THURSDAY, NOVEMBER 22, 1894.

PSYCHOLOGY OF MENTAL ARITHMETICIANS AND BLINDFOLD CHESS-PLAYERS.

Psychologie des Grands Calculateurs et Joueurs d'Échecs. Par Alfred Binet. (Paris: Hachette and Cie., 1894.)

WHOEVER may hereafter write about mental imagery will be imperfectly equipped for his task unless he has mastered the contents of this curious and instructive volume. It analyses the mental processes of two groups of remarkable men—those who possess extraordinary powers of mental arithmetic, and those who are capable of playing eight or more games of chess, blindfold and simultaneously. The idea of making the inquiry is due to the late Prof. Charcot; its prosecution has been conducted almost wholly by M. Binet, and principally at his laboratory in the Sorbonne. The prosecution of such an inquiry with the accuracy needed by modern psychology is exceedingly difficult, and it is also very difficult to express such results as may be obtained from it, in unambiguous language. The author has, however, succeeded in the latter as well as in the former, and he has framed many happy turns of expression which will contribute to the much desired evolution of psychological language.

The book begins by quoting the series of historical cases of mental arithmeticians, that was published by Scripture in 1881, in the *American Journal of Psychology*. They suffice for making useful generalisations, though few of the cases were tested with much precision. Then the original work commences. It refers to two remarkable calculators, who are now living, both of about the age of twenty-six, but whose mental processes entirely differ in their most obvious characteristics. The one is Inaudi, a Piedmontese, who performs his mental sums wholly, or almost wholly, by imagined sounds, *one*, *two*, *three*, &c.; the other is Diamandi, a Greek, who attains the same end almost wholly by imagined figures, as 1, 2, 3, &c. The careful testing of these two men, and the analyses and comparisons of the results, show the strange unlikeness of human minds in the above well-marked features, accompanied, it may be, with a nearer likeness in those deeper and more obscure qualities, which are exceedingly difficult to grasp. I, myself, had the pleasure of testing Inaudi at my own house, in company with a few scientific friends. Even the small number of experiments that there was then time to make, rendered it clear to my own mind that the conclusions which had been arrived at, after prolonged and careful experiments in France, were quite justified, namely, that he performs his long sums almost wholly by his auditive imagination, supplemented possibly by the motive, or gesture sense, but that the visual form of imagination was practically absent during the calculations. His case is an extremely rare one, and proportionately valuable for study. On the other hand, Diamandi is an excellent example of the common type of mental calculators, who work almost wholly by the visual imagination. A comparison between the achievements of Inaudi and Diamandi under similar tests, is the main feature of the first half of Binet's volume. He succeeds in distinctly negativing the assertion that the visual memory, even of a man who is so exceptionally gifted in that way as Diamandi, resembles actual vision either in its accuracy or in its completeness. Thus if a small square table of twenty-five figures, five figures in breadth and five in height, is shown to and learnt by Diamandi, he takes only nine seconds to repeat them in successive lines, but if he is asked to repeat them in the order of the columns, he is just four times as long in doing so, whether the columns are mentally read from their tops downwards, or from their bottoms upwards. He does not therefore read the figures as if they were written on a mental blackboard, which could be done as easily in any one direction as in any other, but he has, in some obscure way, to puzzle the figures out. When another table of twenty-five figures is taken, in which the figures are variously coloured, Diamandi's power of re-presenting colours being about as strong as that of re-presenting form, he has no difficulty in learning them, but he does it by two successive operations, first learning the figures and then the colours, and he is consequently twice as long over his task. This could hardly be the case if the visualised schedule had the completeness of an "after-image" or of a photographic plate.

A great difficulty in the way of testing the power of the memory of professional calculators is caused by their habit of accumulating large stores of mnemonic helps, which produce results that simulate those of a direct memory. It is indeed difficult for any one to free himself wholly from the use of such helps, which arise unbidden, more or less consciously, certain runs of figures, or accidents of position in the page, being more readily fixed in the memory than others. Binet's chapter on this subject is very instructive.

The most famous calculating boys had their calculating faculties developed very early in life. Many began to calculate of their own accord before they could read or write, and for the most part they were born in humble circumstances. It is found, so far as present information goes, that they did not inherit their gifts, except in a few cases, of which the Bidder family is a conspicuous instance. For my own part, I hesitate for awhile to accept the above negative result as a fact, and on the following grounds. Two mental peculiarities have to concur in the making of a calculating boy; the one is a special capacity for mental calculation, and the other is a passion to exercise it. Both of these peculiarities are rare, and they are not necessarily coordinated, therefore the chance of their concurrence in full force may be very small indeed. I have, however, reason to suppose that the capacity for mental calculation is more common than is usually believed, but that it does not commonly interest its possessor, and may even be unknown and consequently neglected by him. Trustworthy evidence for or against its hereditary transmission could hardly be obtained under these conditions. I may quote the case of a deceased lady of remarkable ability, which I indirectly verified to my own satisfaction at the time. She told me, and her husband confirms my recollection, that one night, while travelling to the south of France, she could not sleep, so she

amused herself, as is common on such occasions, with various idle trains of thought. Then it occurred to her to try mental sums, and finding, much to her surprise, that she had great facility in doing them, she became interested and exerted herself to the utmost. Before her train had reached Lyons, she had successfully multiplied one series of eleven figures into another series also of eleven figures. She subsequently trained herself to multiply fifteen figures into another fifteen. I am informed that her first attempt at the latter had one error, and, on being told that it was not correct, she went over it again mentally and gave the correct result. Another case comes to my memory. It appears that there was a craze for mental arithmetic in the period 1820–30, or thereabouts. My father was interested in the subject and made experiments on many friends and on all his servants, with the result, as I used to hear, that the best performer of all, and a really remarkable one, was a somewhat obtuse and uninteresting servant girl. She took no especial pleasure in calculation, and on that account would never have made a study of its processes by herself; nevertheless, she had the capacity for using them. An innate passion for arithmetic, such as all the great calculators possessed, is certainly uncommon. If only a moderate passion for it should exist, it is likely to become repressed by circumstances, because it is nearly useless to the possessor. It is difficult to imagine that anyone who was not fascinated by figures would devote the best part of his time and energy to them. Professional calculators are said to be usually (by no means always) narrow-minded, and to have their heads filled with mnemonic contrivances.

I may be permitted to allude to an inquiry analogous to that which has here been made into the visual and auditive imaginations, which I made on myself, on a small scale, in respect to the olfactile imagination. I tried to perform mental arithmetic, not by imaginary visual symbols, or by imaginary sounds, but by imaginary smells. As sums are set in the two former cases, either in really visible symbols or in really audible sounds, while the results are reached through imaginary ones, so in my experiment the sums were set in real odours, and were worked out through imaginary odours. I described the result briefly, not many months ago, in the *American Psychological Review*, and think the inquiry worth repetition, especially by experimenters who may possess the power of re-presenting odours to themselves more vividly than I have. It would enable them to perceive the processes gone through in mental arithmetic from a new point of view. My apparatus consisted of glass tubes, each drawn to a nozzle at one end like a short syringe. One end of a piece of india-rubber tube, six or eight inches long, was pushed tightly over the other end of the glass. A different odorous substance, camphor, carbolic acid, gasolin, &c., was inserted and packed lightly with cotton wool in the several tubes, whose ends were afterwards tied up. On grasping one of these tubes tightly, at the moment when its nozzle was brought to the nostril, a whiff of its peculiar odour was ejected and simultaneously sniffed up. This could be rapidly repeated three or four times without much diminution of the odour of the whiff. (An arrangement with valves would have much improved its action, by ensuring that no air should be ejected that had not passed through the scent.) I thus possessed a set of tubes that could be used *smellingly*, in the same way as the symbols 1, 2, 3, &c., are used visually, or the words *one*, *two*, *three*, &c., are used audibly. This is not the place to enter into further details. I only desire to emphasise one fact which the experiment taught me, namely, the existence of a large substratum of mental work that my power of introspection failed to penetrate. I progressed far enough to be able to add or subtract small sums, so that a 1 followed by a 2, both in smell language, associated themselves at once with the imaginary sniff of a 3, whenever I was engaged in addition, or with that of a 1 when I was engaged in subtraction. But the two associations of 3 and 1 never clashed; they were mutually exclusive. I could not ascertain through introspection what was the nature of the *attitude of mind* which determined whether the association was to be the one needed for addition or for subtraction, for division or for multiplication. Another point that strongly impressed me was the enormous amount of labour that must have been gone through by all of us in thoroughly learning the multiplication table. I made a very few similar experiments with the gustatile or taste-imagination, but they were troublesome, and I did not follow them up.

There is little room now left to speak of the latter half of Binet's volume, which refers to the great chess-players, who play eight or more games blindfold and simultaneously. The evidence is overwhelming that the faculty of visualising is not exercised by them in the same sharp and distinct way that it is commonly supposed to be They do *not* see the chessmen and the complete board all at once and with clear definition, but they commonly see all besides the portion they are considering, more or less vaguely, and they appreciate the positions of the men as hidden centres of forces. Two letters, which close the volume, by the distinguished chess-players Goetz and Tarrasch, seem to me models of exact introspection and of clear description. FRANCIS GALTON.

THE COLLECTED WORKS OF OLBERS.

Wilhelm Olbers, sein Leben und seine Werke. Im Auftrage der Nachkommen herausgegeben von Dr. C. Schilling. Erster Band, Gesammelte Werke. xix. + 707 pp. 8vo., with portrait. (Berlin, 1894.)

GERMANY has not produced as many amateur astronomers as England has, but among them the man whose complete writings have now been published occupies a most remarkable place. Olbers was an amateur, but his work was that of a professional astronomer. Though occupied all day in the extensive practice of a physician, he devoted his nights to searching for comets, making micrometric observations of these bodies, whether found by himself or others, with the annular micrometer, an instrument the immense value of which he was the first to perceive, and computing their orbits by the simple method devised by him, which he is said first to have applied practically while watching at the bedside of a patient. At the top of his house in the Sandstrasse in Bremen he had his exceedingly

modest observatory, at the equipment of which, consisting only of small and portable instruments, any modern amateur would turn up his nose. For years he was obliged to correct his clock by tedious observations of equal altitudes with a sextant and artificial horizon, until he devised the simpler and quicker method of watching the disappearance of stars behind a distant tower. But his labours brought him a plentiful reward, not only in the discovery of the planets Pallas and Vesta and various comets, and in the renown which these and his important publications procured him, but also in the friendship of Schröter, Zach, Gauss, Bessel, Schumacher, Encke and others, who always in their letters and published writings mention him with the greatest veneration.

The publications of Olbers are scattered through many volumes of the various periodicals of his time, some of which are not readily accessible now-a-days. But most of them are still of the highest importance, not only those describing the method which is practically the only one used for computing cometary orbits, but also those in which Olbers has deposited the results of his deep study of the literature of comets, ancient and modern, as well as the many articles which bear witness to his having possessed mathematical abilities of no mean order. The appearance of the complete edition of his works now before us will therefore be hailed with pleasure by astronomers. It is to be followed by two other volumes, containing the correspondence of Olbers with Gauss, and a biography by the editor.

The celebrated and epoch-making memoir on the most convenient method of computing the orbit of a comet was printed separately (in 1797), and it naturally opens the volume now published. After it (and the appendix published in the *Jahrbuch* for 1833) the editor has placed twelve other papers under the common heading "Abhandlungen." It is not easy to see why these particular papers have been distinguished in this manner. It is not because they are the longest, for some of them occupy only a few pages, so it must be because the editor considers them specially important. But if so, why are others, fully as important, not put along with them, as, for instance, the classical paper on the tail of the great comet of 1811? The arrangement of the other papers in six groups also frequently challenges criticism. Under the heading "Comets" are given no less than 110 papers, but half a dozen notes on comets are relegated to the group of "Miscellanea from letters," near the end of the book, apparently simply because they were written in the form of letters to the editors of various journals. The useful index at the end of the volume will, however, enable the reader to read these notes in connection with the other papers on comets. On the other hand, the papers on the comets of 1802 and 1811 (pp. 293 and 315) are made up of pieces detached from two editorial articles in the *Monatliche Correspondenz*, omitting all the observations not made by Olbers; and this patchwork might, perhaps, better have been put among the miscellaneous notes. It would have been much simpler, and apparently more satisfactory, if all the papers (except the separately published book of 1797) had been printed in chronological order, as the index would even then have made it easy to pick out papers on any special matter. It is, however, more to be regretted that the editor has not seen fit to add some explanatory notes, which would greatly have increased the value of the book to young students of astronomy, who cannot be supposed to be thoroughly acquainted with its literature. We shall only point out a few cases where such notes would have been particularly useful. The first is Olbers' letter to Encke about the mysterious comet alleged to have been observed by D'Angos at Malta in 1784, reprinted here from Encke's well known paper with the startling title, "Imposture astronomique grossière du Chevalier D'Angos." We certainly think that the editor might in a short note have given references to the more recent investigations on this matter by d'Arrest and Gyldén, which render it at least very possible that D'Angos really found and on two nights observed a comet. At any rate we cannot be certain that the whole matter was nothing but a fraud, and a different heading to the article might have been chosen. On page 226 it should have been pointed out that the orbit of the comet of 1558 has also been computed by Hoek (from observations by Paul Fabricius), whose results differ considerably from those of Olbers. On p. 228, Olbers suggests that the manuscripts of Father Schall in the Vatican might contain comet observations from 1618. It would have been useful to have added a note to the effect that these manuscripts have afterwards been found not to contain any such observations (*Corresp. Astron.* v. p. 143). Similarly the article on Cacciatore's supposed planet of 1835 (p. 526) should have been accompanied by a note referring the reader to the calculations of Valz and Luther, as well as to NATURE, vol. xviii. p. 260, which might prevent some rash student from wasting his time on this object.

The papers have been reprinted from the originals without any alterations, so that even errors pointed out in subsequent papers have been allowed to stand (*e.g.* pp. 523 and 538, compare pp. 649 and 542). Some papers will be quite new to most readers, as they were published in journals of limited circulation, such as Harding's *Kleine Ephemeriden*, *Göttingische Anzeigen*, and Gruithuisen's *Analekten* and his *Jahrbuch*. The charming character of Olbers is seen in his notes to Gruithuisen, in which he frequently gently corrects mistakes in the writings of this enthusiastic but somewhat erratic observer. In an appendix are given two papers of 1787 and 1788 on mesmerism. Olbers' dissertation for the degree of M.D. (De oculi mutationibus internis, Göttingen 1780) is not reprinted.

The book is well printed, and has as frontispiece an excellent portrait of Olbers. In addition to a table of contents and an index, it contains a list of all the papers, arranged according to the journals in which they first appeared. No mention is here made of the catalogue of cometary orbits (published in Schumacher's *Abhandlungen*); but this has not been reprinted, and is of course long ago superseded.

In laying aside this splendid volume, we cannot refrain from making one more remark. We have now the collected works of Laplace, Gauss, Bessel, Encke, Olbers; how long are we to wait for a complete edition of the works of William Herschel?

J. L. E. D.

QUATERNIONS.

Anwendung der Quaternionen auf die Geometrie. Von Dr. P. Molenbroek. (Leyden: E. J. Brill, 1893.)

The Outlines of Quaternions. By Lieut.-Colonel H. W. L. Hime. (London: Longmans, Green, and Co., 1894.)

IN these books we have evidence of the growing demand for quaternion literature. Dr. Molenbroek's work is the promised sequel to his first volume on the Theory of Quaternions, and contains many admirable examples of the application of the method to geometry. All who are familiar with Hamilton's and Tait's classics on the subject will recognise many of these examples as old friends, taken almost verbatim from their original sources. In not a few of the applications, however, Dr. Molenbroek ventures into fresh fields, and shows that he can use quaternions with ease and power. It is interesting to notice the occasional effective use of the conjugate quaternion, an invention of the great master which is apt to be lost sight of after the foundations of the calculus have been laid. The treatment throughout is on the familiar Hamiltonian lines, the author's aim being development and not fancied improvements. The book consists of six chapters, in which are taken up—to name a few of the most important applications—spherical trigonometry, the plane and sphere, quadric surfaces, surfaces in general, curves in space, and the theory of rectilinear rays. The elementary properties of the remarkable operator ∇, and the integration of partial differential equations of the first and second orders, are discussed as part of the general theory of surfaces. In the same chapter, Dr. Molenbroek, by means of two new differentiating operators, obtains a simple symbolic representation for the first, second, and higher polars of a point with regard to a given surface. These remarks will indicate sufficiently the scope of a work which, though not altogether above criticism in minor details, is a distinct addition to quaternion literature, and deserves a wide circulation.

Colonel Hime's work is a much more modest production, being intended for the mere beginner. In general scope it might be compared to the first nine chapters of Kelland and Tait's "Introduction to Quaternions." The book contains many good examples in the simpler applications of quaternions to the geometry of triangle, plane, sphere, conic section, cone, &c., but it is less satisfactory in the exposition of the fundamental principles of the calculus. For example, the identification of unit vector and right versor is stated, but the reason for this identification is nowhere distinctly given. Again, the truth that the familiar Hamiltonian symbols $i\ j\ k$ may be regarded as in a sense *imaginaries*, because $i^2 = j^2 = k^2 = -1$, is supposed to lead to the equation

$$i = j = k = \sqrt{-1} = -i = -j = -k \text{ (Eq. 8, p. 40).}$$

This seems to be playing sad havoc with one's very definitions. Then on page 76 we find what is virtually the equation $\delta\beta^{-1}\delta = \gamma$ transformed into $\delta^2 = \gamma\beta$, the non-commutative principle being wholly ignored, and in consequence a quaternion and a scalar equated! These errors, especially the latter, are very surprising in a book whose author is a true disciple of Hamilton. Of minor blemishes we might refer to the appeal to Cartesian expansions in order to demonstrate (?) the associative principle in multiplication. Nor do we quite understand Colonel Hime's system of referring to authorities. For example, why should Prof. Hardy be quoted as the authority for the statement that every versor may be represented by a power of a unit vector; for is it not all in Hamilton (see "Elements," § 309)? Again, Dr. Odstrčil is credited with a proof that the three angles of a plane triangle are together equal to two right angles, the proof being an obvious particular case of Hamilton's remarkable expression for the product of the versor arcs of a spherical triangle. But surely the theorem regarding the angles of a plane triangle *underlies* the fundamental properties of quaternions and versors; so that the supposed proof is really reasoning in a circle. Dr. Odstrčil is worthy of higher praise than this. These blemishes apart, however, and leaving out of account the two errors already noted, we find in Colonel Hime's book a serviceable exposition of the elementary applications of quaternions. A careful study of its pages will go far to fit the reader for the arduous task of grappling with the higher and more characteristic developments to be found in the writings of the masters of the quaternion calculus.

