engine. The author had collected data from various sources, as to the consumption of ordinary town-gas by engines supplying electric light with and without accumulators. The average of all the returns, with engines under varying loads and without accumulators, was about 47 cubic feet per kilowatt-hour; when accumulators were used, the consumption of gas was less, because the engines then worked under a full load. With 47 cubic feet per kilowatt, and 55 watts per 16 candle-power, one light of that power required only 2·6 cubic feet per hour; whereas a standard Argand burner required 5 cubic feet per hour. In this comparison, it was assumed that the glow-lamps and gas-burners were in good order, but under ordinary working conditions they did not maintain so high a duty.

The question of load-factor was a serious one with any type of engine, but with gas-engines the loss was much less than with steam-engines. When a gas-engine was stopped, its consumption of fuel stopped also, and there was no furnace to maintain, nor was there any water to boil at starting. At the same time, it was desirable that the gas-engine should be worked as much as possible under a full load, and in this respect the experience at Dessau was generally confirmed. A central-station was worked under trying conditions, and in the London district there was only a full output of current during from three to five hours in every twenty-four; moreover, about 60 per cent. of the total output was required during that short period. In practice, this meant that in a station where the current was supplied without accumulators, the engines were run at a reduced speed during a portion of the time, and at other times some of them were stopped altogether; but all had to be ready to work in the evening, and occasionally in the day-time, when there was fog. Generally, it might be assumed that the average consumption was more than 6 pounds per kilowatt where accumulators were used, and about 9 to 12 pounds where they were not used. In any case, with the best possible arrangement of steam-power, there must be a large amount of fuel consumed which did no useful work; for, even if some of the fires were drawn, they had to be re-lighted, and the large quantity of water which had cooled during the time of standing must be re-heated.

The author believed that the solution of the difficulty was to be found in the use of gas-plant instead of steam-plant. With a large gas-engine, one brake horse-power per hour could be obtained with a consumption of about 1 lb. of anthracite, or 1¼ lb. of coke; whereas the consumption of coal with the steam-engines used for central-stations, must be taken at about 2½ lbs. per brake horse-power, when working under a full load. A saving of not less than 50 per cent. could therefore be effected in stations where the engines were fully loaded; and where there were great fluctuations in the output, the loss of fuel with boilers not used, or only partly used, could be almost entirely avoided. For a maximum of 400 kilowatts, there would be three gas-generators, each capable of supplying one-third of the maximum required. The production of gas could be raised or lowered in several ways, and the working of each generator could be stopped immediately by shutting off its steam supply. Supposing, therefore, that all three generators were working at their maximum rate, and a gradual reduction was required, this could easily be effected; and when the production of one or two generators could be dispensed with their operation was at once stopped. The third generator could then be kept at work, and its production adjusted to suit the minimum consumption required. A gas-generator had a small grate-area compared with that of a boiler, and much less cooling-surface; it contained no water, and required no chimney-draught. A generator of the size referred to lost only 6 to 8 lbs. per hour whilst standing. If an average of only 40 per cent. of the maximum power were required for twenty-one hours, it was equivalent to letting two of the generators stand for that period; and at 8 lbs. each per hour that meant a total loss of only 3 cwts.; compared with the much greater waste when steam-power was used. As the use of large engines, driven with generator gas, was of recent date, the author proceeded to describe the gas-plant used, and gave the results of engines working regularly with Dowson gas, under the usual conditions obtaining in factories. He also gave the results of brake-tests made with several engines of large size, and reproduced indicator diagrams taken from engines of different makers. Although admirable results had undoubtedly been obtained from engines

working with the Otto cycle, he was of opinion, that, with engines of large size, the results would be still better if the cycle were altered, especially when generator-gas was used. His reasons for this were fully stated in the paper.

The following was a summary of the points urged by the author:—

1.—When town-gas was used for driving the engines of an electrical station, the consumption was about 50 per cent. less than the volume of gas required to give the same amount of light by ordinary burners.

2.—When town-gas was used, neither boiler nor firemen were required, and there were no ashes to remove; less space was needed; no accumulators were required, except such as might be necessary to equalize the load of the engines and to provide for a small amount of storage. The engines could be worked in the most crowded districts, close to where the lights were required, and where boilers were not allowed.