OUR BOOK SHELF.

Sir Victor Brooke, Sportsman and Naturalist. By O. L. Stephen. (London: John Murray, 1894.)

THE late Sir Victor Brooke was an excellent example of a combination of sportsman and naturalist. In this book his life as a sportsman predominates; but a chapter on his researches in natural history, by Sir William Flower, shows that he possessed the keenness of observation required in a man of science. His most important contribution to science was an exhaustive paper, published in the *Proceedings* of the Zoological Society, the subject being the classification of the *Cervidæ*. At one time he was an enthusiastic student of natural history, but the state of Lady Brooke's health having compelled him to live out of England for the greater part of the year, he could not conveniently carry on his researches. From about 1880 his life was chiefly devoted to foreign travel and sport. The extracts from his letters and journals are full of stirring adventures, and contain some interesting observations on animal life and habits. Mr. Stephen prefaces these extracts with a memoir of his dead friend. The book is beautifully printed, and is illustrated by ten fine plates. It appeals particularly to those who were acquainted with Sir Victor Brooke, and who admired his character; nevertheless, such of the public as read it will find the contents interesting.

A Text-book of Dynamics. A Text-book of Statics. By William Briggs and G. H. Bryan. (The University Tutorial Series.) (London: W. B. Clive, 1894.)

THESE books belong to the elementary class, and a perusal of them shows that they will prove excellent additions to this series of useful text-books.

In both the authors have assumed little or no knowledge of trigonometry, and they have been written so that either may be read first. The treatment is conspicuous for its clearness and conciseness, and is all that a student about to enter a course could desire. The figures are neatly drawn, and many new ones are noticeable in the latter book.

Notwithstanding the fact that these text-books are published to meet the requirements of candidates for certain examinations, they may still be used by others, who are making themselves acquainted with these sub-

jects. Besides several excellent series of examples, a very useful summary is added to each chapter, which will be serviceable for revision purposes. The adoption of different sizes and kinds of type, when it is, as here, carefully done, is also a very great boon to beginners.

The Slide-Rule. A Practical Manual. By Charles N. Pickworth, Wh.Sc. (London: Emmott and Co., Ltd., 1894.)

THE most modern form of slide-rule is of the Mannheim or Tavernier-Gravêt type, and undoubtedly surpasses its predecessors in many ways. At the present time this instrument is in general use on the continent, principally in France and Germany, and it is now becoming more popular in England.

The slide-rule may be defined as an instrument for mechanically effecting calculations by logarithmic computation. By its aid arithmetical, algebraical, and trignometrical processes may be performed much more quickly and with greater ease than by the ordinary methods, while the accuracy of the results are quite within the limits of error for all practical purposes. There is no doubt that when the instrument is better known, and its labour-saving property recognised, it will be more commonly seen in the laboratory and workshop than it is now. So many manipulations can be done with it that, without some guide, its full value cannot be appreciated. In the present little manual the author brings these all together, and in such a form that the reader can, by paying attention to the mechanical and mathematical principles, obtain an intelligent interest in the manipulations, and have confidence in the results.

W. J. L.

I Fondamenti Matematici per la Critica dei Risultati Sperimentali. Del Prof. P. Pizzetti. (Genova, 1892.)

AN elaborate memoir, of the nature of a complete treatise on the Method of Least Squares, in its application to the reduction to order of a long-continued series of experiments and of their numerical results.

It contains a valuable bibliography of writings on the subject, arranged alphabetically according to authors' names.

Hitherto the astronomer has made most use of this theory; but the artillerist is now finding it important for his purposes, in calculating from the number of hits to effect a desired amount of destruction the amount of ammunition required.

G.

Teppich-erzeugung im Orient. By various Contributors Pp. 204. (Wien: K. K. Österr. Handels-Museum, 1895.)

THIS work consists of a series of monographs on important antique tapestries contained in European museums and private collections, contributed by Sir George Birdwood, Mr. C. Purdon-Clarke, Mr. Vincent J. Robinson, Mr. S. J. A. Churchill, Dr. W. Bode, M. Gerspach, and M. O. M. Stoeckel. In addition to the history of antique tapestries, the work contains descriptions of a number of the more important types of modern tapestries of the Levant, Persia, and India. The illustrations are numerous and of high quality.

A Laboratory Manual. By W. R. Orndorff, A.B., Ph.D. (Boston: D. C. Heath. London: Isbister and Co., 1894.)

A COURSE of experiments in organic chemistry, systematically arranged as an adjunct to Prof. Ira Remsen's work on the "Compounds of Carbon." As Dr. Orndorff has had a large experience in the laboratory work to which the book refers, the conditions of the experiments described can be depended upon, which is the highest recommendation that can be given to a manual of this kind.

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.*]

Finger-Prints.

I HAVE been quite unable, since I saw Mr. Faulds' letter in your issue of October 4, to take the matter of it in hand hitherto; and I do so now only because I think Mr. Faulds is entitled to raise the question if he pleases. To the best of my knowledge, Mr. Faulds' letter of 1880 was, what he says it was, the first notice in the public papers, in your columns, of the value of finger-prints for the purpose of identification. His statement that he came upon it independently in 1879 (? 1878) commands acceptance as a matter of course. At the same time I scarcely think that such short experience as that justified his announcing that the finger-furrows were "for-ever unchanging."

How I chanced upon the thing myself in 1858, and followed it up afterwards, has been very kindly stated on my authority by Mr. Galton, at whose disposal I gladly placed all my materials on his request. Those published by him are only a part of what were available. (See his "Finger-Prints," page 27, and his "Blurred Finger-Prints.") To what is there stated I need now only add, at Mr. Faulds' request, a copy of the demi-official letter which I addressed in 1877 to the then Inspector-General of Jails in Bengal. That the reply I received appeared to me altogether discouraging was simply the result of my very depressed state of health at the time. The position into which the subject has now been lifted is therefore wholly due to Mr. Galton through his large development of the study, and his exquisite and costly methods of demonstrating in print the many new and important conclusions he has reached.

I take the opportunity, in reference to a late article on Anthropometry (in the *Nineteenth Century* of September 1894, p. 365), to deprecate, as being to the best of my knowledge wholly unproved, the assertion that the use of finger-marks in this way was "originally invented by the Chinese." I have met no evidence which goes anywhere near substantiating this. As a matter of fact, I exhibited the system to many passengers and officers of the P. and O. steamship *Mongolia* in the Indian Ocean, during her outward voyage in February 1877; and I have the finger-prints of her captain, and of all those persons, with their names. It is likely enough that the idea, which caught on rapidly among the passengers, may have found a settlement in some Chinese port by this route, and have there taken a practical form; but whether that be so or not, I must protest against the vague claim made on behalf of the Chinese, until satisfactory evidence of antiquity is produced.

Littlemore, November 7. W. J. HERSCHEL.

(TRUE COPY OF OFFICE COPY.)

Hooghly, August 15, 1877.

MY DEAR B——.—I enclose a paper which looks unusual, but which I hope has some value. It exhibits a method of identification of persons, which, with ordinary care in execution, and with judicial care in the scrutiny, is, I can now say, for all practical purposes far more infallible than photography. It consists in taking a seal-like impression, in common seal ink, of the markings on the skin of the two forefingers of the right hand (these two being taken for convenience only).

I am able to say that these marks do not (bar accidents) change in the course of ten or fifteen years so much as to affect the utility of the test.

The process of taking the impression is hardly more difficult than that of making a fair stamp of an office seal. I have been trying it in the Jail and in the Registering Office and among pensioners here for some months past. I have purposely taken no particular pains in explaining the process, beyond once showing how it is done, and once or twice visiting the office, inspecting the signatures, and asking the *omlah*[1] to be a little more careful. The articles necessary are such as the *daftari*[2] can prepare on a mere verbal explanation.

Every person who now registers a document at Hooghly has to sign his "sign-manual." None has offered the smallest objection, and I believe that the practice, if generally adopted, will put an end to all attempts at personation.

[1] Clerks. [2] Man in charge of stationery.

The cogency of the evidence is admitted by every one who takes the trouble to compare a few signatures together, and to try making a few himself. I have taken thousands now in the course of the last twenty years, and (bar smudges and accidents, which are rarely bad enough to be fatal) I am prepared to answer for the identity of every person whose "sign-manual" I can now produce if I am confronted with him.

As an instance of the value of the thing, I might suggest that if Roger Tichborne had given his "sign-manual" on entering the Army on any register, the whole Orton case would have been knocked on the head in ten minutes by requiring Orton to make his sign-manual alongside it for comparison.

I send this specimen to you because I believe that identification is by no means the unnecessary thing in jails which one might presume it should be. I don't think I need dilate on that point. Here is the means of verifying the identity of every man in jail with the man sentenced by the court, at any moment, day or night. Call the number up and make him sign. If it is he, it is he; if not, he is exposed on the spot. Is No. 1302 really dead, and is that his corpse or a sham one? The corpse has two fingers that will answer the question at once. Is this man brought into jail the real Simon Pure sentenced by the magistrate? The sign-manual on the back of the magistrate's warrant is there to testify, &c.

For uses in other departments and transactions, especially among illiterate people, it is available with such ease that I quite think its general use would be a substantial contribution towards public morality. Now that it is pretty well known here, I do not believe the man lives who would dare to attempt personation before the registrar here. The *mukhtears*[1] all know the potency of the evidence too well.

Will you kindly give the matter a little patient attention, and then let me ask whether you would let me try it in other jails?

The impressions will, I doubt not, explain themselves to you without more words. I will say that perhaps in a small proportion of the cases that might come to question the study of the seals by an expert might be advisable, but that in most cases any man of judgment giving his attention to it cannot fail to pronounce right. I have never seen any two signatures about which I remained in doubt after sufficient care.

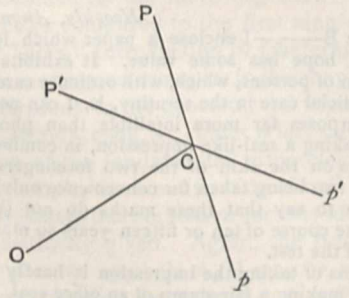
Kindly keep the specimens carefully.

Yours sincerely,
W. HERSCHEL.

Boltzmann's Minimum Function.

MR. CULVERWELL, in his letter to NATURE of October 25, questions the existence of Boltzmann's minimum function, and asks will somebody tell us what the H-theorem really proves?

As I have made use of the theorem on several occasions, I may be permitted to say a word in its defence. I will endeavour to answer Mr. Culverwell's question what the theorem proves for the simple case of equal elastic spheres. If I can do that, it will probably not be difficult to generalise the result.



Let then V, or OC in the figure, denote the velocity of the common centre of gravity of two elastic spheres, each having diameter c. Let R be their half relative velocity. If we describe a spherical surface with radius R about centre C, and if Pp be any diameter of it, the actual velocities of two spheres are OP and Op.

Let the number per unit of volume of spheres whose velocities are represented by lines drawn from O to points within the element of surface dS at P be denoted by FdS. Let $f d$S denote the corresponding number for the element dS at p. Then F$f d$S is the number of pairs whose relative velocity R falls within the cone described with solid angle dS about PCp as axis. Let P'Cp' be any other diameter, and let F'dS', $f'd$S' be the corresponding number of spheres with velocities OP' and Op'.

If a pair of spheres collide the relative velocity assumes, as the result of collision, a new position only, and what that position shall be depends on the coordinates of the collision, *i.e.* the point in which a line parallel to the relative velocity through the centre of one sphere cuts a circular area of radius c, drawn through the centre of the other sphere at right angles to that line. If the collision coordinates be taken at random, then the following condition holds, viz.:—For any given direction of R before collision, all directions after collision are equally probable. Call that condition A.

Now assume condition A to be fulfilled, and consider all collisions which take place between pairs of the V R spheres.

The number which after the collisions belong to the class F$f d$S will be on the above assumption $\frac{d\mathrm{S}}{4\pi}\int\int \mathrm{F}' f d\mathrm{S}'$.

But before the collisions it is F$f d$S. Therefore, as the result of collisions it is increased by $d\mathrm{S}\left(\frac{\int\int \mathrm{F}' f d\mathrm{S}'}{4\pi} - \mathrm{F}f\right)$. That is by $\frac{d\mathrm{S}}{4\pi}\int\int(\mathrm{F}'f' - \mathrm{F}f)d\mathrm{S}'$, F$f$ being treated in the integration as constant.

Therefore

$$\frac{d\mathrm{F}}{dt} = \frac{df}{dt} = \frac{\pi c^2 \mathrm{R}}{4\pi}\int\int(\mathrm{F}'f' - \mathrm{F}f)d\mathrm{S}'$$

and if

$$\mathrm{H} = \int\int f(\log f - 1)d\mathrm{S},$$

$$\begin{aligned}\frac{d\mathrm{H}}{dt} &= \frac{\pi c^2 \mathrm{R}}{4\pi}\int\int d\mathrm{S}\int\int(\mathrm{F}'f' - \mathrm{F}f)\log(\mathrm{F}f)d\mathrm{S}' \\ &= \frac{\pi c^2 \mathrm{R}}{4\pi}\int\int\int\int d\mathrm{S}d\mathrm{S}'(\mathrm{F}'f' - \mathrm{F}f)\log(\mathrm{F}f) \\ &= \frac{\pi c^2 \mathrm{R}}{4\pi}\int\int\int\int d\mathrm{S}d\mathrm{S}'(\mathrm{F}f - \mathrm{F}'f')\log \mathrm{F}'f' \text{ by symmetry} \\ &= \tfrac{1}{2}\frac{\pi c^2 \mathrm{R}}{4\pi}\int\int(\mathrm{F}'f' - \mathrm{F}f)\log\frac{\mathrm{F}f}{\mathrm{F}'f'}d\mathrm{S}d\mathrm{S}',\end{aligned}$$

which is necessarily negative if not zero. The above is true for all values of V and R, and therefore for the whole system.

Thus we have proved that if condition A be satisfied, then if all directions of the relative velocity for given V are not now equally likely, the effect of collisions is to make H diminish.

The objection that I understand to be made is that if you reverse all the velocities after collisions, the system will retrace its course with H increasing—which is supposed to be contrary to the thing proved.

The objection is wrong because in your reverse motion condition A is not fulfilled. The proof (is not wrong but) ceases to be applicable by failure of the condition on which it is based.

Somebody may perhaps say that by this explanation I save the mathematics only by sacrificing the importance of the theorem, because I must (it will be said) admit that there are, after all, as many cases in which H increases as in which it diminishes. I think the answer to this would be that any actual material system receives disturbances from without, the effect of which, coming at haphazard, is to produce that very distribution of coordinates which is required to make H diminish. So there is a general tendency for H to diminish, although it may conceivably increase in particular cases. Just as in matters political, change for the better is possible, but the tendency is for all change to be from bad to worse.

S. H. BURBURY.

1 New Square, Lincoln's Inn, November 12.

The Kinetic Theory of Gases.

I CANNOT quite agree in Mr. Bryan's remembrance of what took place in the discussion of the Thermodynamics Report at Oxford. As far as I recollect, Prof. Boltzmann's reply was not in special reference to such a point as the specific heats of gases, but was in answer to a very vigorous, if somewhat general, onslaught of Prof Fitzgerald, who simply stated that it appeared evident from the spectra of gases and other considerations, that the energy could not be equally divided among all the degrees of freedom of the coordinates, and said what he wanted to know from Prof. Boltzmann was *when the theory*

[1] Attorneys.

became inapplicable, what assumptions became invalid?—why, if Dr. Watson's method of generalised coordinates were valid, the ether, the solar system and the universe generally were not subject to the Maxwell-Boltzmann law, so that the mean kinetic energy of every coordinate in the universe should be the same and so on, insisting that what he wanted to know was *why the theory failed, what* assumptions were invalid.

After the other speakers had concluded, Prof. Boltzmann arose to reply, and he took up a perfectly logical position. He said that the theory as it left his hands was a mathematical theorem, a piece of pure mathematics, and that it was for *physicists* to say how far it applied to gases—that the reason of any disagreement between the theory and the facts was "a mystery, as Lord Salisbury had said."

That appears an unassailable position, and the only misapprehension which, so far as I can see, could arise, would be that Boltzmann had admitted not only that his work was a piece of pure mathematics, but that it was *nothing more*, a bare theorem without the promise that future adaptations would lead to an even closer accord between the theory and the facts. If such an impression as that has got abroad, Mr. Bryan has done good service in calling attention to the matter.

There seem many difficulties about the suggestion (made by Dr. Larmor at Oxford, and referred to by Mr. Bryan in his letter) that the spectra of gases need not be explained by the Boltzmann law, as they arise not from molecular but from ethereal vibrations set up by the molecules. Surely if so, the molecules cannot be regarded as an independent system, and Dr. Watson's generalised coordinates must include ethereal coordinates also, and the Maxwell-Boltzmann law must be supposed to hold for matter and ether alike, which does not seem to get over the difficulty.

November 10. EDWD. P. CULVERWELL.

Homogeneity of Structure the Source of Crystal Symmetry.

MR. BARLOW'S letter on this subject (p. 58) raises a problem of considerable interest, which may be stated in simple words.

He has inquired in the most general manner possible how anything can be uniformly distributed in space so as to constitute a homogeneous system; the word homogeneous may be taken to signify that round any one member of the system the distribution of the remainder is the same as round any other. It is not necessary to say that the units of which the system consists are figures or solids, but merely that, whatever the unit may be, it is homogeneously repeated.

Now repetition may conceivably take place by sliding the unit from one position to another, by rotating it about an axis, by reflecting it across a plane, or by a combination of these processes; in other words, by translation, rotation, and inversion. If the last process be excluded, we cannot arrive at all the types of symmetry presented by crystals; if it be included, we obtain all those types and no others. Therefore the crystal structure is one in which this process is operative. Mr. Barlow himself does not include inversion as a mode of homogeneity, but regards it as an additional property possessed by some crystal structures. Earlier writers have specialised the problem by taking a particular unit. Bravais and Sohncke, for example, to whom the modern treatment of the subject is entirely due, have investigated systems of points. Now the reflection of a point is an identical point, so that it is useless to introduce the principle of reflection or inversion as distinct from translation in order to derive any *one* point of such a regular system from another. The same is true of spheres and many symmetrical figures, and unfortunately molecules have usually in such investigations been treated as points or spheres or symmetrical figures.

Mr. Barlow does not consider that his solution of the geometrical problem supplies a theory of crystal structure or settles the question whether the seat of the symmetry is in the arrangement or in the configuration of the molecules.

But it appears to me that a step of very great importance has been made, for, surely, these investigations prove that the symmetry of such a structure *can* be entirely explained by the arrangement of the units. I would go farther, and ask whether the result does not suggest that the units which determine the symmetry of a crystal are units capable of repetition by the processes of translation, rotation, and inversion. If this be so, we are not justified in treating them generally as points or as symmetrical figures.

Many things besides unsymmetrical figures can be conceived which are capable of such repetitions; for example, a solenoid, a vortex motion, a system of forces in statical equilibrium.

I would add that Mr. Barlow's investigation cannot be said either to support or to contradict the theories of Fedorow and Schönflies; it is, as he remarks, purely geometrical, and in this respect is identical with their researches, and leads to the same results. It is true that Fedorow has proposed a theory of crystal structure, but this is only an application of the geometrical principles which he had previously established.

H. A. MIERS.

British Museum (Natural History), November 19.

Gravitation.

I REGRET that I cannot agree with Dr. Joly's suggestion (*vide* p. 57 *supra*) that the curious adhesion which I observed between solids immersed in a stretched liquid, lends itself to any explanation of gravitation on the lines that he indicates. The phenomenon is, and was described by me as, one of *adhesion*, and not, as Dr. Joly puts it, of *attraction*, for there was no evidence of any approach of bodies separated by a measurable thickness of liquid, and there is, further, no reason to suppose that the phenomenon would occur unless the medium were already modified in the neighbourhood of the solid surfaces, *i.e.* unless a condition which we may provisionally ascribe to gravitation already existed. For this reason Dr. Joly's suggestion appears to me to be an invitation to argue in a circle.

If there were evidence, which there is not, that the ether round celestial bodies was modified to a great distance, the suggestion would, I think, be legitimate, but it would then be necessary to explain the modification.

Devonport, November 18. A. M. WORTHINGTON.

The Foucault Pendulum Experiment.

PROF. GREENHILL gives currency to quite an erroneous idea in last week's NATURE (p. 50). He says "in the Foucault experiment of the pendulum which shows the rotation of the earth, the slightest current of air will destroy and reverse the desired motion; so that it is advisable in showing the experiment to have an elastic ball concealed in the palm of the hand, which can send a slight current of air on the bob of the pendulum, and thus accelerate the initial precession of the plane of the vibration so as to gratify the eyes of the audience and diminish their impatience at the slowness of the motion." If Prof. Greenhill will go to the Western Galleries of the South Kensington Museum any day, he will be able to see a Foucault pendulum fulfilling its purpose without being particularly protected from draughts, and without the accessory puffs to which he refers. The pendulum is suspended in a place where people are continually passing to and fro, yet its plane of vibration always rotates in the same direction as watch-hands, or rather the table under the pendulum turns in the opposite direction. I have watched the pendulum dozens of times without seeing it fail.

G. A. R.

November 19.

An Observation on Moths.

AN experiment was tried in 1894, on a number of pupæ of *Samia promethea* and *Samia cecropia*, which brought out a point of which I have seen no mention. When the moth is almost ready to burst through the thin shell which encloses it, this outer skin becomes dark-coloured and friable, and the insect can often be seen moving within.

If the enclosing envelope is then removed with a scalpel and forceps, the moth struggles out, apparently as lively as when legitimately hatched.

The only hitch in the proceedings seems to be in the non-expansion of the wings, the development of which usually takes place at once. The moth crawls about, like a forlorn penguin, for a period varying from one to three days, when the wings seem to realise the absurd state of affairs, and make a brave effort to fulfil their part of the contract. The effort, however, is only partially successful, for owing to their dry condition the expansion is irregular and incomplete, and the poor moth remains a helpless cripple.

This would seem to demonstrate that the wings do not mature as rapidly as the rest of the body, and that until complete maturity is reached, no effort towards expansion is made.

L. C. JONES.

PHOTOGRAPHS OF A TUMBLING CAT.

M. MAREY'S recent photographs of a falling cat, taken with the view of determining the mechanical conditions which enable the animal to alight on its feet, have excited considerable interest. Figs. 1 and 2 accompanied his paper on the tumbling of cats, presented to the Paris Academy, and are reproduced in *La Nature*. The former gives a side view of pussy, and the latter a back view. The cat was held by its feet, and was let go in that position. In each of the pairs of figures, the series of images runs from right to left, and the lower is a continuation of the upper. The expression of offended dignity shown by the cat at the end of the first series indicates a want of interest in scientific investigation.

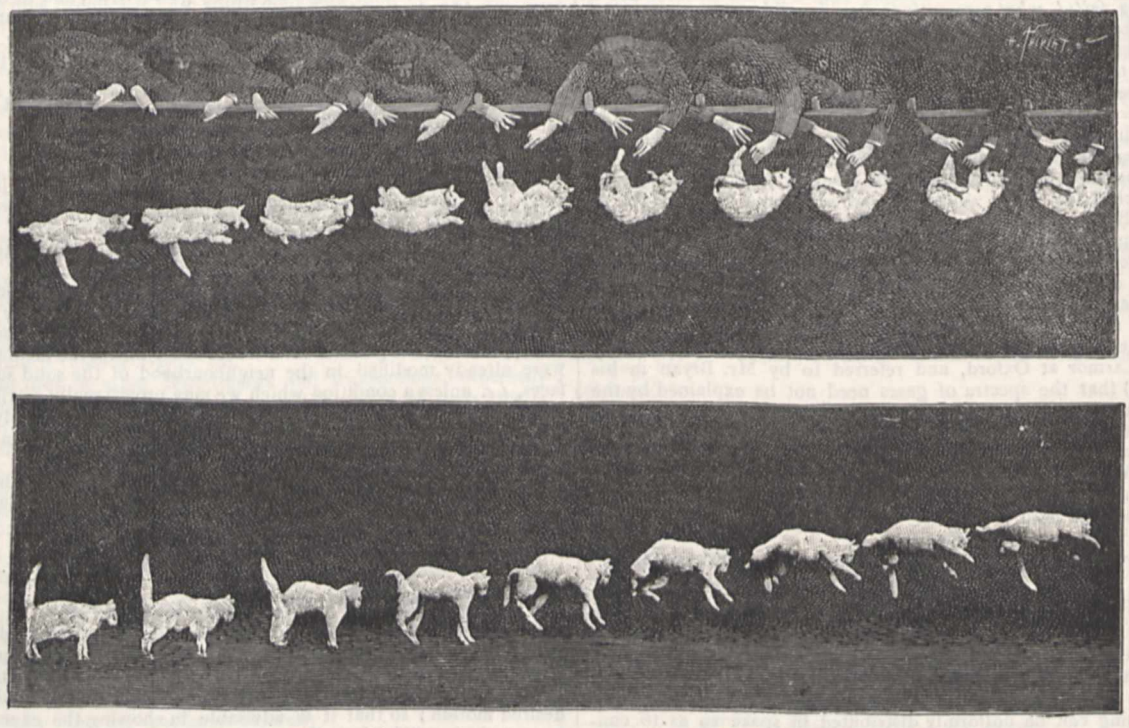


FIG. 1.—Side view of a falling cat. (The series runs from right to left.)

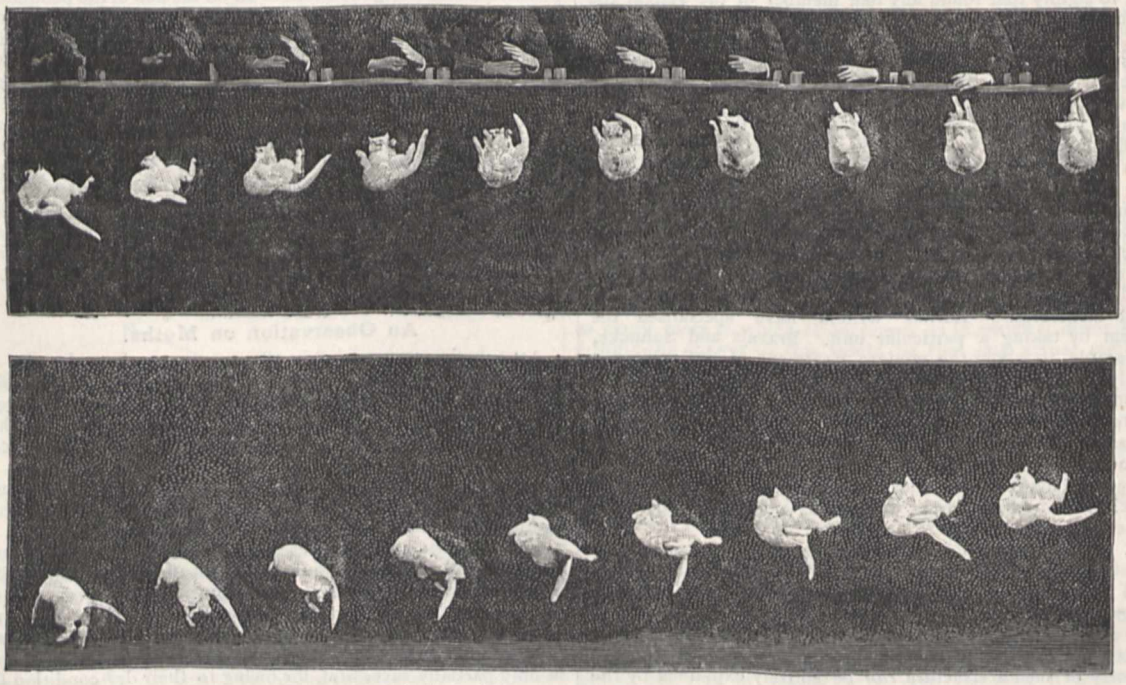


FIG. 2.—End view of a falling cat. (The series runs from right to left.)

The rotation of the fore and hind parts of the cat's

body takes place at different stages. At first the twist is almost exclusively confined to the fore part, but when this amounts to about 180 degrees the rear part of the animal turns. M. Marey is of the opinion that an inspection of the figures altogether excludes the idea that the animal uses the hands that let it go as a fulcrum by means of which a movement of rotation is obtained. The first few images in each of the two series show that at the beginning of the fall the cat exhibits no tendency to turn either one side or the other.

As to the hypothesis that the resistance of the air affords a means of turning, this also appears to be inadmissible; because, on account of the tumbling motion of the animal, if this resistance had an appreciable effect, it would produce a rotation in the opposite direction to that observed.

M. Marey thinks that it is the inertia of its own mass that the cat uses to right itself. The torsion couple which produces the action of the muscles of the vertebra acts at first on the forelegs, which have a very small motion of inertia on account of the front feet being foreshortened and pressed against the neck. The hind legs, however, being stretched out and almost perpendicular to the axis of the body, possesses a moment of inertia which opposes motion in the opposite direction to that which the torsion couple tends to produce. In the second phase of the action, the attitude of the feet is reversed, and it is the inertia of the forepart that furnishes a fulcrum for the rotation of the rear.

BIOLOGY IN THE UNITED STATES—A PROSPECT.[1]

THIS volume is slightly larger than its predecessor published in 1891, and is an advance upon it in the number and class of its illustrations. During the interval of publication of the two volumes, much of the work announced in the first one has appeared in full; and the present one shows that although, perhaps, more might be made of the resources of the Wood's Holl Laboratory and its rich surroundings by a better appreciation on the part of the scientific public, there is no falling off in either the energy or enthusiasm of its founders and chief supporters. The ten lectures reported in this volume are chiefly special ones, given by investigators who undertake to review their chosen field of labour, and to set forth the results of their own inquiry—it being an avowed object to bring forward unsettled problems of the day, and discuss them freely. The lectures are published for the first time, with the exception of that which is the most striking of the series and one of the most remarkable contributions to recent biological literature, viz. Prof. C. O. Whitman's thesis on "The Inadequacy of the Cell-theory of Development," originally read before the Zoological Congress of the World's Columbian Exposition, and already reprinted in the *Journal of Morphology*. Prof. Whitman's work in this department dates from his inaugural dissertation for the degree of Doctor of Philosophy in the University of Leipzig, dealing with the embryology of *Clepsine*, in which he laid the foundation of his now famous teloblast theory. The researches which this essay has provoked rank foremost in interest among all those recently devoted to the study of the germinal blastemata.

No one has more assiduously followed up Prof. Whitman's suggestive lines than Prof. E. B. Wilson, whose lecture on "The Mosaic Theory of Development" ranks first in order in the present volume. His recent work on the cell-lineage of *Nereis* is second only to that of Whitman in interest and importance. His present treatise is a review of the embryological work of the last decade in its bearing upon the biogenetic law. Prof. Whitman would seek the secret of organisation in ultimate elements of living matter "for which *idiosomes* seems an appropriate name"; Prof. Wilson, that of differentiation during development in the interaction of the embryo-cells. There next follows a lecture by Dr. E. G. Conklin, on "The Fertilisation of the Ovum," *apropos* of the author's researches into the development of the marine gasteropod *Crepidula plana*.

Lecture iii. is by Prof. Jacques Loeb, "On some Facts and Principles of Physiological Morphology." He first considers the question of "heteromorphosis" or substitution of organs, as illustrated (under the maltreatment of *Antennularia*) by the development of new roots and apices in relation to gravitation, and by root formation at points of contact with solid bodies, in *Margeliss* and other hydroids. He shows that it is possible to obtain roots and polyps at will over various and interchangeable areas, in direct response to modified conditions of growth. There follows this a lecture by Prof. Ryder on "Dynamics in Evolution," which is suggestive but imaginary. New terms and statements of probabilities it does contain, but new facts it does not. Its most interesting portions are those relating to surface tension in its probable bearings on protoplasmic activity; but it appears to us rather more sensational than sound. The comparison of the behaviour of a contracted smoke-ring to an amœba in motion is suggestive, perhaps in a sense not intended by the author. Dr. Watasĕ follows with a dissertation "On the Nature of Cell Organisation."

Lecture vii. is a very welcome one, by Dr. Howard Ayers, on *Bdellostoma Dombeyi*, *apropos* of its author's work upon the comparative morphology and physiology of the vertebrate ear. He deals at some length with the habits of the animal, and adduces additional evidence for the belief in the primitive, as distinguished from the alleged "by parasitism degenerate" nature of the cyclostomi which has been so generally accepted. He records the fact that the gills vary in number from eleven to thirteen on either side, in individuals from different localities; he regards this variation as indicative of suppression, and the numerically highest as the most primitive type, instituting comparisons with the larval *Amphioxus* which appear to us unsound. We welcome his conclusion that the numerical variation of the gills has nothing to do with the formation of the ductors œsophago-cutaneus. He provisionally argues that *Bdellostoma* is unique in the fact that geographical distribution has had little or no effect upon its anatomical structure; and proposes to recognise but a single genus and species of this form, in a manner curiously mindful of his notorious attempt to similarly unite *Protopterus and Lepidosiren*. Not even allowing for the possibility that the hitherto accepted species of Bdellostomas may be distinct in their habits as well as taxonomically, this proposal appears to us premature, and systematic ichthyologists will certainly not acquiesce to it. In common with most subsequent investigators, he finds himself unable to confirm Beard's alleged discovery of calcified teeth in these creatures. He regards Beard's "bone" as "much hardened horn, produced by the methods used in preparation." This we cannot accept. The cells of Beard's "calcified teeth," although uncalcified, are mesoblastic, and the structure described by him as an "enamel cap" (whatever it may be) certainly does appear in individual sections. He finds that hermaphrodites occur even among old individuals; but while examples possessed of ripe ova and spermatozoa may be forthcoming, he finds them to be rare, and concludes that preponderance of *males* is the ordinary condition. His observations upon the olfactory organ

[1] "Biological Lectures delivered at the Marine Biological Laboratory of Wood's Holl." Vol. ii. (Boston: Ginn and Co., 1894.)

have led him to the belief in the paired nature of the cyclostome nose, but they are curiously at variance with those of Von Kupffer that have lately led to the opposite conclusion. His remarks upon the functions of the thread-forming type of cutaneous gland are particularly welcome, in correlation with Weymouth Reid's work upon the origin and constitution of the thread substance. Concerning the ear, he records the striking result that while removal of one labyrinth leads to marked disturbances in the equilibrative function, on the removal of both ears all trace of such disturbance disappears. Morphologists and physiologists will await with interest the full edition of this important communication.

Lectures viii. and ix. are botanical, and as unequal in merit as any two in the whole work. One of them, by Prof. Muirhead Macfarlane, on "Irrito-contractility in Plants," is a record of some beautiful and striking experiments, a very charming one being that with a block of ice, from which he has drawn the conclusion that displacement of the *Oxalis* leaf under its action is the effect of cold and not of weight. The author reverts to his earlier observation, no less beautiful and striking, that in order to induce the closure of the *Dionæa* leaf the application of two successive stimuli within proper intervals is necessary. He deduces two leading principles—(1) that plants, like animals, being in a condition of protoplasmic continuity, are, by virtue of it, possessed of a power of general contractility; and (2) that the positions taken up by the *Oxalis* and other leaves under the action of the tropical sun are due to heat and not light effects. The other lecture, by Prof. W. P. Wilson, on "The Influence of External Conditions on Plant Life," contains little new, and is in part vague and unintelligible.

The volume closes with an illustrated report on "The Marine Biological Stations of Europe," by Dr. Bashford Dean, and an appendix on "The Work and the Aims of the Marine Biological Laboratory" at Wood's Holl, by Prof. Whitman, giving a list of close upon 100 papers produced under its auspices.

It cannot have escaped the reader's notice that the contents of the book are largely reports upon experimental work which bears directly upon the recent theories of Weismann, so popular in our own land. Contemporaneously with the labours of Wilson and Loeb, of which an account is given in its pages, the work of Driesch, Herbst, and others, which carries us back through that of Vejdovský, Chun, and Chabry, to the classical observation of Hæckel, now twenty-five years old, that detached portions of the fully segmented ovum (of the Siphonophoran *Crystallodes*) may give rise to young animals, have materially modified our conception of certain fundamentals of embryology. The observation that variation in development, "twinning," and other kindred phenomena, may bear a definite relationship to variation in temperature, chemical composition, and osmotic pressure of the surrounding medium, is now well established. The discovery that after the removal of either the micromeres or macromeres, the segmenting embryonic mass may still form a gastrula—that the differentiation of outer layer cells to form certain larval organs may be directly a question of location—and that certain blastomeres if separated at the two-celled stage may each give rise to an embryo one-half size, and if isolated at the four-celled stage to one of one-fourth size, is very extraordinary; and, viewing the situation generally, one is prone to ask where now *are* the said theories? Concerning them, Prof. Wilson replies "the fine spun thread . . . leads us little by little into an unknown region, so remote from the *terra firma* of observed fact that verification and disproof are alike impossible." The theories of Weismann were originally framed with the laudable desire of stimulating inquiry. They do not seek to explain the actual *modus operandi* of the hereditary process so much as to localise the seat of hereditary tendency and influence. The implication that neither proof nor disproof are possible, applies, for the matter of that, to even the theory of descent with modification *versus* that of special creation. The educated mind has, however, upon purely logical grounds, chosen between the alternatives in this instance, and it may be safely relied upon to do so in the other. G. B. H.