3.—When generator-gas was used, the consumption of fuel under a full load would be at least 50 per cent. less than with steam-power, and the loss due to steam-boilers not being fully worked could be almost entirely avoided.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—We regret to hear that Professor Cayley has been suffering from serious illness, and that he is in consequence unable to give this term his advertised course of lectures in Pure Mathematics.

L. Cobbett, M.A., M.B., of Trinity College, has been appointed Demonstrator of Pathology in the place of Dr. E. Lloyd Jones, who has resigned the office.

Mr. F. Darwin, Deputy Professor of Botany, announces a special course of lectures in the Chemical Physiology of Plants, to be given by Mr. Acton, of St. John's College, on Tuesdays in the present Lent Term.

Mr. J. Y. Buchanan, F.R.S., announces a second course of lectures in Geography, to be given in the Easter Term.

Mr. A. E. Shipley has been appointed an additional member of the Special Board for Biology and Geology.

SCIENTIFIC SERIALS.

Journal of the Royal Agricultural Society of England, 3rd series, vol. iii. pt. 4.—Cottage sanitation (illustrated), by H. McLean Wilson, a paper prepared under the supervision of Dr. Spottiswoode Cameron and T. Pridgin Teale, F.R.S. It contains a discussion of the principal sanitary defects, which are most likely to be found in the houses of agricultural labourers, with valuable suggestions and remedies. The object aimed at is "to put the whole country, and every house in the country, into such a condition that if the epidemic (cholera) should break out it would have no chance of spreading."—Field experiments on the fixation of free nitrogen, by James Mason, gives an account of the enriching of some plots of poor land on the Oxford clay at Eynsham by the growth of two leguminous crops in succession. The two crops chosen were beans and mixed clovers. So far as they go the results are striking. Prior to 1888 the land had never been cultivated or received any manure. Brought into tillage in that year two plots produced 10½ cwts. and 9 cwts. per acre of barley and oats respectively, straw included,—an excessively low return. In the autumn of 1888 the plots were treated with 20 cwts. of basic slag per acre, and the subsoil with the same amount. Beans in the following year yielded an average of 46 bushels and 23 cwts. straw per acre. In 1890 mixed clovers gave a yield of 28 cwts. per acre as the average of the two plots, and in 1891 a crop of three tons clover-hay was obtained. Potatoes were grown upon the plots last year, and gave an average yield of eight tons per acre. Excepting the basic slag, no manure of any kind had ever been applied to the plots. The experiments are being continued and extended.—Wild birds, useful and injurious (illustrated), by C. F. Archibald.—Utilization of straw as food for stock, by Joseph Darby. Showing methods of using chaffed straw as a remedy for the deficient hay crop of last summer, with records of previous experiences under similar circumstances.—Yew poisoning, by Mr. E. P. Squarey, Mr. Charles Whitehead, Mr. W. Carruthers, F.R.S., and Dr. Munro. But few definite conclusions can be arrived at, owing to the conflicting nature of the information available. It appears, however, (1) that both the male and female yews are poisonous; (2) the poisonous alkaloid (or alkaloids) exists chiefly in the leaves and in the seeds; (3) the fleshy part of the fruit is harmless, or nearly so; (4) the amount of poisonous alkaloid in the leaves varies considerably with individual trees, and perhaps with the season of the year. Dr. Munro contributes a review of the chemical work done upon taxine, the only alkaloid in yew which has been investigated; very little is known with certainty about it, either as to its chemical nature or its physiological action. As Dr. Munro suggests, "yew leaves merit *exhaustive* chemical examination."—Besides the official reports, there are several short articles, including one upon the ferments of milk, abridged by Dr. Munro from Prof. H. W. Conn's pamphlet on the subject, issued last summer; also a paper upon the decline of wheat-growing in England, by the editor.