NOTES.

THE anniversary meeting of the Royal Society will be held on Friday, November 30.

AT the first monthly meeting of the Royal Statistical Society for the present session, held on Tuesday afternoon, a gold Guy Medal was presented to Dr. Robert Giffen, C.B., F.R.S., in recognition of his long and exceptional services to statistical science.

M. LOUIS FIGUIER, who died on November 8, was an eminent populariser of the results of scientific research. He was born at Montpellier in 1819, where he took his degree of Doctor of Medicine in 1841. A few years later he became Professor of Pharmacy in the Paris École de Pharmacie. In 1850 he took his degree as Doctor of Science at Toulouse. He published some important memoirs on chemical subjects, but will be remembered chiefly for his numerous works on popular science. Since 1856, he issued every year the *Année Scientifique*, in which he summarised the most interesting and important scientific discoveries of the year.

THE Manchester correspondent of the *Lancet* says that the sum of £783 10*s.* 3*d.* has been raised for the fund in memory of the late Prof. Milnes Marshall, and after expenses £760 2*s.* 3*d.* will be left. Of this sum £650 have been invested in Manchester Corporation Stock to provide for the maintenance of the Marshall Biological Library given to the Owens College by the relatives of Prof. Marshall, while £102 8*s.* 6*d.* have been similarly invested to provide a "Marshall Gold Medal" to be annually competed for at the Owens College athletic sports.

DR. J. SCHEINER, of the Potsdam Astro-Physical Observatory, has been appointed Extraordinary Professor in Berlin University.

A SEVERE earthquake occurred on Friday last in Sicily and Southern Italy. The shocks were felt not only in the city and district of Messina, and several other places in Sicily, but also throughout the province of Reggio di Calabria, in Southern Italy. The disturbance was also recorded upon the seismic instruments at Rome and Ischia. Shocks of more or less violence were felt at Palmi, Seminara, Santa Eufemia, and San Procopio, in the province of Reggio di Calabria. The centre of the disturbance in this province appears to have been in the west, round the towns of Palmi and Bagnara. San Procopio, a town near Palmi, has been almost entirely destroyed, and it is estimated that at least two hundred persons have perished at that place alone. Since Friday the district of Reggio di Calabria has been slightly disturbed, but these tremors have not caused any further damage.

THE Drapers' Company have contributed £20 to the funds of the Epping Forest Museum, now being formed in Queen Elizabeth's Lodge, Chingford, by the Essex Field Club, under the sanction of the Epping Forest Committee of the Corporation of London. The museum is intended to illustrate the natural history, antiquities, and scenery of this beautiful district.

THE *Weekly Weather Report* of the 17th instant shows that in many districts the rainfall greatly exceeded the mean; over all the southern counties of England the amount was nearly four times as much as the average. The largest amounts recorded at

individual stations during the week were 6·25 inches at Godmanstone (near Dorchester), 5·51 inches at Scilly, 5·13 inches at Killarney, and 4·70 inches at Falmouth, while 4·60 inches fell at Crowborough, Sussex, in six days. The rainfall since the beginning of the year has now exceeded the average in all districts, except the Midland Counties and the west coast of Scotland. The excess in the south of England and south of Ireland amounts to over five inches.

REPORTS in the medical papers show that the enthusiasm roused in France by the results of the anti-toxin treatment of diphtheria has by no means abated. We learn from the *British Medical Journal* that the administrative Society of the Sauveteurs de la Seine have presented M. Roux with the Grand Diplôme d'Honneur. The Var General Council has voted an equivalent of £40 for the Pasteur Institute, and £80 towards creating a similar institute at Marseilles. The Lille Municipal Council has declared for the erection of a diphtheria laboratory, and has opened a subscription in order to collect the necessary funds. The city of Lille has subscribed £1000. The Council has undertaken to furnish from £1400 to £1600 for a municipal bacteriological laboratory. The Havre municipality has voted £200 towards the cost of establishing a laboratory for the preparation of anti-diphtheric serum. The Paris correspondent of the *Lancet* reports that the Municipal Council of Paris has voted a subvention of fifteen thousand francs to the Pasteur Institute in aid of the preparation and distribution of anti-toxin. A sum of seven thousand six hundred francs has also been voted for the erection of accommodation for immune horses, and an allowance of fifteen hundred francs has been made to enable the institute to prepare and distribute anti-diphtheric serum during the present month and the month of December. In our own country, Sir Joseph Lister's appeal for funds has resulted in the sum of £850 being raised. It is estimated that at least £2000 will be required by the British Institute of Preventive Medicine in order to establish an installation for the manufacture of a sufficient quantity of the fluid to supply the demand.

A MARINE laboratory founded and maintained by a religious corporation, is probably unique of its kind ; but such is the case with the Russian station on the island of Solowetzk, in the White Sea, as an interesting article in *Die Natur* informs us. From the early part of the fifteenth century Solowetzk or Holy Island has been the seat of an important monastery, but the foundation, in 1881, of a marine laboratory in connection with it was principally due to the efforts of Prof. R. Wagner, of St. Petersburg, and to the friendly offices of the late Archimandrite Mileti. The laboratory results from the conversion of a herring factory already existing there on a favourable site. It is now a convenient two-storied building, furnished with tank-room, museum, and six work-rooms with large windows, fully provided with all necessary utensils and reagents. Perpetual day is enjoyed from the middle of May to the middle of July, and during that period the energetic naturalist can work continuously with his microscope night and day, if he so pleases. A little fleet of sailing-boats is at the disposal of the station, but, owing to the uncertainty of the winds, a steam-launch is found to be a great desideratum. The attendants are selected from the peasants serving longer or shorter periods in the monastery, and the laboratory naturally suffers a good deal of inconvenience from the frequent changes which ensue. The director for some three years past has been M. Knipowitsch, whose local knowledge has considerably facilitated the researches of visiting naturalists. A long deep lagoon on the east of the island presents features of unusual interest to the biologist. Owing to its physical conformation the lower layers of water remain throughout the year at a constant low temperature, enabling such Arctic forms as *Yoldia arctica* to survive through the summer heat ; while the warming of the tidal surface waters in summer favours the development of such forms as *Cyprina islandica*, and markedly hastens the development of medusæ such as *Cyanea* and *Aurelia*. Solowetzk may be reached from St. Petersburg either *viâ* Jaroslaw and Archangel, or, more directly, *viâ* the lakes, Povjonetz and Szumski.

CAPTAIN WIGGINS, who had left the Yenesei in the *Stjernen*, late in the season for England, has been wrecked in Yugor Strait, but a telegram from Archangel states that all on board are well. Particulars have not yet been received, but the fact points to a serious condition of the ice in the Kara Sea.

THE Christmas Lectures to Young People, arranged by the Royal Geographical Society, will this year be delivered by Dr. H. R. Mill. The course, entitled "Holiday Geography," will include four lectures, dealing respectively with maps as holiday companions ; geographical pictures, with special reference to amateur photography ; a neglected corner—the English lakes ; and a geographical holiday on the edge of the Alps. The lectures will take place in the map-room of the Royal Geographical Society, and will be profusely illustrated by the lantern.

THE Royal Geographical Society initiated the new technical meetings for geographers on Monday afternoon, by the discussion of a paper on a pre-Columbian discovery of America, by Mr. Yule Oldham. The claim for the discovery of Brazil by a Portuguese navigator in 1447 was based on a map of Andrea Biancho prepared in 1448, on which an "authentic island 1500 miles west of Cape Verde" was shown. This evidence was supported by various additional arguments, including the St. Brandan's Island of Martin Behaim's globe of 1492. A very lively discussion ensued, in which Mr. E. G. Ravenstein, Mr. Payne, Mr. Beazeley, Dr. Schlichter, Mr. Delmar Morgan, and others took part. The general conclusion of the meeting was unfavourable to the view of the early discovery of Brazil, but all speakers united in expressing their admiration of the manner in which Mr. Oldham marshalled the facts and expounded his theory.

DR. ADOLF E. FORSTER, of Vienna, has made a very careful study of the temperature variations in the rivers of Central Europe, which has just been published in Prof. Penck's *Geographische Abhandlungen*. He has collected a great number of isolated sets of observations, in several cases extending over many years, which have been made by different observers on the main rivers and tributaries of the Vistula, Oder, Elbe, Weser, Rhine, Danube, Adige, Po, Rhone, Loire, Seine, and Thames. These are discussed in order to bring out the amount of diurnal range, the effect on the mean result of different methods of observations (including the effect of depth), the relation between the temperature of water and air in different classes of rivers, the annual march of river-temperature, the variability of water-temperature from the long-period means, the influence of ice, and various other factors, such as the effect of dynamical heating on account of fall from higher to lower levels. Dr. Forster recognises the necessity of farther observations of a strictly comparable kind in order to obtain sure results, especially with regard to the bearing of river-temperature on meteorology ; but the results he has obtained are of great interest. He shows how the relation of air- and water-temperature depends on the character of the water-surface considered. In glacier-fed rivers the air is colder than the water only for four months in winter and early spring ; in summer the maximum temperature of air and water coincides with the greatest excess of air-temperature. A similar though less marked relation holds good for mountain streams which are not fed by glaciers. In lakes and the outlets of lakes the air-temperature is higher than that of the water only during the four months during which heat is being stored, th curves crossing close to the maximum. In rivers flowing

over plains, such as the Oder at Breslau, and the Marne at its junction with the Seine, the water-temperature remains throughout the year from one to three degrees Centigrade warmer than t he

HERR E. LECHER, in the *Wiener Berichte*, gives an account of an experiment he has performed to test whether when a magnet turns about its magnetic axis the lines of force remain at rest or turn with the magnet. A magnet is divided by an equatorial plane into two parts, which can turn independently. Under these circumstances it is possible, by means of suitable contact brushes, to obtain from the two extremities of the magnet an induced current of such a magnitude as cannot be explained by the cutting of the rotating lines of force by the extremely short brushes employed. These currents can be explained if we suppose, as did Faraday at one time, that a rotating magnet cuts its own lines of force which remain fixed in space.

MR. CARL BARUS, in the current number of the *American Journal of Science*, describes a simple chronograph pendulum which is likely to be very useful to those who have no break-circuit chronometer or seconds clock at their disposal. It is a simple mechanism by which an ordinary seconds pendulum is both kept in motion and made to record its oscillations on one or more chronographs sharply. The heavy metallic bob of the pendulum is electrically connected with the knife-edge, and its top is surmounted by a soft iron armature, which is attracted during part of the swing by an electromagnet, and thus kept in motion. A longer and very much lighter pendulum, consisting of a flat bob suspended by two wires, is suspended by the side of the first, and swings in the same plane, but with a longer period. As the heavy pendulum approaches it, it touches a platinum spring projecting from the other bob, makes current for a moment, and works the chronograph, and at the same time sends the current through the electromagnet. The contact is quite momentary, as the spring causes the wire pendulum to be hurled off ballistically. On its return it is brought to rest, without rebounding, by a stop, against which it leans till the seconds pendulum returns. The bob of the light pendulum is made up of two small square parallel plates, between which the wires and the platinum strip are clutched by a single central screw. A band of platinum foil is wrapped round the heavy bob, in order to ensure reliable electric contact. The chronographs and the electromagnet are connected in parallel. The records show that the time of contact does not reach 0·1 sec. It is desirable to use electromagnets of high resistance to prevent exhausting the battery.

PART I. of vol. vii. of *Cohn's Beiträge* is taken up with a long paper, by Dr. W. Rothert, on Heliotropism. He finds that the heliotropic stimulus received on one part may be transmitted to another part of the same organ, or even to a different organ, and there give rise to heliotropic curvature. The transmission can only take place in a basipetal direction, and its rate is always small; in favourable cases 2 cm. per hour. Contrary to Darwin's views, he believes that the whole region which is capable of heliotropic curvature, is also heliotropically sensitive, although this sensitiveness is often unequally distributed in the same region. In all cases of this unequal distribution, it is a small region at the apex of the organ which is distinguished by a greater sensitiveness, whilst the rest exhibits this sensitiveness often in a far less degree. Further, the author investigated the effects of cutting off the apex of the cotyledon of seedlings of grasses, and found that this gives rise to two independent phenomena: a diminution in the rate of growth of the base, and a complete suspension of its heliotropic and geotropic sensitiveness. Both these effects are, however, only temporary. It was also unexpectedly found that these effects are not consequent on every injury done to the cotyledon, but that large cuts made either into the apex, or even two semi-sections made below the apex from opposite sides of the organ, and only 2 mm. apart, do not cause the diminution in the rate of growth, nor the suspension of heliotropic and geotropic sensitiveness, but that this is only effected by the complete section of the cotyledon.

MESSRS. W. WESLEY AND SON'S "Natural History and Scientific Book Circular," No. 122, contains a full classified list of important works on botany.

THE thirteenth monthly part of "The Royal Natural History" (Frederick Warne and Co.), being the first part of the third volume of the work, has been published.

THE Royal College of Physicians, Edinburgh, has just issued the fifth volume of Reports from their Laboratory, edited by Drs. J. Batty Tuke and D. Noël Paton. The volume presents the results of investigations carried out during the past two years.

THE ninth number of the handy and useful *Alembic Club Reprints* (Edinburgh: W. F. Clay) is devoted to Davy's papers on the property and nature of "muriatic acid" and "oxymuriatic acid," published in the *Philosophical Transactions* between 1809 and 1818. Our readers need hardly be reminded that though Gay-Lussac and Thenard were inclined to believe in the elementary nature of the latter, it was Davy who established the correctness of this view. This reprint of the eight communications to the Royal Society, on his experiments to demonstrate the elementary nature of chlorine, will be valued by students of historical chemistry.

WE have received No. 6 of *The Scientific Roll*, conducted by A. Ramsay, and dealing with the baric condition of the atmosphere. This publication is intended to be a summary of what is known of this subject from the works of various writers, so that anyone may make himself acquainted with what has been written without obtaining and reading the original books, some of which are now difficult of access. The present number contains notes taken from Prof. Kämtz' *Vorlesungen über Meteorologie*, published in 1840, and translated into English by Mr. C. V. Walker in 1845. In addition to retaining the original scales, the author reduces all values to what he terms the "baric unit," which is taken as equivalent to one million pounds weight on the square mile. Thus one inch of mercury at 60° F., and under the ordinary pressure of sea-level, corresponds to 2000 such baric units, and a millimetre under the same conditions to 78·74 baric units.

PROF. LOTHAR MEYER communicates to the *Berichte* a warning note concerning the dangerous nature of explosive mixtures of acetylene and oxygen. It is a well-known fact, frequently demonstrated upon chemical lecture-tables, that detonating mixtures of hydrogen and oxygen, or of marsh gas, ethylene, or carbon monoxide and oxygen, may be ignited in an open glass cylinder without danger provided the vessel is not narrowed at the neck, which would be likely to cause undue pressure. Prof. Meyer states that he has frequently performed the experiment with the above gaseous mixtures, employing a strong straight glass cylinder four centimetres wide and with very thick base, without ever having experienced an accident. Upon performing the experiment recently, however, with a mixture of acetylene and two and a half to three times its volume of oxygen, igniting the gas by approaching the mouth of the cylinder to a flame, the cylinder was blown to innumerable fragments in his hand, happily and almost miraculously without injuring him, although unprotected by a cloth, and the report of the explosion was so loud as to deafen for a time those in the neighbourhood. It has long been known that acetylene explodes with oxygen in closed vessels with great violence, frequently destroying an eudiometer, but this remarkable destruc-

tion of an open cylinder is a new evidence of its disruptive force. In the year 1884 Prof. Meyer, in conjunction with Prof. Seubert, showed that the detonating mixture of acetylene and oxygen ignites at a lower pressure than all other combustible gases, a pressure equal to thirty-two millimetres of mercury being sufficient to enable it to explode, while hydrogen and oxygen require a pressure of at least one hundred millimetres, and carbon monoxide and oxygen over two hundred millimetres. This, however, is not sufficient to account for the enormous pressure developed in an open cylinder. Moreover, it cannot be due to the more rapid rate of propagation of the explosion, for M. Berthelot and Prof. Dixon have independently found that the rapidity in the case of the acetylene detonating mixture is but slightly greater than in the mixtures of oxygen with ethylene or marsh gas, and much less than in the case of a mixture of hydrogen and oxygen. Prof. Meyer suggests that the smaller amount of hydrogen contained in acetylene than the other hydrocarbons, resulting in the production of less water vapour and relatively more carbon dioxide, together with the fact that the theoretical temperature of the combustion calculated from existing thermal data, is extremely high in the case of acetylene, may afford some explanation of the extraordinary energy developed during the explosion of the latter.

A PURE white di-sulphide of tin has been obtained by Dr. Schmidt in the laboratory of the Berlin University, which is further distinguished by the property of being readily soluble in ammonium carbonate. It may easily be prepared as follows: Metallic tin is first dissolved in hydrochloric acid, and the stannous chloride oxidised by digestion with nitric acid to stannic chloride, and the excess of acid largely removed by evaporation. After dilution with water the tin is precipitated as the ordinary yellow sulphide by sulphuretted hydrogen. The washed precipitate is next freed from traces of arsenic by solution in concentrated hydrochloric acid and reprecipitating the diluted and filtered solution with sulphuretted hydrogen. The well-washed yellow precipitate is then digested with a large excess of ammonium hydrate for some days at the ordinary temperature, when the whole of it eventually dissolves except small traces of the black sulphides of lead and bismuth. Upon diluting the clear ammoniacal solution and neutralising it with dilute sulphuric acid, an almost perfectly white precipitate is obtained. This precipitate dissolves at once almost completely in ammonium carbonate, and upon again neutralising with dilute sulphuric acid the disulphide precipitated is pure white. This new form of stannic sulphide is very voluminous, and it apparently owes its absence of colour and greater bulk to the fact that stannic sulphide here exists either in a different state of molecular aggregation or of hydration. It is significant that upon drying it becomes amber-yellow and loses its property of dissolving in ammonium carbonate.