American Journal of Science, January.—The age of the earth, by Clarence King. This paper contains an application of Lord Kelvin's reasoning from probable rates of refrigeration to the determination of the earth's age, aided by Dr. Carl Barus's recent work in geological physics, especially his determination of the latent heat of fusion, specific heats melted and solid, and the volume expansion between the melted and solid state, of the rock diabase. Thermal considerations have shown that with a given initial excess of temperature of the earth over surrounding space, and an assigned value for rock conductivity, it is possible to determine the curve of temperature from the earth's centre to its surface. It appears that for an initial temperature of 2000° C., the initial maximum temperature must still extend uniformly from the centre to within a few hundred miles of the surface for any admissible value of the age. But since the pressures increase steadily as we proceed towards the centre, there must be a point at which their effect outweighs that of the temperature, and the material, though very hot, remains in the solid state. Now on the data supplied by Barus's researches it is possible to state what temperatures are necessary to keep a certain representative species of rock in the fluid state at successive points within the earth. The amount of possible liquid layer is limited by the facts of tidal rigidity, which fix the maximum admissible temperature at 1950° and the age at 24×10^6 years. Lower values are excluded by the gradient of temperature observed on proceeding downwards from the surface. This value, twenty-four million years, agrees fairly well with the age assigned by Helmholtz and Kelvin to the sun. It is also concluded that the earth never was all liquid, that the original liquid layer did not exceed 53 miles, and that the spheroidal shape is due to the plasticity of the lithosphere as manifested under the action of very slowly applied forces.—Tertiary geology of Calvert Cliffs, Maryland, by Gilbert D. Harris.—"Anglesite" associated with boleite, by F. A. Genth.—Preliminary account of the iced-bar base apparatus of the United States Coast and Geodetic Survey, by R. S. Woodward.—Some experiments with an artificial geyser, by J. C. Graham.—Observations of the Andromed meteors of November 23 and 27, 1892, by H. A. Newton.—Preliminary notice of a meteoric stone seen to fall at Bath, South Dakota, by A. E. Foote.—New Cretaceous bird allied to Hesperornis, by O. C. Marsh.—Skull and brain of Claosaurus, by O. C. Marsh.

THE *Botanical Gazette* for October contains an interesting article by Mr. H. L. Russell on the bacterial investigation of the sea and its floor. The author has had the opportunity of carrying on bacteriological observations in sea-water, both from the Bay of Naples and from the coast of Massachusetts. He finds micro-organisms invariably present in sea water, though not in such large numbers as in fresh water, even at a great distance from the shore, and to a depth of 3200 feet; and a larger number in the slime at the bottom than in the water itself. Some marine forms are cosmopolitan, and the bacteria that are so universally present in sea-water and mud seem to be quite peculiar to this habitat.—Mr. E. L. Berthoud describes the mode in which the geographical distribution of some plants has been greatly extended by the agency of the buffalo.—In the number for November Prof. Underwood gives a report of the proceedings of the International Botanical Congress lately held at Genoa.—Mr. G. W. Martin contributes an account of the development of the flower and embryo-sac in *Solidago* and *Aster*.

Bulletin of the New York Mathematical Society, vol. ii. No. 2, November 1892.—This number practically consists of one paper, and that a very interesting one, by Dr. Emory McClintock, "On the Non-Euclidian Geometry," a subject which has been more than once brought before our readers. In vol. viii. (1873) appeared Clifford's translation of Riemann's Habilitationsschrift "ueber die Hypothesen welche der Geometrie zu Grunde liegen" (1854). In 1883 this geometry was considered in Cayley's British Association address, and quite recently (February 25, 1892) in a translation of Poincaré's "Revue Generale des Sciences." "The chief lesson to be obtained from all non-euclidian diversions is that the distinguishing mark of euclidian geometry is fixity of distance-measurement, by which alone it is possible to draw the same figure upon different scales. That the same figure may be drawn upon different scales might well be laid down as the axiom necessary and sufficient to distinguish euclidian from non-euclidian geometry." To this is appended a footnote which says that this is "referred to as 'the axiom of similars' by Sir *Richard* (sic) Ball in the article 'Measurement' of the "Encycl. Brit." A short article follows on the new logarithmic tables of J. de Mendizábal-Tamborrel (Paris, Hermann, 1891). In addition there are the usual "Notes," but no list of publications.

No. 3, December 1892.—This number contains a careful criticism of Ball's "Mathematical Recreations," with suggestions and discussions by Prof J. E. Oliver of Ithaca, New York, and an account of Dr. Julius Bauschinger's "Zweites Münchener Sternverzeichniss, enthaltend die mittleren Oerter von 18,200 Sternen für das Aequinoctium, 1880," by Prof. T. H. Safford. "Notes" and "New Publications" follow.