THE additions to the Zoological Society's Gardens during the past week include a Lesser White-nosed Monkey (*Cercopithecus petaurista*), a Pel's Owl (*Scotopelia peli*), an Angolan Vulture (*Gypohierax angolensis*), a Black Kite (*Milvus migrans*), a Buzzard (*Buteo*, sp. inc.) from West Africa, presented by Mr. C. B. Mitford; two —— Baboons (*Cynocephalus*, sp. inc.) from East Africa, presented by Mr. Charles Palmer; a Chilian Sea Eagle (*Geranoætus melanoleucus*) from South America, presented by the Rev. Fred L. Curne; two Bronze-winged Pigeons (*Phaps chalcoptera*) from Australia, presented by Mrs. Amy Jones; ten Surinam Toads (*Pipra americana*) from Surinam, presented by Mr. F. E. Blaauw; five Three-streaked Euprepes (*Euprepes trivittatus*) from South Africa, presented by Mr. J. E. Matcham: a Muscat Gazelle (*Gazella muscatensis*) from Muscat, an Echnida (*Echnida hystrix*) from New South Wales, deposited; four Lapwings (*Vanellus cristatus*), British, purchased.

OUR ASTRONOMICAL COLUMN.

OBSERVATIONS OF THE TRANSIT OF MERCURY.—Several French astronomers made preparations for observing the recent transit of Mercury across the sun, but the weather conditions on the other side of the Channel were just as unfavourable as they were here. The current *Comptes rendus* contains a brief note on the transit, by M. Trouvelot. This observer saw Mercury projected upon the sun at 4h. 12m. The planet was sharply defined, and appeared as a circular, intensely black, spot on the luminous background of the sun. In spite of careful observation, M. Trouvelot was unable to detect any trace of a luminous ring such as he observed round the planet during the transit of 1878. The unfavourable conditions of observation, however, are sufficient to explain the absence of the phenomenon.

Dr. Janssen also contributes a note on the transit of Mercury to *Comptes rendus*. He intended to look particularly for the "black-drop" observed during the transit of Venus in 1874, but clouds prevented the observation.

EPHEMERIS OF ENCKE'S COMET.—The following positions for Encke's Comet during this year are from an ephemeris given by Dr. O. Backlund in the *Astronomische Nachrichten*, No. 3263. The comet will pass perihelion on February 4, 1895. In the year 1862, its perihelion passage occurred on February 6.

Ephemeris for 0h. Berlin Mean Time.

1894.	R.A. app. h. m. s.	Decl. app. ° ′ ″
Nov. 22 ...	22 35 54·79 ...	+ 9 6 51·0
,, 24 ...	33 25·02 ...	8 40 53·6
,, 26 ...	31 7·93 ...	8 15 59·1
,, 28 ...	29 3·11 ...	7 52 9·1
,, 30 ...	27 9·98 ...	7 29 24·0
Dec. 2 ...	25 28·18 ...	7 7 43·2
,, 4 ...	23 57·09 ...	6 47 5·3
,, 6 ...	22 36·02 ...	6 27 27·9
,, 8 ...	21 24·29 ...	6 8 48·5
,, 10 ...	20 21·19 ...	5 51 3·6
,, 12 ...	19 25·94 ...	5 34 8·3
,, 14 ...	18 37·75 ...	5 17 57·7
,, 16 ...	17 55·77 ...	5 2 25·7
,, 18 ...	17 19·11 ...	4 47 25·7
,, 20 ...	16 46·82 ...	4 32 50·6
,, 22 ...	16 17·82 ...	4 18 32·0
,, 24 ...	15 50·85 ...	4 4 19·0
,, 26 ...	15 24·59 ...	3 49 59·2
,, 28 ...	14 57·30 ...	3 35 18·2
,, 30 ...	22 14 27·09 ...	+ 3 19 58·3

RECENT OBSERVATIONS OF JUPITER.—Prof. E. E. Barnard communicates to this month's *Astronomy and Astro-Physics* an account of his recent observations of the great red spot and other markings on Jupiter. The following points with regard to these features are of interest to observers: "The surface of Jupiter is very strongly marked, during this opposition, by two broad reddish belts, one on each side of the equator, and a broad white belt between them at the equator. The great red spot is fairly distinct in outline, though quite pale—a feeble red. The great bay in the south equatorial belt north of the red spot is still persistent and well marked." Prof. Barnard has observed a number of small black and white spots in Jupiter's northern hemisphere. Two of these objects, a black and a white spot, can easily be seen opposite the great red spot on the planet's disc. Prof. Barnard's measures indicate that the white spot will be in conjunction with the dark one about the middle of January next year, but as the two objects are not exactly on the same parallel, they will only graze in passing one another. The black spot appears to have about the same rotation period of the great red spot. Numerous white spots have been observed in Jupiter's southern hemisphere. A few dusky markings have also been seen on the great white equatorial belt.

THE NEW CYPRESS OF NYASALAND.

IN the most easterly corner of the British Protectorate of Nyasaland, immediately south of Lake Shirwa (between 35° and 36° E. lat, and a little north of 16° S. lat.), lies the large isolated mountain-mass of Milanji. From the plains which surround it the land rises gradually to a height of about 3000 feet, and forms the lower spurs of the mountain. Above these outliers the mountain is carried up another 3000 feet in abrupt elevations, only broken in places where the larger streams flow down. This

rampart of cliffs borders the upper plateau of Milanji, which is elevated about 6000 feet above the sea-level, and is of considerable extent, though split up into various portions by ravines and precipices. In the centre of the plateau peaks rise to a further height of 3500 feet, thus giving Milanji a total elevation of nearly 10,000 feet above the sea-level.[1]

Mr. Alexander Whyte, the naturalist attached to the staff of Mr. H. H. Johnston, C.B., H.B.M. Commissioner and Consul-General, who usually resides at Zomba, made a botanical excursion to Milanji in 1892, and obtained a good series of the mountain-plants. An account of this collection, prepared by the officers of the Botanical Department in the British Museum, is given in a recently issued part of the Botanical *Transactions* of the Linnean Society.

photograph, and kindly lent to us by the Linnean Society. The timber is of a pale reddish colour, of excellent quality, and easily worked. The bark on the old trees is of great thickness, consisting of layers which are annually shed and renewed. The foliage recalls that of the juniper, while the fruits or cones, which are crowded from four to six together on short lateral shoots, are about three-quarters of an inch long, and from that to one inch wide when open. They consist of four thick woody scales, united below, spreading above, and bearing at their bases on the internal surface a number of small winged seeds.

Examination of the specimens sent home has shown that we are here dealing with a new species of *Widdringtonia*, a small genus of conifers allied to the cypress and juniper. Mr. Whyte's discovery has considerable scientific interest, from the fact that

The Milanji Cypress (*Widdringtonia whytei*).

Among the many plants new to science discovered by Mr. Whyte, and described in this memoir, one is of special interest, owing to its importance from an economic point of view.

In his exploration of the mountain, Mr. Whyte was much impressed with "a large cypress," which formed the most striking feature of the upper plateau. One prostrate trunk, and that by no means the largest seen, measured 140 feet in length, with a diameter of 5½ feet at six feet from the base, and had a clean, straight stem of ninety feet. In other cases long straggling branches are given off nearer the base, as shown in the accompanying figure, prepared by Mr. Worthington Smith from a

it extends the geographical range of the genus, hitherto known only from South Africa, Madagascar and Mauritius, into tropical Africa; and his name has been fittingly associated with the plant, which will henceforth be known as *Widdringtonia whytei*.

Its nearest ally, *W. juniperoides*, is found in the Cederberg Mountains, Cape Colony, where, according to a note by Parlatore in De Candolle's *Prodromus* (vol. xvi. part 2, p. 442), it once formed large forests, but is now rare. The Milanji species is also threatened with extinction; in this case by the bush-fires, the devastating effects of which, Mr. Whyte says, it is deplorable to witness, and which reach even the lofty and almost inaccessible plateau. These fires, originating during the

[1] See "Routes and Districts in Southern Nyasaland," by Bertram L. Sclater, R.E., *Geograph. Journ.*, November 1893.

dry months of August and September in the villages on the lower slopes of the mountain, gradually creep up the precipitous cliffs from tuft to tuft of dried herbage till they gain the grassy table-lands, and raging over the plain eat their way along the edges of the remaining belts of forest; annually scorching, if not burning, the bark and timber of the outside trees, and killing outright the young seedlings. In exceptionally dry seasons even the damper gorges are invaded, and Mr. Whyte describes hundreds of giant trees lying prostrate and piled on each other in all stages of destruction. We are glad to learn that Mr. Johnston, under whose directions Mr. Whyte's exploration was made, has taken steps to prevent a recurrence of such disasters.

Widdringtonia whytei promises to be of great economic value from the excellent quality of its timber for building purposes and furniture. It is easily worked, and is moreover a tree of rapid growth, for Mr. Whyte tells us that in a plantation which he has formed near the residency at Zomba, three-year-old seedlings have already reached a height of ten feet.

Seeds of the new conifer, forwarded by Mr. Whyte, reached this country in 1893, and healthy seedlings have been raised in the Royal Gardens, Kew; in the Botanical Gardens, Edinburgh; in Messrs. Veitch's Nurseries; and in the Zoological Society's Gardens; so that we may hope to see this fine tree ultimately established in Europe.

The existence of a large cedar-like tree on Milanji was first discovered by the Rev. Robert Acland, of the Blantyre Mission, who visited the mountain in 1889 for the purpose of founding a Mission Station. In Mr. Buchanan's narrative of his journey along the southern frontier of Nyasaland (*Proc. R. Geogr. Soc.* 1891, p. 271) it will be found alluded to as "a species of pine-tree" existing in the ravines on the north-eastern slope. In the latter part of 1891, Dr. W. A. Scott and Mr. Henry Brown made the first ascent of Milanji, going up the southern face, and ascertained the existence of large forests of the so-called "pine" at an altitude of 6000 feet above sea-level. A month later Mr. Whyte succeeded in ascending to the trees, and, as already stated, obtained the first specimens which reached this country, and enabled the tree to be classified and described.

When Fort Lister was founded in 1893, the cedar forests were found to come down to a much lower altitude on the north-east slopes of Mt. Milanji, and advantage was at once taken of this to procure a supply of the timber. It was cut up on the spot, and the planks carried to Zomba, where they have been employed for many purposes. When the residency at Zomba was re-roofed with iron this timber was used for the woodwork. There can be, therefore, no question about the value of this discovery.

SCHIAPARELLI ON MARS.

THE following extracts from a translation communicated to *Astronomy and Astro-Physics*, by Prof. W. H. Pickering, are of special interest at the present time, for they set forth Schiaparelli's observations of the planet Mars, and show his views on various Martian phenomena. The original article was contributed by this keen observer to *Natura ed Arte*.

THE POLAR CAPS.

Many of the first astronomers who studied Mars with the telescope, noted on the outline of its disc two brilliant white spots of rounded form and of variable size. In process of time it was observed that whilst the ordinary spots upon Mars were displaced rapidly in consequence of the planet's daily rotation, changing in a few hours both their position and their perspective, that the two white spots remained sensibly motionless at their posts. It was concluded rightly from this, that they must occupy the poles of rotation of the planet, or at least must be found very near to them. Consequently they were given the name of polar caps or spots. And not without reason is it conjectured, that these represent upon Mars an immense mass of snow and ice, similar to that which to-day prevents navigators from reaching the poles of the Earth. We are led to this conclusion not only by the analogy of aspect and of place, but also by another important observation.

As things stand, it is manifest, that if the white polar spots of Mars represent snow and ice, they should continue to decrease in size with the approach of summer in those places, and increase during the winter. Now this very fact is observed in the most evident manner. In the second half of the year 1892 the southern polar cap was in full view; during that interval, and especially in the months of July and August, its rapid diminution from week to week was very evident, even to those observing with common telescopes. This snow (for we may well call it so), which in the beginning reached as far as latitude 70°, and formed a cap of over 2000 kilometres (1200 miles) in diameter, progressively diminished, so that two or three months later little more of it remained than an area of perhaps 300 kilometres (180 miles), at the most, and still less was seen later in the last days of 1892.[1] In these months the southern hemisphere of Mars had its summer; the summer solstice occurring upon October 13. Correspondingly the mass of snow surrounding the northern pole should have increased; but this fact was not observable, since that pole was situated in the hemisphere of Mars which was opposite to that facing the Earth. The melting of the northern snow was seen in its turn in the years 1882, 1884, and 1886.

The southern snow, however, presents this peculiarity, that the centre of its irregularly rounded figure does not coincide exactly with the pole, but is situated at another point, which is nearly always the same, and is distant from the pole about 300 kilometres (180 miles) in the direction of the Mare Erythræum. From this we conclude that when the area of the snow is reduced to its smallest extent, that the south pole of Mars is uncovered; and therefore, perhaps, the problem of reaching it upon this planet is easier than upon the Earth. The southern snow is in the midst of a huge dark spot, which with its branches occupies nearly one-third of the whole surface of Mars, and is supposed to represent its principal ocean. Hence the analogy with our arctic and antarctic snows may be said to be complete, and especially so with the antarctic one.

The mass of the northern snow-cap of Mars is on the other hand centred almost exactly upon its pole. It is located in a region of yellow colour, which we are accustomed to consider as representing the continent of the planet. From this arises a singular phenomenon which has no analogy upon the Earth. At the melting of the snows, accumulated at that pole during the long night of ten months and more, the liquid mass produced in that operation is diffused around the circumference of the snowy region, converting a large zone of surrounding land into a temporary sea, and filling all the lower regions. This produces a gigantic inundation, which has led some observers to suppose the existence of another ocean in those parts, but which does not really exist in that place, at least as a permanent sea. We see then (the last opportunity was in 1884) the white spot of the snow surrounded by a dark zone, which follows its perimeter in its progressive diminution, upon a constantly diminishing circumference. The outer part of this zone branches out into dark lines, which occupy all the surrounding region, and seem to be distributory canals, by which the liquid mass may return to its natural position. This produces in these regions very extensive lakes, such as that designated upon the map by the name of *Lacus Hyperboreus;* the neighbouring interior sea called *Mare Acidalium* becomes more black, and more conspicuous. And it is to be remembered as a very probable thing, that the flowing of this melted snow is the cause which determines principally the hydrographic state of the planet, and the variations that are periodically observed in its aspect. Something similar would be seen upon the Earth, if one of our poles came to be located suddenly in the centre of Asia or of Africa. As things stand at present, we may find a miniature image of these conditions in the flooding that is observed in our streams at the melting of the Alpine snows.

Other white spots of a transitory character, and of a less regular arrangement, are formed in the southern hemisphere, upon the islands near the pole, and also in the opposite hemisphere, whitish regions appear at times surrounding the north pole, and reaching to 50° and 55° of latitude. They are perhaps transitory snows, similar to those which are observed in our latitudes. But also in the torrid zone of Mars are seen some very small white spots more or less persistent. Perhaps we may be permitted to account for these by the existence of a mountain capable of supporting extensive ice-fields. The existence of such a mountain has been supposed also by some recent observers, founded upon other facts.

MARTIAN METEOROLOGY.

As has been stated, the polar snows of Mars prove, in an incontrovertible manner, that this planet, like the Earth, is surrounded by an atmosphere capable of transporting vapour from one place to another. These snows are in fact precipitations of

[1] A note on the melting of the southern snow-cap this year appeared in the last number of NATURE (p. 64).

vapour, condensed by the cold, and carried with it successively. How carried with it, if not by atmospheric movement? The existence of an atmosphere charged with vapour has been confirmed also by spectroscopic observations, principally those of Vogel; according to which this atmosphere must be of a composition differing little from our own, and above all *very rich in aqueous vapour*. This is a fact of the highest importance, because from it we can rightly affirm with much probability, that to water, and to no other liquid is due the seas of Mars and its polar snows. When this conclusion is assured beyond all doubt, another one may be derived from it, of not less importance—that the temperature of the Arean climate, notwithstanding the greater distance of that planet from the Sun, is of the same order as the temperature of the terrestrial one. Because, if it were true, as has been supposed by some investigators, that the temperature of Mars was on the average very low (from 50° to 60° below zero !), it would not be possible for water vapour to be an important element in the atmosphere of that planet, nor could water be an important factor in its physical changes; but would give place to carbonic acid, or to some other liquid whose freezing point was much lower.

The elements of the meteorology of Mars seem then to have a close analogy to those of the Earth. But there are not lacking, as might be expected, causes of dissimilarity. From circumstances of the smallest moment, nature brings forth an infinite variety in its operations. Of the greatest influence must be the different arrangement of the seas and the continents upon Mars, and upon the Earth. We have already emphasised the fact of the extraordinary periodical flood, which at every revolution of Mars inundates the northern polar region at the melting of the snow. Let us now add that this inundation is spread out to a great distance by means of a network of canals, perhaps constituting the principal mechanism (if not the only one) by which water (and with its organic life) may be diffused over the arid surface of the planet. Because on Mars it rains very rarely, *or perhaps even, it does not rain at all.*

The atmosphere of Mars is nearly perpetually clear, and sufficiently transparent to permit one to recognise, at any moment whatever, the contours of the seas and continents, and more than that, even the minor configurations. Not indeed that vapours of a certain degree of opacity are lacking, but they offer very little impediment to the study of the topography of the planet. Here and there we see appear from time to time a few whitish spots, changing their position and their form, rarely extending over a very wide area. They frequent by preference a few regions, such as the islands of the *Mare Australe*, and on the continents, the regions designated on the map with the names of *Elysium* and *Tempe*. Their brilliancy generally diminishes and disappears at the meridian hour of the place, and is reinforced in the morning and evening, with very marked variations. It is possible that they may be layers of cloud, because the upper portions of terrestrial clouds, where they are illuminated by the Sun, appear white. But various observations lead us to think that we are dealing rather with a thin veil of fog, instead of a true nimbus cloud, carrying storms and rain. Indeed it may be merely a temporary condensation of vapour, under the form of dew or hoar-frost.

Accordingly, as far as we may be permitted to argue from the observed facts, the climate of Mars must resemble that of a clear day upon a high mountain. By day a very strong solar radiation hardly mitigated at all by mist or vapour, by night a copious radiation from the soil towards celestial space, and because of that a very marked refrigeration. Hence a climate of extremes, and great changes of temperature from day to night, and from one season to another. And as on the Earth at altitudes of 5000 and 6000 metres (17,000 to 20,000 feet), the vapour of the atmosphere is condensed only into the solid form, producing those whitish masses of suspended crystals, which we call cirrus clouds, so in the atmosphere of Mars, it would be rarely possible (or would even be impossible) to find collections of cloud capable of producing rain of any consequence. The variation of the temperature from one season to another would be notably increased by their long duration, and thus we can understand the great freezing and melting of the snow, which is renewed in turn at the poles at each complete revolution of the planet around the Sun.

TOPOGRAPHICAL TINTS.

In its general topography Mars does not present any analogy with the Earth. A third of its surface is occupied by the great *Mare Australe*, which is strewn with many islands, and the continents are cut up by gulfs and ramifications of various forms. To the general water system belongs an entire series of small internal seas, of which the Hadriacum and the Tyrrhenum communicate with it by wide mouths, whilst the Cimmerium, the Sirenum, and the Solis Lacus are connected with it only by means of narrow canals. We shall notice in the first four a parallel arrangement, which certainly is not accidental, as also not without reason is the corresponding position of the peninsulas of Ausonia, Hesperia, and Atlantis. The colour of the seas of Mars is generally brown, mixed with grey, but not always of equal intensity in all places, nor is it the same in the same place at all times. From an absolute black it may descend to a light grey, or to an ash colour. Such a diversity of colours may have its origin in various causes, and is not without analogy also upon the Earth, where it is noted that the seas of the warm zone are usually much darker than those nearer the pole. The water of the Baltic, for example, has a light, muddy colour, that is not observed in the Mediterranean. And thus in the seas of Mars we see the colour become darker when the sun approaches their zenith, and summer begins to rule in that region.

All of the remainder of the planet, as far as the north pole, is occupied by the mass of the continents, in which, save in a few areas of relatively small extent, an orange colour predominates, which sometimes reaches a dark red tint, and in others descends to yellow and white. The variety in this colouring is in part of meteorological origin, in part it may depend on the diverse nature of the soil, but upon its real cause it is not as yet possible to frame any very well-grounded hypothesis. Some have thought to attribute this colouring to the atmosphere of Mars, through which the surface of the planet might be seen coloured, as any terrestrial object becomes red, when seen through red glass. But many facts are opposed to this idea, among others, that the polar snows appear always of the purest white, although the rays of light derived from them traverse twice the atmosphere of Mars under great obliquity. We must then conclude that the Arean continents appear red and yellow, because they are so in fact.

Besides these dark and light regions, which we have described as seas and continents, and of the nature of which there is at present scarcely left any room for doubt, some others exist, truly of small extent, of an amphibious nature, which sometimes appear yellowish like the continents, and are sometimes clothed in brown (even black in certain cases), and assume the appearance of seas, whilst in other cases their colour is intermediate in tint, and leaves us in doubt to which class of regions they may belong. Thus, all the islands scattered through the Mare Australe and the Mare Erythræum belong to this category, so too the long peninsula called Deucalionis Regio and Pyrrhæ Regio, and in the vicinity of the Mare Acidalium the regions designated by the names of Baltia and Nerigos. The most natural idea, and the one to which we should be led by analogy, is to suppose these regions to represent huge swamps, in which the variation in depth of the water produces the diversity of colours.

Not without reason, then, have we hitherto attributed to the dark spots of Mars the part of seas, and that of continents to the reddish areas which occupy nearly two-thirds of all the planet, and we shall find later other reasons which confirm this method of reasoning. The continents form in the northern hemisphere a nearly continuous mass, the only important exception being the great lake called the Mare Acidalium, of which the extent may vary according to the time, and which is connected in some way with the inundations which we have said were produced by the melting of the snow surrounding the north pole. To the system of the Mare Acidalium undoubtedly belong the temporary lake called Lacus Hyperboreus and the Lacus Niliacus. This last is ordinarily separated from the Mare Acidalium by means of an isthmus or regular dam, of which the continuity was only seen to be broken once for a short time in 1888. Other smaller dark spots are found here and there in the continental area, which we may designate as lakes, but they are certainly not permanent lakes like ours, but are variable in appearance and size according to the seasons, to the point of wholly disappearing under certain circumstances. Ismenius Lacus, Lunæ Lacus, Trivium Charontis and Propontis are the most conspicuous and durable ones. There are also smaller ones, such as Lacus Mœris and Fons Juventæ, which at their maximum size do not exceed 100 to 150 kilometres (60 to 90 miles) in diameter, and are among the most difficult objects upon the planet.

THE CANALS OR CHANNELS.

All the vast extent of the continents is furrowed upon every side by a network of numerous lines or fine stripes of a more or less pronounced dark colour, whose aspect is very variable. These traverse the planet for long distances in regular lines, that do not at all resemble the winding courses of our streams. Some of the shorter ones do not reach 500 kilometres (300 miles), others on the other hand extend for many thousands, occupying a quarter or sometimes even a third of a circumference of the planet. Some of these are very easy to see, especially that one which is near the extreme left-hand limit of our map, and is designated by the name of Nilosyrtis. Others in turn are extremely difficult, and resemble the finest thread of spider's web drawn across the disc. They are subject also to great variations in their breadth, which may reach 200 or even 300 kilometres (120 to 180 miles) for the Nilosyrtis, whilst some are scarcely 30 kilometres (18 miles) broad.

These lines or stripes are the famous canals of Mars, of which so much has been said. As far as we have been able to observe them hitherto, they are certainly fixed configurations upon the planet. The Nilosyrtis has been seen in that place for nearly one hundred years, and some of the others for at least thirty years. Their length and arrangement are constant, or vary only between very narrow limits. Each of them always begins and ends between the same regions. But their appearance and their degree of visibility vary greatly, for all of them, from one opposition to another, and even from one week to another, and these variations do not take place simultaneously and according to the same laws for all, but in most cases happen apparently capriciously, or at least according to laws not sufficiently simple for us to be able to unravel. Often one or more become indistinct, or even wholly invisible, whilst others in their vicinity increase to the point of becoming conspicuous even in telescopes of moderate power.

Every canal[1] (for now we shall so call them) opens at its ends, either into a sea, or into a lake, or into another canal, or else into the intersection of several other canals. None of them have yet been seen cut off in the middle of the continent, remaining without beginning or without end. This fact is of the highest importance. The canals may intersect among themselves at all possible angles, but by preference they converge towards the small spots to which we have given the name of lakes. For example, seven are seen to converge in Lacus Phœnicis, eight in Trivium Charontis, six in Lunæ Lacus, and six in Ismenius Lacus.

The normal appearance of a canal is that of a nearly uniform stripe, black, or at least of a dark colour, similar to that of the seas, in which the regularity of its general course does not exclude small variations in its breadth, and small sinuosities in its two sides. Often it happens that such a dark line opening out upon the sea is enlarged into the form of a trumpet, forming a huge bay, similar to the estuaries of certain terrestrial streams. The Margaritifer Sinus, the Aonius Sinus, the Auroræ Sinus, and the two horns of the Sabæus Sinus are thus formed, at the mouths of one or more canals, opening into the Mare Erythræum or into the Mare Australe. The largest example of such a gulf is the Syrtis Major, formed by the vast mouth of the Nilosyrtis, so called. This gulf is not less than 1800 kilometres (1100 miles) in breadth, and attains nearly the same depth in a longitudinal direction. Its surface is little less than that of the Bay of Bengal. In this case we see clearly the dark surface of the sea continued without apparent interruption into that of the canal. Inasmuch as the surfaces called seas are truly a liquid expanse, we cannot doubt that the canals are a simple prolongation of them, crossing the yellow areas or continents.

Of the remainder, that the lines called canals are truly great furrows or depressions in the surface of the planet, destined for the passage of the liquid mass, and constituting for it a true hydrographic system, is demonstrated by the phenomena which are observed during the melting of the northern snows. We have already remarked that at the time of melting they appeared surrounded by a dark zone, forming a species of temporary sea. At that time the canals of the surrounding region become blacker and wider, increasing to the point of converting, at a certain time, all of the yellow region comprised between the edge of the snow and the parallel of 60° north latitude, into numerous islands of small extent. Such a state of things does not cease, until the snow, reduced to its minimum area, ceases to melt. Then the breadth of the canals diminishes, the temporary sea disappears, and the yellow region again returns to its former area. The different phases of these vast phenomena are renewed at each return of the seasons, and we have been able to observe them in all their particulars very easily during the oppositions of 1882, 1884, and 1886, when the planet presented its northern pole to terrestrial spectators. The most natural and the most simple interpretation is that to which we have referred, of a great inundation produced by the melting of the snows—it is entirely logical, and is sustained by evident analogy with terrestrial phenomena. We conclude, therefore, that the canals are such in fact, and not only in name. The network formed by these was probably determined in its origin in the geological state of the planet, and has come to be slowly elaborated in the course of centuries. It is not necessary to suppose them the work of intelligent beings, and notwithstanding the almost geometrical appearance of all of their system, we are now inclined to believe them to be produced by the evolution of the planet, just as on the Earth we have the English Channel and the Channel of Mozambique.

[1] The correct translation of the Italian word *canale*, used with reference to the streaks on Mars, is channel or strait, and not canal.

THE GEMINATION OF THE CANALS.

The most surprising phenomenon pertaining to the canals of Mars is their gemination, which seems to be produced principally in the months which precede, and in those which follow the great northern inundation, at about the times of the equinoxes. In consequence of a rapid process, which certainly lasts at most a few days, or even perhaps only a few hours, and of which it has not yet been possible to determine the particulars with certainty, a given canal changes its appearance, and is found transformed through all its length, into two lines or uniform stripes, more or less parallel to one another, and which run straight and equal with the exact geometrical precision of the two rails of a railroad But this exact course is the only point of resemblance with the rails, because in dimensions there is no comparison possible, as it is easy to imagine. The two lines follow very nearly the direction of the original canal, and end in the place where it ended. One of these is often superposed as exactly as possible upon the former line, the other being drawn anew, but in this case the original line loses all the small irregularities and curvature that it may have originally possessed. But it also happens that both the lines may occupy opposite sides of the former canal, and be located upon entirely new ground. The distance between the two lines differs in different geminations, and varies from 600 kilometres (360 miles) and more, down to the smallest limit at which two lines may appear separated in large visual telescopes—less than an interval of 50 kilometres (30 miles). The breadth of the stripes themselves may range from the limit of visibility, which we may suppose to be 30 kilometres (18 miles), up to more than 100 kilometres (60 miles). The colour of the two lines varies from black to a light red, which can hardly be distinguished from the general yellow background of the continental surface. The space between is for the most part yellow, but in many cases appears whitish. The gemination is not necessarily confined only to the canals, but tends to be produced also in the lakes. Often one of these is seen transformed into two short, broad, dark lines parallel to one another, and traversed by a yellow line. In these cases the gemination is naturally short, and does not exceed the limits of the original lake.

The gemination is not shown by all at the same time, but when the season is at hand, it begins to be produced here and there, in an isolated, irregular manner, or at least without any easily recognisable order. In many canals (such as the Nilosyrtis for example) the gemination is lacking entirely, or is scarcely visible. After having lasted for some months, the markings fade out gradually and disappear until another season equally favourable for their formation. Thus it happens that in certain other seasons (especially near the southern solstice of the planet) that few are seen, or even none at all. In different oppositions the gemination of the same canal may present different appearances as to width, intensity and arrangement of the two stripes, also in some cases the direction of the lines may vary, although by the smallest quantity, but still deviating by a small amount from the canal with which they are directly associated. From this important fact it is immediately understood that the gemination cannot be a fixed formation upon the surface of Mars, and of a geographical character like the canals.

The observation of the geminations is one of the greatest difficulty, and can only be made by an eye well practised in

such work, added to a telescope of accurate construction and of great power. This explains why it is that it was not seen before 1882. In the ten years that have transpired since that time, it has been seen and described at eight or ten observatories. Nevertheless, some still deny that these phenomena are real, and tax with illusion (or even imposture) those who declare that they have observed it.

EXPLANATIONS OF THE GEMINATION OF CANALS.

Having regard then to the principle that in the explanation of natural phenomena, it is universally agreed to begin with the simplest suppositions, the first hypotheses on the nature and cause of the geminations have for the most part put in operation only the laws of inorganic nature. Thus the gemination is supposed to be due either to the effects of light in the atmosphere of Mars, or to optical illusions produced by vapours in various manners, or to glacial phenomena of a perpetual winter, to which it is known all the planets will be condemned, or to double cracks in its surface, or to single cracks of which the images are doubled by the effect of smoke issuing in long lines and blown laterally by the wind. The examination of these ingenious suppositions leads us to conclude that none of them seem to correspond entirely with the observed facts, either in whole or in part. Some of these hypotheses would not have been proposed had their authors been able to examine the geminations with their own eyes.

It is far easier to explain the gemination if we are willing to introduce the forces pertaining to organic nature. Here the field of plausible supposition is immense, being capable of making an infinite number of combinations capable of satisfying the appearances even with the smallest and simplest means. Changes of vegetation over a vast area, and the production of animals, also very small, but in enormous multitudes, may well be rendered visible at such a distance. An observer placed in the moon would be able to see such an appearance at the times in which agricultural operations are carried out upon one vast plain—the seed-time and the gathering of the harvest. In such a manner also would the flowers of the plants of the great steppes of Europe and Asia be rendered visible at the distance of Mars—by a variety of colouring. A similar system of operations produced in that planet may thus certainly be rendered visible to us. But how difficult for the Lunarians and Areans to be able to imagine the true causes of such changes of appearance, without having first at least some superficial knowledge of terrestrial nature! So also for us, who know so little of the physical state of Mars, and nothing of its organic world, the great liberty of possible supposition renders arbitrary all explanations of this sort, and constitutes the gravest obstacle to the acquisition of well-founded notions. All that we may hope is that with time the uncertainty of the problem will gradually diminish, demonstrating, if not what the geminations are, at least what they cannot be. We may also confide a little in what Galileo called "the courtesy of nature," thanks to which, sometimes from an unexpected source, a ray of light will illuminate an investigation at first believed inaccessible to our speculations, and of which we have a beautiful example in celestial chemistry. Let us therefore hope and study.

EARLY BRITISH RACES.[1]

II.

IN continental caves human skeletons of this period have been found; of these, perhaps, the best known is the famous Neanderthal one, from a cave near Düsseldorf. Upon this skeleton alone it would not have been prudent to have based the characters of Palæolithic cave men, because the circumstances under which it was found have given rise to some doubt as to its being of this age, and it is by some considered to belong to the next period which we have to deal with. When it is taken in conjunction with others presenting similar characters, regarding which there is no doubt as to the age to which they belong, the evidence it affords is considerably strengthened. The find of two skeletons at Spey (in Belgium) in 1886, has been most important, both in advancing our knowledge and confirming the characters ascribed to this race from various less complete specimens. The cranium of the Neanderthal skeleton, though very imperfect, is long and proportionately narrow in form, having a cephalic index of 72, the glabella, brow ridges, and external orbital processes are enormously developed, the forehead is remarkably flattened, the occiput is prominent, and the elevation of the whole vault is extremely low. The skulls of both the Spey skeletons are also long and narrow, one having a cephalic index of 70, and the other of 74·6; the superciliary ridges and also the glabella are very prominent; the frontal sinuses are large, the external orbital processes are thick and projecting, the ridges on the frontal, parietal, and temporal bones for muscular attachments are strongly developed; the occiput is prominent with a well-marked "torus" at the junction of the curved muscular ridges, which are also large; the cranial vault is low and flattened from above downwards, and presents an antero-posterior curve very similar to the outline of the side of an ellipse. The malar bones have thick and broad orbital processes, the orbital cavities are deep, and the orbital breadth is but slightly inferior to the width; the zygomatic arches are large. The size of the lower molar teeth increases from before backwards, the first molar being the smallest, and the wisdom or last molar the largest. The lower jaw shows no prominence of the chin; indeed, it recedes somewhat from the alveolar border downwards, and has a symphesial angle of 111°. It is thus a counterpart of the Naulette mandible, which presents similar characters, both as regards the molars and symphesial angle. The stature of the Neanderthal skeleton, estimated from the length of the femur, is 1·604 metres (5 ft. 3 in.), and from the humerus 2 cm. less; that of the Spey skeleton (there being only one of these in which the long bones could be measured), estimated from the femur and tibia, is 1·504 metres (4 ft. 11¼ in.), and from the femur alone, 1·540 metres (5 ft. 0¾ in.). The stature of the Naulette skeleton, that of a woman, estimated from the ulna, is 1·433 metres (4 ft. 4½ in.), and shows that she also was very short.

The long bones of both upper and lower limbs of the Neanderthal skeleton are characterised by their unusual thickness, and the great development of the elevations and depressions for the attachment of muscles, the articular ends of the femur are also of larger size than usual. The femur of the Spey skeleton is more arched forward than usual, it is somewhat flattened from side to side in section, and the articular ends are of large size, especially the lower, in which there is enormous antero-posterior development of the articular surface of the condyles. The tibia is actually and proportionately very short, flattened laterally, and therefore platycnemic. The bones generally are remarkable for their stoutness, and indicate that the muscles attached to them were large and powerful, especially those of the lower limb. In respect to the platycnemism of the tibia, the Spey skeleton corresponds to the Langerie Basse and Madelaine bones from the Perigord Caves, and confirms in a very positive manner the evidence of their surroundings and relicts that Palæolithic people were sons of the chase, as it is connected with the development of the tibialis posticus muscle, and not a race character.