Wiedemann's Annalen der Physik und Chemie, No. 12.—On the temperature coefficient of the electrical resistance of mercury and on the mercury resistances of the Imperial Institution, by D. Kreichgauer and W. Jaeger. The coefficient was measured in the case of the copies of standard resistances already described. The formula obtained for the resistance w_t at temperature t by two independent methods was

$$w_t = w_o\ (1 + 0{\cdot}000875t + 0{\cdot}00000125t^2)$$

—Generation of electricity by friction of gases against metals, by K. Wesendonck.—On galvanic polarization at small electrodes, by F. Richarz.—Electric oscillations in wires, direct measurement of the moving wave, by Kr. Birkeland. The oscillations were produced in two copper wires running parallel to each other at a distance of 80cm. They were 30m. long, and ended in one direction in brass plates 40cm. square, facing two similar plates connected with the terminals of the spark gap of a powerful induction coil. The potentials along the wire when the coil was working were determined by measuring the length of the sparks crossing between the knobs of a spark micrometer, one of them being connected with the wire by a sliding contact, the other leading through a telephone to earth. Statical effects on the telephone were made inappreciable by laying a thread moistened with dilute sulphuric acid across the wires near the "collector" plates. Under these circumstances the passage of sparks was immediately indicated by the telephone, and their length could be measured down to 0·0005mm.—Determination of dielectric constants by means of the differential inductor, by Oscar Werner.—Measurement of resistances by means of the telephone, by Max Wien.—Diffusion of light by rough surfaces, by Christian Wiener. Experiments made on cast gypsum show that Lambert's law of diffusion, according to which the brightness of a surface is independent of the angle from which it is seen, is not strictly correct. The brightness at the edge of a round surface is 0·6 times that given by his law. In the vicinity of reflection points the brightness is greater, and at the greatest brightness the angle of incidence is greater than the angle of reflection.—A unit for measuring intensity of sensation, by the same.—On internal friction of solid bodies, especially metals, by W. Voigt.—Measurement of the coefficient of diffusion of liquids, by F. Niemoeller.—Absolute compressibility of mercury, by G. de Metz.—Propagation of energy through the ether, by G. Helm.—On the utilization and action of the telephone in electrical null methods; reply to Hr. Winkelmann, by E. Cohn.—On the solution of sodium silicates, and influence of time upon their constitution, by F. Kohlrausch.—Behaviour of polarized light in refraction, by G. Quincke.—On a mercury arc light, by L. Arons.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Meteorological Society, December 21.—C. Theodore Williams, President, in the chair.—The following papers were read:—Moving anticyclones in the Southern Hemisphere, by Mr. H. C. Russell, F.R.S., Government Astronomer, New South Wales. The author describes the results of his practical study of the daily weather charts for Australasia, and states that the leading fact brought out is that the weather south of 20° S. latitude is the product of a series of rapidly moving anticyclones, which follow one another with remarkable regularity, and are the great controlling force in determining local weather. These anticyclones are more numerous in summer than in winter, the average number for the year being 42. They usually take seven or eight days to travel across Australia in summer, and nine or ten days in winter; the average daily rate of translation being 400 miles. The shape of the anticyclone appears to undergo some modification as it nears the east coast. The winds on the north side of the anti-cyclone are not so strong as those on the south side, and the intensity of the weather is in proportion to the difference in pressure between the anticyclone and the V-depression, but the relation of the pressures varies frequently before the wind responds, the pressure appearing to be controlled from above by the more or less rapid descent of air which feeds the anticyclone. Cyclonic storms are very unusual, and do not occur more than once in two or three months.—The tracks of ocean wind systems in transit over Australasia, by Capt. M. W. C. Hepworth. The author has examined the daily weather charts of Australia and New Zealand, and has prepared maps showing the daily positions of the centres of high and low pressures for a whole year. He finds that the wind systems, which make their first appearance to the westward and south-westward, advance to the eastward rapidly, and frequently very rapidly, during the winter months, but during the summer months they usually move more slowly, and not unfrequently recurve. Their progress is retarded by contact with the areas of high pressure which they encounter; the mean of the tracks of these anticyclones, moving also from west to east, appears to be across the southern portion of Australia and onward, crossing the islands of New Zealand during the winter months, but to the southward of Western and South Australia, across Victoria and New South Wales, and thence to the north-eastward, avoiding New Zealand during the summer months.—Rainfall of Nottinghamshire, 1861–90, by Mr. H. Mellish. The author has collected and discussed all the rainfall records made in the county during the thirty years, and finds that in the extreme west the mean rainfall is 27 inches or more, and that over the rest of the county it varies between 25 and 27 inches, except north of the Manchester, Sheffield and Lincolnshire Railway, where the rainfall is less than 25 inches, and in the north-east towards Gainsborough, where it is not more than 23 inches. The year of greatest rainfall was 1872, and of least rainfall 1887. October is the wettest month and February the driest.—A new instrument for cloud measurements, by Dr. Nils Ekholm.