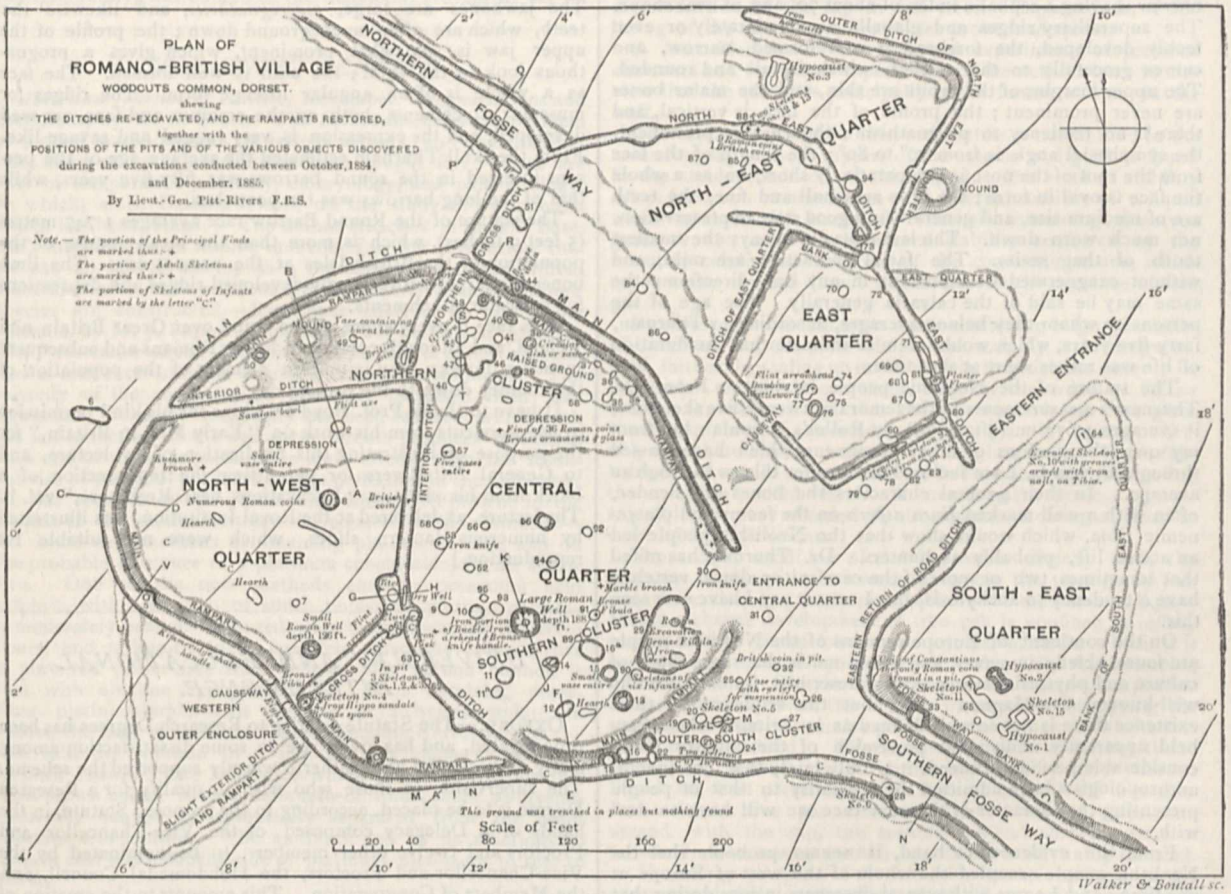
Portions of skulls and skeletons found in various parts of the continent, associated with Palæolithic implements and animal remains of late Pleistocene times, support the peculiar race characters of the specimens just described. The osteological remains of Palæolithic age now in hand from different parts of the continent seem to me to afford sufficient evidence of the existence, both in drift and in cave deposits, of a race of men possessing physical characters quite distinct from those of the Neolithic period, which we will next consider. The assertions which have been made at various times with respect to individual specimens being more or less pathological, will, to my mind, not hold good when we find specimen after specimen from the same deposits showing similar characters. It may not be possible, in some cases, to establish the fact that the specimen cannot have been deposited at a later period in the stratum in which it is found, but a careful examination of each specimen, such, for example, as Prof. Topinard has made of the mandible from Naulette, shows anatomical conditions which, not in one respect but in several, indicate as distinctly as his implements the progress of man's evolution, and preclude the idea of this type being a variety of the Neolithic people. The specimens of Palæolithic man seem to me to show identity of race, whether they have been found in the river-drift or in the Palæolithic stratum of caves. The idea of Prof. Boyd Dawkins, that the implements found in the river-drifts and later Palæolithic deposits of caves, give evidence of there being two Palæolithic races, is not supported by the osteological remains yet to hand. From extensive examination of ancient British skeletons,

[1] Continued from p. 70.

I do not consider that there is any evidence of the existence of the direct descendants of Palæolithic man among the osteological remains of Neolithic or subsequent date in Britain. Here he seems to be as extinct as many of his contemporary animals of the late Pleistocene period; this may not be the case with respect to his existence in other parts of Europe. Whether he has still representatives in America, as surmised by Prof. Boyd Dawkins and some American anthropologists, is outside the scope of the present lecture.

The next period at which we find remains of man in Britain is separated from the previous one by a space of time measurable only by the changes occurring in the interval. Great Britain and Ireland had once more become islands almost of the same dimensions as at the present day, with a moister and more continental climate—hotter in summer and colder in winter—abundant forests extending as far as the extreme north of Scotland, and numerous morasses and peat bogs. Not less significant was the advance in civilisation man had made since Palæolithic times, as we now find him dwelling in fixed habitations, with a knowledge of the arts and agriculture, with domestic animals, and with stone implements of a much more developed character, as he had now learned to smooth them by grinding and polishing.

These Neolithic people, as they are called, lived in camps, surrounded by ditches and ramparts, on the tops or sides of hills, or in suitable valleys. The camps were intersected with numerous drains or ditches, which would show that the climate was moist. Inside the camps they hollowed out pits, in or round which they dwelt. Excellent examples of the encampments or villages of the same Neolithic people, but of a much later date, have been discovered and described by General Pitt-Rivers in his excavations near Rushmore, from the main outlines of which some idea may be formed of what their earlier dwelling-places were probably like (Fig. 16).



Walker & Boutall sc.

FIG. 16.

From these camps have been obtained spindle whorls and bone combs toothed at one end, showing that they were acquainted with the arts of spinning and weaving, bone needles, fragments of coarse pottery, made by hand and not turned on the wheel, either plain or ornamented with simple lines or dots, bones of the roe, red deer, dog, goat, short-horned ox, horse, pig, &c., and fish, but no trace of metal is found. Of all their implements the stone axe is perhaps the most important. Flints used for implement-making were now often quarried from below the soil, with antlers of deer as picks. The implements were distributed over districts far removed from where they were made, probably by barter, Jadite or Nephrite implements having been found in Britain, which Mr. Rudler has shown may have been obtained from Switzerland, Silesia, or Styria. They possessed canoes formed out of the trunks of trees, in which they probably reached this country from the continent.

They buried their dead in caves, which had been used a dwellings, in their camps, and in chambered and unchambered barrows. The most characteristic British barrows of this period are of long oval shape, and often of large size, but Neolithic interments are also found in circular barrows. The dead were buried in a contracted or crouched position, and with them, stone and bone implements of various kinds, and pottery, which would seem to show that these articles were intended for the use of the dead or their spirits. Relics of art in the form of carvings are seldom found, and are very inferior to those of late Palæolithic times.

Osteological remains of the Neolithic people are distributed all over Britain, from the south of England to the extreme north of Scotland. They are most numerous in the south-west of England, especially in Wilts and Gloucestershire, the part of the country occupied by the Drobuni, or Silures, at the beginning of the historic period. They have been found in considerable

numbers in Yorkshire, Derbyshire, and Stafford. Huxley and Wilson have described the same race from horned cairns in Caithness, and from other places of Scotland. I have described them from Wiltshire, Yorkshire, Middlesex, and from Orkney.

There is some doubt of their having been found yet at an early period in Ireland, as Prof. Macalister informs me that he has not recognised them in Ireland, where there are no long barrows. Sir William Wild, on the other hand, recognised Neolithic skulls from Somersetshire as identical with certain ancient Irish skulls. Any skulls from Ireland I have seen, which have shown characters similar to the Neolithic skulls from England, are of later date, but Huxley describes them from chambered tombs, peat mosses, and river deposits of Ireland. I think we may conclude, as regards Ireland, that although it is doubtful whether the Neolithic people were there at as early a date as in Britain, they were certainly there later.

The characters of the skeletons are well marked. The skull is large and well formed, the calvaria is long and proportionally narrow, having a cephalic index of about 70, and of oval shape. The superciliary ridges and glabella are moderately or even feebly developed, the forehead is well formed, narrow, and curves gracefully to the occiput, which is full and rounded. The upper margins of the orbits are thin, and the malar bones are never prominent; the profile of the face is vertical, and there is no tendency to prognathism; the chin is prominent, the symphesial angle is from 70° to 80°; the length of the face from the root of the nose is comparatively short, but as a whole the face is oval in form; the jaws are small and fine, the teeth are of medium size, and generally in a good state of preservation, not much worn down. The last molar is always the smallest tooth of that series. The facial characters are mild, and without exaggerated development in any one direction; the same may be said of the calvaria generally. The age of the persons to whom they belong averages, according to Thurnam, forty-five years, which would seem to indicate that the duration of life was rather short at that time.

The stature of the Neolithic people is short. From Dr. Thurnam's measurements of the femora of twenty-five skeletons, it averages 1·674 m. (5ft. 6½in.) by Rollet's formula; but from my own observations of other specimens which have passed through my hands, I am inclined to consider this as too high an average. In their general characters the bones are slender, often with a well-marked *linea aspera* on the femur and platycnemic tibia, which would show that the Neolithic people led an active life, probably as hunters. Dr. Thurnam has noted that sometimes two or more of the cervical or dorsal vertebræ have a tendency to anchylosis, but I cannot say I have ever seen this.

On the continent of Europe remains of the Neolithic people are found chiefly in caves, and show much the same state of culture and physical features as just described, for instance the well-known Cro-Magnon race; but the sequence of their existence there is not so well defined as in Britain, where they held apparently undisputed possession of the country for a considerable period. Indeed, it is only lately that continental anthropologists have admitted their priority to that of people presenting the character of the next race we will have to deal with.

From the evidence to hand, it seems probable that the Neolithic people occupied the whole of the west of Europe at one time; and I agree with several observers in considering that they are to be identified with the old Iberian race, of which the Basque may be considered a remnant. There is certainly a strong similarity between Basque skulls and those of the Neolithic people of Britain.

Unlike Palæolithic man the Neolithic people have never become extinct in Britain, and their descendants exist to the present time. It is true that subsequent invaders drove them, in many instances, to particular parts of the country, as early history and the excavations of General Pitt-Rivers and others show; but skeletons from ancient tombs indicate that they also mixed with their conquerors.

The next people to appear upon the scene, previous to the dawn of history, are those who were in possession of the greater part of Britain at the time of the Roman invasion. They came into Britain from France and Belgium at a considerably earlier period, and subjugated or displaced the Neolithic race. These are the so-called Celts. Their advent is marked by the introduction of the use of metals into Britain, and they are associated with the Bronze age. From the custom they had of interring their dead, whom they chiefly cremated, in barrows of a circular shape, they are often known as the Round Barrow people. They show a marked advance in civilisation beyond that of Neolithic times, as they were agriculturists, and lived by tilling the soil; they manufactured weapons and ornaments of bronze, and richly decorated pottery; their flint implements also were of better make, as evidenced by their beautiful barbed arrow-heads. To this period belong many of the curious lake dwellings found all over Great Britain and Ireland, Picts houses of Scotland, and bee-hive houses of Ireland.

Their osteological remains show that the skull was large with strongly-developed superciliary ridges and glabella, the brow well formed and broad, the upper occipital region not projecting, the tuberosity being the most prominent. In general form the brain-case is broader and rounder than in the Neolithic race, the cephalic index centring round 81; they were, therefore, a distinctly brachycephalic people. The upper border of the orbit is thick, the malar bones are prominent and large. The jawbones are large, *macrognathous*, and likewise the teeth, which are often much ground down; the profile of the upper jaw is somewhat prominent, which gives a prognathous look to the skull; the chin is well formed. The face as a whole is of an angular lozenge form. The ridges for muscular attachments, both on the cranium and face, are well developed, and the expression is very rugged and savage-like. From the skull Thurnam estimated the average age of the persons interred in the round barrows was fifty-five years, while that of the long barrows was ten years less.

The stature of the Round Barrow race averages 1·747 metres (5 feet 9 inches), which is more than the mean stature of the population of the British Isles at the present day. The limb bones are large, with strongly-developed ridges and depressions for muscular attachments.

This race is everywhere to be found over Great Britain and Ireland, and although conquered by the Romans and subsequent invaders, forms a very important element of the population of the country down to the present day.

[I have to thank Prof. Boyd Dawkins for his kind permission to use woodcuts from his work on "Early Man in Britain," for the purpose of illustrating this publication of my lecture, and to General Pitt-Rivers for permitting the reproduction of a block from his plate in "Excavations near Rushmore," vol. ii. The lecture, as delivered at the Royal Institution, was illustrated by numerous lantern slides, which were not suitable for reproduction.]

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The Statute relating to Research Degrees has been promulgated, and has given rise to some dissatisfaction among many of those who have hitherto warmly supported the scheme. The supervision of those who wish to qualify for a Research Degree is to be placed, according to the proposed Statute, in the hands of a Delegacy composed of the Vice-Chancellor and Proctors and twelve other members, to be nominated by the Vice-Chancellor and Proctors, the Hebdomadal Council, and the Members of Congregation This amounts to the creation of a new Delegacy similar in constitution and in powers to the existing Delegacy of non-collegiate students, and it is felt that it is a most unsuitable mode of supervising the work of men none of whom may be less than twenty-one years of age. It was thought that the supervision of the researchers should be vested in the Professorial body, and it is much to be hoped that the proposed Statute will be thrown out in Congregation, for it is nearly certain that no persons qualified for research would submit themselves to the supervision of such a heterogeneous body as the proposed Delegacy, and the scheme, of which so much is expected, would become a dead letter.

In a meeting of the Junior Scientific Club, held on Friday, November 16, Mr. P. Elford, of St. John's, exhibited a specimen of shale oil, and papers were read by Mr. F. Druce, of Magdalen College, on anticyclones and other types of atmospheric pressure, and by Mr. W. W. Fisher, of Corpus Christi College, on the Oxford water supply.

Mr. P. L. Sclater, F.R.S., has been elected an honorary Fellow of Corpus Christi College.

CAMBRIDGE.—Dr. Forsyth, F.R.S., has been appointed Chairman of the Examiners for Part II. of the Mathematical Tripos.

Mr. E. H. Hankin, Fellow of St. John's College, and Professor of Bacteriology at Agra, has been appointed to represent the University at the Indian Medical Congress to be held at Calcutta in December.

The following is the Syndicate appointed to consider a report on the question of special encouragement, by new degrees or otherwise, for post-graduate study and research in the University: The Vice-Chancellor, Dr. Maitland, Dr. D. Macalister, Dr. Jebb, Dr. Forsyth, F.R.S., Prof. Marshall, Prof. Gwatkin, Prof. Foster, F.R.S., Prof. Thomson, F.R.S., Mr. A. W. W. Dale, of Trinity Hall, and Mr. W. Bateson, F.R.S., of St. John's College.

A Grace authorising the Cavendish Laboratory Syndicate to obtain specifications and tenders for the proposed extension of the Laboratory, was offered to the Senate on November 22.

SCIENTIFIC SERIALS

American Journal of Science, November.—On variations and mutations, by W. B. Scott. The author discusses the problem of animal morphology in its various aspects, and the different lines along which a solution has been sought for. These are that of comparative anatomy, embryology, and palæontology, to which, since Bateson's work on the study of variation, a fourth has been joined. The author criticises in detail Bateson's method and its results, and comes to the conclusion that we can no longer assume as a fundamental and self-evident truth that individual variations are the material from which new species are constructed.—Resonance analysis of alternating currents, by M. J. Pupin. This analysis is performed by means of a "resonator circuit" consisting of an inertia coil, a rheostat and a condenser in shunt with an electrostatic voltmeter. The capacity of the condenser is gradually increased from zero upwards. Whenever a capacity has been reached, which with the self-induction of the resonator circuit produces resonance with one of the harmonics in the main circuit, then the resonant rise of potential produces a large deflection in the voltmeter. In this manner all the harmonics which are present in the current of the main circuit can be detected in a few minutes.—On some new methods of obtaining platinochlorides, and on the probable existence of a platinum subchloride, by M. Carey Lea. One of the new methods employs potassium acid sulphite, with a solution of which potassium platinic chloride is moderately heated. The reduction takes about ten to twelve hours, and is known to be complete when the solution has a pure red colour free from yellow. The second method is that with alkaline hypophosphites. If in obtaining potassium platinochloride with the aid of a hypophosphite in excess, the heat is continued after complete conversion to the red salt, the solution in a few minutes changes from red to dark brown. The substance which gives the solution this dark brown colour is very deliquescent, and cannot be crystallised. It cannot be completely separated from the other substances in solution. The author is led by its reactions to suspect that it is a subchloride of platinum, analogous to that of silver.

Journal of Anatomy and Physiology, October. — Dr. Gustav Mann, in a paper entitled "Histological Changes induced in Sympathetic, Motor and Sensory Nerve Cells by Functional Activity (preliminary note)," gives an account of experiments made by him to test the observations of Hodge and F. Vas. Dr. Mann's observations relate to the cervical sympathetic ganglia (which also formed the subject of F. Vas's investigations), the motor area of the cerebrum, and to the retina and optic centres of the brain. His results in part agree with those of Hodge, in part with those of Vas, but they also in other particulars go beyond both. He considers that he has placed beyond doubt, that: (1) During rest, several chromatic materials are stored up in the nerve cell, and that these materials are used up by it during the performance of its function. (2) Activity is accompanied by an increase in size of the cells, the nuclei, and the nucleoli of sympathetic, ordinary motor and sensory ganglionic cells. (3) Fatigue of the nerve cell is accompanied by shrivelling of the nucleus, and probably also of the cell, and by the formation of a diffuse chromatic material in the nucleus.

SOCIETIES AND ACADEMIES

LONDON.

Royal Society, November 15.—"On the Ascent of Sap." By Henry H. Dixon, Assistant to the Professor of Botany, Trinity College, Dublin, and Dr. J. Joly, F.R.S.

Strasburger's experiments have eliminated the direct action of living protoplasm from the problem of the ascent of sap, and have left only the tracheal tissue, as an organised structure, and the transpiration-activity of the leaf wherein to seek an explanation of the phenomenon. The authors investigate the capability of the leaf to transpire against excessive atmospheric pressures. In these experiments the leaf was found able to bring forward its water meniscuses against the highest pressures attained and freely transpire. Whether the draught upon the sap established at the leaf during transpiration be regarded as purely capillary or not, these experiments lead the authors to believe that it alone is quite inadequate to effect the elevation by direct tension of the sap in tall trees. Explanations of the lifting of the sap from other causes prove inadequate.

A reconsideration of the principal experiments of previous observers and some new experiments of the authors lead to the view that the ascent is principally in the lumen and not in the wall.