Geological Society, December 21, 1892.—Prof. J. W. Judd, F.R.S., Vice-President, in the chair.—The following communications were read:—On a Sauropodous Dinosaurian vertebra from the Wealden of Hastings, by R. Lydekker. In addition to *Hoplosaurus armatus* and *Pelerosaurus Conybearei*, there is evidence of another large Sauropodous Dinosaur in the Wealden, now known as *Morosaurus brevis*. Up to the present time it has been impossible adequately to compare *Hoplosaurus armatus* with *Morosaurus brevis*; but recently Mr. Rufford has sent to the British Museum an imperfect dorsal vertebra of a large Sauropodous Dinosaur from the Wealden of Hastings, which enabled the required comparison to be made. The author describes the vertebra, contrasts it with that of *Hoplosaurus armatus*, and gives presumptive evidence that it should be referred to the so-called *Morosaurus Becklesi* (Marsh), which apparently cannot be separated from *M.* (*Cetiosaurus*) *brevis*. He has not been able to compare Mr. Rufford's specimen with the dorsals of the American *Morosaurus*, in order to discover whether the English Dinosaur is correctly referred to that genus. This paper led to a discussion, in which the chairman, Mr. Hulke, Prof. Seeley, Mr. E. T. Newton, and the author took part.—On some additional remains of Cestraciont and other fishes in the Green Gritty Marls, immediately overlying the Red Marls of the Upper Keuper in Warwickshire, by the Rev. P.

B. Brodie. The vertebrate remains occur in a very thin band of marly friable sandstone lying between two beds of green marl, though in some places the same bed has itself no admixture of sandy material. Bones and teeth are so numerous that it might almost be called a bone-bed. It does not exceed three inches in thickness. It contains ichthyodorulites of Cestraciont fishes, abundant palatal teeth of *Acrodus keuperinus*, ganoid fish-scales, and abundant broken bones, some of which may belong to fishes, others to labyrinthodonts, and amongst the latter a fragment of a cranial bone. The Chairman congratulated the Society on the presence of one of its Fellows who had been connected with it for nearly sixty years, and had read his first paper almost half a century ago. He hoped that the Society would still continue to receive communications from the same source of like interest and value. Mr. J. W. Davis, Mr. H. B. Woodward, and Mr. E. T. Newton also spoke.—*Calamostachys Binneyana*, Schimp, by Thomas Hick. Communicated by J. W. Davis.—Notes on some Pennsylvanian calamities, by W. S. Gresley. — Scandinavian Boulders at Cromer, by Herr Victor Madsen, of the Danish Geological Survey. Communicated by J. W. Hulke, F.R.S. During a visit to Cromer in 1891 the author devoted much attention to a search for Scandinavian boulders, and obtained three specimens; one (a violet felspar-porphyry) was from the shore, and the other two were from the collection of Mr. Savin. The first was considered to come from south-east Norway, and indeed Mr. K. O. Björlykke, to whom it was submitted, refers it to the environs of Christiania. The author considered that the two specimens presented to him by Mr. Savin, who had taken them out of Boulder Clay between Cromer and Overstrand, were from Dalecarlia; and these were submitted to Mr. E. Svedmark, who compared one of them (a brown felspar-hornblende-porphyry) with the Grönklitt porphyry in the parish of Orsa, and declared that the other (a blackish felsite-porphyry) might also be from Dalecarlia. This paper was discussed by Mr. C. Reid, Mr. J. W. Davis, the Rev. P. B. Brodie, Dr. Hicks, Mr. Marr, and the Chairman.

EDINBURGH.

Royal Society, December 19, 1892.—Sir Douglas Maclagan, President, in the chair.—Dr. Hunter Stewart read a paper on an extension of Kjeldahl's method of organic analysis, and described an apparatus which he had devised for the estimation of the amount of organic carbon present in water.—Prof. Rutherford read a note by Dr. W. G. Aitchison Robertson on the madder-staining of dentine. Rabbits were fed on madder for some time and were then killed, the dentine being then found to be stained. When other food was supplied for a time, the process of feeding on madder being resumed afterwards, two coloured layers were found in the dentine, with an intermediate colourless layer.—Prof. C. G. Knott read a paper on recent innovations in vector theory. He entered into a critical examination of the anti-quaternionic attitudes taken up by Prof. Willard Gibbs, Mr. Oliver Heaviside, Prof. Macfarlane, and others. His chief arguments were (1) that the quaternion was as fundamental a geometric conception as either its scalar or its vector part—indeed more fundamental; (2) that in the development of his dyadic notation, Prof. Gibbs, being forced to bring the quaternion in, logically condemned his own position; (3) that a really flexible vector analysis must be versorial, the equations $ij = k$, $jk = i$, $ki = j$, &c., being from the geometrical and physical point of view essentially rotational; (4) that the non-associative character of the vector-analysis, in which i^2, j^2, k^2, were *assumed* to be + 1, rendered it totally unfit for higher physical research; (5) that this tinkering with the algebraic sign quite spoiled the real efficiency of the very beautiful quaternion operator ∇.—Prof. Gibbs, for example, being compelled to introduce the (supposed) new functions of operation Pot, New, Lap, Max, which in quaternions are the very simplest of inverse functions of ∇, and are best expressed as such.

DUBLIN.

Royal Dublin Society, December 21, 1892.—Prof. A. C. Haddon in the chair.—Prof. Sollas, F.R.S., read a paper on pitchstone and andesite from tertiary dykes in Donegal. The author found that a microscopical examination of some remarkably fresh glassy rocks from Donegal revealed a close resemblance between them and rocks of the same age in Arran. This helps to confirm the supposed great extension of tertiary dykes through the north-west of Ireland. Prof. Sollas next read a paper on the variolite and associated igneous rocks of Roundwood, co. Wicklow. He described them as a complex of basic rocks, including altered ophitic dolerite, spilite (variolite du Drac), and spherulitic tachylite (variolite de la Durance). In connection with the epidotisation of the rock the author pointed to the excessive fissuring which it has undergone; and showed that the formation of epidote is attended with considerable diminution of volume, sufficient to account for the cracks. The formation of serpentine and chlorite is attended with expansion, and chlorite can scarcely be formed without the simultaneous liberation of a disproportionately large percentage of quartz. This explains the common association of chlorite with the quartz of quartz veins.—Sir Howard Grubb, F.R.S., described a new system of mounting for monster reflecting telescopes.—Mr. H. H. Dixon read a paper on the germination of seedlings in the absence of bacteria. Seeds, the outer coats of which were sterilized, germinated in the absence of bacteria, and being kept absolutely free from bacteria did not, after growth had ceased, suffer the decay of death, but remained for more than twenty months apparently unchanged. An apparatus for sterilising the outer coats of the seeds and sowing them without the introduction of bacteria was also described.—A paper was communicated by Prof. A. C. Haddon, and Miss A. M. Shackleton, describing some new species of Actiniæ from Torres Straits.

BERLIN.

Meteorological Society, December 6.—Dr. Vettin, President, in the chair.—Prof. Assmann gave a detailed description of the meteorographs set up in the "Urania-pillars." Each pillar contains a thermograph, a barograph, and a hygrograph, placed side by side in a metal case through which a rapid current of air is kept up. The thermograph consists of a Bourdon spring, filled with alcohol, whose movements are communicated to an external recording-lever. The barograph is made of four boxes joined together, and delicately balanced by a weight, whose movements are similarly recorded externally. The hygrograph consists of a bundle of hairs 2 m. in length. The above instruments have continued to work well after several months' use. Their chief defect is due to the hygroscopic properties of the paper on which the three levers trace their record. The large amount of material in the shape of meteorograms already collected has revealed a number of interesting facts. Thus, for instance, the temperatures recorded on two closely-adjacent pillars may differ by 1° or more not only on a warm summer day, but also during the night of November 26, the coldest of this year. In one case the air was found to be warmed by the adjacent row of houses exposed to direct sunlight. In another the radiation was observed to be greater opposite a gateway than in the street. The very considerable local differences of air-temperature recorded on closely-neighbouring pillars could scarcely have been *à priori* expected.

Physiological Society, December 9, 1892.—Prof. du Bois Reymond, President, in the chair.—Prof. Exner, of Vienna, gave a *résumé* of his researches on the innervation of the crico-thyroid muscle in rabbits and dogs. In each he had found a branch from the pharyngeal branch of the vagus distributed to this muscle, together with the superior laryngeal nerve, to which he has given the name of median laryngeal nerve. The communication was illustrated by an experimental demonstration.—Dr. Hansemann stated that he had obtained photographs of microscopic objects, which when placed in a stereoscope, presented an appearance of solidity. They were produced by taking one photograph of the object in focus for a given level, and then a second photograph at a different level. These photographs united stereoscopically gave the impression of solidity.—Prof. Hilgard drew attention to the remarkable fact that the most civilized races of antiquity usually established themselves in dry districts. This he attributed to the fact, borne out by numerous analyses of soils in America, that in dry regions the earth is far richer in mineral food-stuffs necessary to plant life than in wet regions where these are largely washed out of the soil. Hence in dry regions simple irrigation suffices to produce a luxuriant vegetable growth, while on the other hand the soil of moist regions is very rapidly exhausted.

PARIS.

Academy of Sciences, January 9.—M. de Lacaze-Duthiers in the chair.—Drainage waters of cultivated lands, by M. P. P. Dehérain. An experimental investigation of the substances found in water drained from various cultivations showed that all the waters contained a fair proportion of nitrates. Even beet-root, which not only utilizes nitrogen for the formation of its

albuminoids, but also stores nitrates in its tissues, gave 31, 39, and 95 gr. of nitric acid per cubic metre of drainage water. Beetroot gives, however, the least quantity of nitrogen in the drained water in proportion to the crop. Next comes Turkey corn, and then potatoes. It appears certain that all nitrogen which enters the soil is either assimilated or else lost. In the case of a bad harvest there is a loss both from the poverty of the crop and the impoverished state of the soil.—On the small planets and nebulæ discovered at the Nice Observatory by MM. Charlois and Javelle, and at the Mounier observing station, by M. Perrotin. A list of eight minor planets discovered by the photographic method in four weeks, *i.e.* one-sixteenth of the time necessary to achieve the same result by eye observation.—Dilatation and compressibility of water, by E. H. Amagat. Tables are given showing the relative volumes of a quantity of water at pressures varying from 1 to 3000 atmospheres and temperatures ranging from 0° to 198°; and others showing the compressibility of water under the same conditions. This is seen to vary inversely as the pressure, and also inversely as the temperature up to very high pressures, when it begins to increase with the temperature.—Observations of Brooks's comet (November 19, 1892), made at the Paris Observatory (west equatorial), by M. O. Callandreau.—Observations of solar phenomena, made at the observatory of the Roman College during the third quarter of 1892, by M. P. Tacchini.—On the reduction of elliptic integrals, by M. J. C. Kluyver.—On the thermal variation of the electric resistance of mercury, by M. Ch. Ed. Guillaume. Pointing out the remarkable agreement of his results with those obtained by Messrs. Kreichgauer and Jäger, at the Physico-Technical Institute of Germany (see *Wiedemann's Annalen*, No. 12).—On the measurement of power in multiphase currents, by M. Blondel.—Absolute value of the magnetic elements on January 1, 1893. The elements for that date, determined at the magnetic observatory of the Parc Saint-Maur, situated in long. 0° 9′ 23″ E. and lat. 48° 48′ 34″ N., are the following :—

	Absolute values on January 1, 1893.	Secular variation in 1892.
	° ′	′
Declination	15 24·3 ...	− 6·4
Inclination	65 8·5 ...	− 0·5
Horizontal force ...	0·19596 ...	+ 0·00016
Vertical force ...	0·42297 ...	+ 0·00019
Total force	0·46616 ...	+ 0·00024

The values for the magnetic and meteorological observatory of Perpignan, long. 0° 32′ 45″ E., lat. 42° 42′ 8″ N., are

	Absolute values on January 1, 1893.	Secular variation in 1892.
	° ′	′
Declination	14 12·9 ...	− 5·9
Inclination	60 13·3 ...	− 1·8
Horizontal force ...	0·22278 ...	+ 0·00030
Vertical force	0·38933 ...	+ 0·00003
Total force	0·44856 ...	+ 0·00017

—On the purification of arsenical zinc, by M. H. Lescoeur. Zinc destined for toxicological operations can be obtained free from arsenic, antimony, sulphur, and phosphorus by two successive operations, viz. oxidation by means of nitre, and fusion with chloride of zinc.—Combinations of quinoleine with the halogen salts of silver, by M. Raoul Varet.—Symmetric dipropylurea and dipropylsulphourea, by M. F. Chancel.—On a substance derived from chloral, or chloralose, and its physiological and therapeutic effects, by MM. Hanriot and Ch. Richet.—On phagocytosis observed on the living animal, in the branchii of the lamellibranch molluscs, by M. de Bruyne.—New observations on the affinities of the different groups of gasteropods, by M. E. L. Bouvier.—On an anomaly recently presented by the secular variation of the magnetic needle, by M. Léon Descroix.—Influence of motion on the development of fowls' eggs, by M. A. Marcacci.

AMSTERDAM.

Royal Academy of Sciences, December 24, 1892.—Prof. Van de Sande Bakhuysen in the chair.—In a paper read by MM. S. Hoogewerff and W. A. van Dorp, some isoimides of camphoric acid were described. These were obtained by the action of $POCl_3$ or $CH_3.COCl$ on some substituted camphoramic acids. The following reaction takes place :—

$$C_8H_{14}\begin{matrix}CO.NHR\\COOH\end{matrix} + CH_3.COCl = C_8H_{14}\begin{matrix}C=NR\\>O\\C=O\end{matrix} + HCl + CH_3COOH$$

where R is put for CH_3, C_2H_5 or C_7H_7. The isoimides are very unstable; they easily add one molecule of water, re-generating the acids from which they derive. By the action of heat they are transformed into the ordinary imides $C_8H_{14}\begin{matrix}-CO\\-CO\end{matrix}\!>NR$. —The same authors called attention to the fact that it seems to be a general reaction of the anhydrides of bibasic acids to dissolve in the aqueous solutions of ammonia and the primary amines, forming the corresponding acid amides : $R\begin{matrix}CO\\CO\end{matrix}\!>O + NH_2.R_1 = R\begin{matrix}CO.NHR_1\\COOH\end{matrix}$. — Mr. Bakhuis Roozeboom dealt with the solubility-curve for systems of two bodies. The general form of such a curve in its totality, as yet not known even by the researches of Engel, has been encountered by the author and Mr. Schreinemakers in studying the solubility of $Fe_2Cl_6.12H_2O$ in solutions of HCl. The curve is a continuous one, combining the two solubilities of the hydrate, recently made known by the author. It presents a summit when the proportion of Fe_2Clf is the same as in the solid hydrate. Part of the solutions give on water-additions a deposit of the hydrate, part of them give redissolution. The general form of the curve for double salts would be represented in its totality by a closed curve, surrounding the point, indicating the composition of the double salt. With this form the same division of the solutions in regard to their behaviour on water-addition is possible as above.—Prof. Lorentz treated of Stokes's theory of the aberration of light. The hypothesis of M. Stokes, that the movement of the ether admits of a velocity-potential, is in contradiction with the supposition that, at the surface of the earth, the velocity of the ether is equal to that of the planet. It might, however, be doubted whether, in M. Stokes's explanation, the first hypothesis is really necessary. In the present note it is shown that it cannot be avoided.

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