The explanation of how the tensile stress is transmitted in the ascending sap without rupture of the column of liquid is found in the stable condition of this liquid. The state of stability arises from two circumstances: the internal stability of a liquid when mechanically stretched, whether containing dissolved gases or not, and the additional stability conferred by the minutely subdivided structure of the conducting tissue, which renders the stressed liquid stable even in the presence of free gas.

By direct experiments upon water containing large quantities of dissolved air, the state of internal stability is investigated And, further, by sealing up in the vessels, in which the water to be put under tension is contained, chips of the wood of *Taxus baccata*, the authors find that their presence in no case gives rise to rupture of the stressed liquid, but that this occurs preferably anywhere else, and usually on the glass walls. The establishment of tensile stress is effected in the usual way, by cooling the completely filled vessel. A measurement possessing considerable accuracy afforded 7½ atmospheres as being attained in some of the experiments.

The second condition of stability arises directly from the property of the pit-membranes to oppose the passage of free gas, while they are freely permeable to the motion of a liquid. Hence a chance development of free gas is confined in effect to the minute dimensions of the compartment in which it is evolved, and this one lumen alone is rendered for the time being non-conducting. On the other hand, in the water-filled portion of the tracheal tissue, the closing membranes, occupying the median and least obstructive position, the motion of the stress sap is freely allowed. The structure of the conducting tissue is, in fact, a configuration conferring stability on a stressed liquid in the presence (from various causes) of free gas. As neither free gas nor unwetted dust particles can ascend with the sap, the authors contend that the state of tensile stress necessary to their hypothesis is inevitably induced.

The energy relations of the leaf with its surroundings, on the assumption that evaporation at capillary water-surfaces is mainly responsible for the elevation of sap, may be illustrated by the well-known power of the water-filled porous pot to draw up mercury in a tube to which it is sealed. The authors describe an engine in which the energy entering in the form of heat at the capillary surfaces may be in part utilised to do mechanical work: a battery of twelve small porous pots, freely exposed to the air, keeping up the continuous rotation of a fly-wheel. Replacing the porous pots by a transpiring branch, this too maintains the wheel in rotation. This is, in fact, a vegetable engine. In short, the transpiration effects going on at the leaf are, in so far as they are the result of spontaneous evaporation and uninfluenced by other physiological phenomena, of the "sorting demon" class, in which the evaporating surface plays the part of a sink of thermal energy.

If the tensile stress in the sap is transmitted to the root, the authors suggest that this will establish in the capillaries of the root-surface meniscuses competent to condense water rapidly from the surrounding soil. They show by experiment the power possessed even by a root injured by lifting from the soil, of condensing water vapour from a damp atmosphere. Such a state

of things may be illustrated by a system (which the authors realised) consisting of two porous pots connected by a tube and all filled with water; one, the "leaf," exposed to the air gives out vapour, the other, the "root," buried in damp earth supplies the demand of the "leaf," and an upward current in the connecting tube is established.

"Further Observations on the Organisation of the Fossil Plants of the Coal-Measures. Part ii. The Roots of *Calamites*." By Dr. W. C. Williamson, F.R.S., and Dr. D. H. Scott, F.R.S.

The conclusions at which the authors arrive are the following:—

(1) The fossils hitherto described under the name of *Astromyelon Williamsonis* are the adventitious roots of *Calamites*.

(2) Their structure is in all respects that characteristic of roots, as is proved by the centripetal primary wood, the alternating strands of primary wood and phloëm, the endogenous mode of branching, and the absence of nodes.

(3) The smallest specimens, with little or no medulla, represent the finest branches of the same roots, of which the large medullate forms are the relatively main axes.

Linnean Society, November 1.—Mr. C. B. Clarke, F.R.S., President, in the chair.—Mr. Alexander Whyte was admitted.—Messrs. H. and J. Groves exhibited an undescribed *Chara* from Westmeath, and made remarks upon its peculiar mode of growth.—Mr. J. O. Tepper exhibited photographs of a new and remarkable fungus from South Australia, *Laccocephalum basilapiloides*, which explained the formation of the peculiar stone-like nodules occasionally found when clearing scrub-land. These were found to be due to the agglutinating nature of the mycelium of this fungus, the grains being permanently cemented by lime and ferruginous oxides.—The Rev. G. Henslow made some remarks on a peculiar mode of propagation of *Oxalis cernua*, observed in Malta, and exhibited some views taken during his sojourn here.—Mr. Miller Christy exhibited a long piece of leaden pipe which had been gnawed through its entire length by rats, in a manner which showed that the object was not, as generally supposed, to get access to water.—Mr. H. M. Bernard exhibited some photographs of corals taken with the "Kodak" camera.—A series of that remarkable beetle *Golinthus giganteus*, from West Africa, was shown by Dr. Heath, and Mr. E. M. Holmes exhibited some plants from Japan.—On behalf of Mr. A. W. Waters, a paper was then read on Mediterranean and New Zealand Retipora and on a fenestrate bryozoan; and on behalf of Dr. J. Müller, a paper on certain lichens in the Kew Herbarium.

Zoological Society, November 6.—Sir W. H. Flower, K.C.B., F.R.S., President, in the chair.—The President read a letter addressed to him by the late Emin Pasha, containing a diary of ornithological observations made during the last part of his journey towards the Congo. This letter and journal had been taken from the Arabs on the Upper Congo by the officers of the Congo Free State, and forwarded to the President.—A communication from Mr. F. E. Blaauw, contained some remarks on the colour of the bill in a living specimen of *Cygnus americanus*.—A communication was read from Mr. R. Trimen, containing a reply to some remarks of Dr. A. G. Butler on his paper on the Manica Butterflies collected by Mr. Selous.—A communication was read from Dr. R. W. Shufeldt, containing a correction to his paper on the affinities of the *Steganopodes*, recently published in the Society's *Proceedings*.—Mr. O. Salvin, F.R.S., exhibited a pair of the newly described butterfly *Ornithoptera paradisea*, from the Finisterre Mountains, German New Guinea.—Mr. C. Davies Sherborn exhibited a copy of, and made remarks on the recently issued reprint of George Ord's "American Zoology."—Mr. G. A. Boulenger, F.R.S., exhibited a Gecko, forwarded to him by Mr. R. T. Lewis, which had been captured in winter (July), fully active, on the snow upon the highest portion of the Drakensberg Range, Natal. It belonged to a genus believed until 1888 to be characteristic of the Australian fauna, and differed from its nearest ally, *Œdura africana*, in the smaller and convex granules covering the head and in the rostral shield not entering the nostril. Mr. Boulenger proposed for it the name *Œdura nivaria*.—Mr. Martin Jacoby read descriptions of some new species of the genus *Œdionychis* and allied genera of Coleoptera.—Mr. W. G. Ridewood read a paper on the hyoid arch of *Ceratodus*. The author instituted a comparison between the ventral elements of the hyoid arch of *Ceratodus* and the basi- and hypo-hyal cartilages of the Elasmobranchii. The relations of the hyomandibular cartilage were dealt with in detail, and attention was called to the wide range of variation which this vestigial cartilage exhibits. Arguments were also adduced to show that there is no connection between the reduction of the hyomandibular in the Dipnoi and its adaptation as a secondary suspensorium in the hyostylic fishes.—Mr. G. A. Boulenger, F.R.S., read a third report on additions to the Batrachian Collection in the Natural History Museum, containing a list of the species, new or previously unrepresented, of which specimens had been added to the collection since 1890, and descriptions of some new species.—A communication was read from Mr. R. J. Lechmere Guppy, containing an account of some Foraminifera from the microzoic deposits of Trinidad.—A communication was read from Sir Walter L. Buller, containing remarks on a petrel lately described as new by Captain Hutton, under the name of *Œstrelata leucophrys*.

Geological Society, November 7.—Dr. Henry Woodward, F.R.S., President, in the chair.—Sir John Lubbock exhibited some interesting specimens from the valley of Lauterbrunnen at Murren. The rock forms part of the calcareous strata which stretch to the south-west to Leuk, and to the north-east to the celebrated gorges of the Aar. It has also a great thickness, and is coloured in the geological map of Switzerland as Malm, though some Swiss geologists have recently attributed it to the Trias. Notwithstanding the careful researches of the Swiss geologists no fossils, however, had yet been found in it. During one of the recent excursions of the International Geological Congress, Sir John Lubbock found a layer which is rich in fossils—amongst others *Nummulites Ramondi*, *Orbitoides disparesus* and *Orbitoides papyraceus*. The rock therefore is not Malm, but Eocene. The species have been verified by Prof. Rupert Jones. Sir John Lubbock showed the spot to Prof. Etheridge, who also exhibited some fossils from the same layer. The find will necessitate a substantial correction of the geological map, and is perhaps the more interesting because the specimens were found in a quarry by the roadside in the village of Murren, and actually between the two principal hotels.—Notes on some recent sections in the Malvern Hills, by Prof. A. H. Green, F.R.S. The sections described occur on the east side of the Herefordshire Beacon, and for convenience are named the Warren House Rocks. They are bedded, and have a general north-and-south strike. The great bulk of the rocks are hard, close-grained, and splintery, and are largely altered, and in many cases thickly veined with calcite. Details of their structure were given; and the author stated that he is inclined to regard them as a group of bedded acid lavas and tuffs, crossed by three bands of dolerite. What little balance of evidence there is seems to be in favour of the intrusive character of the dolerites. No true limestones have been found, and the only very calcareous rock seen is regarded as a rock belonging to the volcanic group which has been largely calcified. A discussion followed, in which Mr. Watts, Dr. Hicks, Mr. Rutley, and Mr. Harker took part.—The Denbighshire series of South Denbighshire, by Philip Lake. The area to which this paper chiefly referred is the south-western quarter of the Llangollen basin of Silurian rocks. The beds are there very little disturbed, and the sequence was readily made out. On comparison with other areas it was found that the succession is almost identical with that in the Long Mountain, in North Denbighshire, and in the Lake district. Prof. Hughes, Mr. Hopkinson, Dr. Hicks, Mr. Marr, and Mr. Watts made a few remarks upon the subject of the paper.—On some points in the geology of the Harlech area, by the Rev. J. F. Blake.

Entomological Society, November 7.—Colonel Charles Swinhoe, Vice-President, in the chair.—Colonel Swinhoe exhibited a female of *Papilio telearchus*, Hewitson, which he had received by the last mail from Cherra Punji. He said that this was the only known specimen of the female of this species, with the exception of one in Mr. L. de Nicéville's collection, which he had described in the *Journal* of the Bombay Natural History Society in 1893. He also exhibited a male of the same species for comparison.—Mr. C. G. Barrett exhibited abnormal forms of *Pararge megæra*, *P. ægeria*, *Melitea athalia*, *Chrysophanus phlæas*, *Charæas graminis*, *Lophopteryx camelina*, *Plusia gamma*, *Cucullia chamomillæ*, *Boarmia repandata*, var. *conversaria*, and other species, all collected by Major J. N. Still on Dartmoor,

Devon. He also exhibited for Mr. Sydney Webb, of Dover, a long series of most remarkable varieties of *Arctia caja*, and *Arctia villica*.—Mr. Gervase F. Matthew, R.N., exhibited seven beautiful and striking varieties of *Arctia villica*, bred from larvæ obtained on the Essex coast, near Dovercourt, in March and April 1893 and 1894.—Herr Jacoby exhibited two specimens of *Blaps mucronatus*, with soft elytra, taken on a wall at Hampstead. The Rev. Canon Fowler and Mr. G. C. Champion made some remarks on the subject of the elytra of immature beetles.—Mr. H. Goss exhibited a specimen of *Periplaneta australasiæ*, received from Mr. C. E. Morris, of Preston, near Brighton. Mr. McLachlan said the species had been introduced into this country, but was now considered a British insect.—Mr. B. G. Rye exhibited specimens of the following rare or local species of Coleoptera, and gave the names of the localities in which they had been taken: *Cicindela germanica*, *Eumicrus rufus*, *Triarthron markeli*, *Mezium affine*, *Homaloplia ruricola*, *Anomala frischi*, var. *julii*, *Synaptus filiformis*, *Lixus paraplecticus*, *Balaninus cerasorum*, *Asemum striatum*, and *Zeugophora flavicollis*.—Mr. McLachlan exhibited for Mr. G. C. Bignell two new species of Ichneumonidæ, from Devonshire, viz. *Pimpla bridgmani*, Bign., a parasite on a spider, *Drassus lapidicolens*, Walck., and *Praon absinthii*, Bign., a parasite on *Siphonophora absinthii*, Linné.—Mr. C. O. Waterhouse stated that the Acridium received from Captain Montgomery, and exhibited by Mr. Goss at the last meeting, was *Acridium septemfasciatum*, and he exhibited the species with the wings extended.—Mr. Ridley exhibited a species of a scale insect (? *Lecanium*) found on a nutmeg tree in Malacca, and made some remarks on *Formica smaragdina*,, which makes its nest on the trees, joining the leaves together by a thin thread of silk at the ends. The first step in making the nest is for several ants to bend the leaves together and hold on with their hind legs, and one of their number after some time runs up with a larva, and irritating it with its antennæ, makes it produce a thread with which the leaves are joined; when one larva is exhausted a second is fetched, and the process is repeated.—Mr. Waterhouse read a paper entitled "Some remarks on the Antennæ of Insects." A discussion followed, in which Messrs. Champion, Jacoby, McLachlan, and Gahan took part.

Mathematical Society, November 8.—Mr. A. B. Kempe, F.R.S., President, in the chair.—At this meeting, which was the first held since the incorporation of the Society, the by-laws, which had been drawn up by the council, were passed unanimously. The ballot was then taken, and the gentlemen whose names were published in NATURE (November 1, No. 1305, p. 19) were declared duly elected to form the new council and officers. The new President (Major MacMahon, F.R.S.) having taken the chair, Mr. Kempe read his address, the title of which was "Mathematics." Other communications made were—a generalised form of the hypergeometric series, and the differential equation which is satisfied by the series, F. H. Jackson; third (and concluding), memoir on certain infinite products, Prof. L. J. Rogers; on the kinematics of non-Euclidean space, Prof. W. Burnside, F.R.S.

Royal Microscopical Society, October 17.—The Rev. Edmund Carr in the chair.—Dr. W. H. Dallinger, F.R.S., described a new model microscope which had been made by Messrs. Watson.—Messrs. Ross exhibited examples of their "Eclipse" microscopes.—Mr. R. T. Lewis exhibited some parasites which had been found upon a penguin from Isipingo, Durban.—Dr. H. Stolterfoth's paper on the genus *Corethron* was read by Prof. Jeffrey Bell.—Mr. E. B. Green read a paper on some parasitic growths on the root-hairs of plants. Mr. A. W. Bennett made some remarks on Mr. Green's paper.—Prof. Bell called attention to the loss the Society had suffered by the death of Dr. G. E. Blenkins, a former secretary.—Mr. F. Chapman gave a *résumé* of part of his paper on the Foraminifera of the Gault of Folkestone. The chairman and Prof. Bell made a few remarks on Mr. Chapman's contribution.—Owing to the absence of the author, Mr. Nelson's paper, on the measuring of the refractive indices of various media, was deferred to the next meeting on November 21.

CAMBRIDGE.

Philosophical Society, October 29.—Prof. T. McKenny Hughes, President, in the chair.—The officers for the ensuing session were elected as follows:—President: Prof. J. J. Thomson. Vice-Presidents: Prof. Sir G. G. Stokes, Prof. Hughes, Mr. F. Darwin. Treasurer: Mr. Glazebrook. Secretaries: Mr. Larmor, Mr. Newall, Mr. Bateson. New Members of Council: Dr. Glaisher, Prof. Ewing, Mr. F. H. Neville, Mr. E. H. Griffiths, Mr. W. B. Hardy, Mr. H. F. Baker. The retiring President, Prof. Hughes, before vacating the chair, addressed the Society. The President elect, Prof. Thomson, on taking the chair, referred to the loss sustained by science in the death of Prof. von Helmholtz.—Note on geometrical mechanics, by Prof. Sir Robert S. Ball.—On a model of the twenty-seven lines on a cubic surface, by Mr. W. H. Blythe. Mr. Blythe exhibited a model of the twenty-seven straight lines on a cubic surface, together with the drawings from which it was constructed. He stated that the 135 points of intersection of these lines can, in a special case, be determined by a simple geometrical construction without reference to any equation. Seven points taken at random on the edges of a tetrahedron are sufficient to give values to all necessary constants, and these points acting as pointers by pairs, fix the position of eleven other points; these eighteen points being used to determine others, and so on. This method is also applicable to the general case, but determines fifteen lines only; when however the sixteenth line or one point on it is fixed by a process of adjustment the remaining points can be found in the same way.—Exhibition of some photographs showing the marks made by stars on photographic plates exposed near the focus of a visual telescope, by Mr. H. F. Newall.

PARIS.

Academy of Sciences,, November 12.—M. Lœwy in the chair.—The President announced the death of M. Duchartre, and an account of this botanist's life and works was delivered by M. Bornet.—On the transit of Mercury, by M. J. Janssen. Owing to unfavourable weather, only a part of the transit was observed at Paris.—Researches on the condensation of electrolytic gases by porous bodies, particularly by metals of the platinum group; applications to the gas battery; electric accumulators under pressure, by MM. L. Cailletet and E. Collardeau. Platinum and palladium in the spongy condition, and ruthenium, iridium, and gold in the finely divided state form poles which condense electrolytic gases, and hence produce a gas battery, on subsequent connection of the poles, capable of giving up the stored energy during a short time. The storage capacity may be vastly increased by subjecting the poles to great pressure during charging. With spongy platinum and iridium a storage capacity may be attained greater than the practical capacity of lead accumulators per unit weight. Silver, tin, nickel, cobalt, and carbon do not form accumulators under these conditions with capacity increasing with the pressure.—New details concerning the Nymphæinæ of the Lower Cretaceous system, by M. G. de Saporta.—A study of the causes of saline digestion, by M. A. Dastre. Saline digestion is not due to the action of soluble ferments, and is not caused by microbes.—On the disappearance of the southern polar spot of Mars, by M. G. Bigourdan.—The transit of Mercury, by M. E. L. Trouvelot. (See our Astronomical Column.)—On an error detected in the "theory of numbers" of Legendre, by M. Dujardin.—On the representation of left-handed algebraical curves and on a formula by Halphen, by M. Léon Autonne.—On an empirical formula, by M. Pervouchine, by M. Ernest Cesàro.—Direct experimental determination of the specific heat of saturated vapour and of the heat of internal vaporisation, by M. E. Mathias. The general method given permits, by means of a double series of calorimetric experiments with an apparatus charged once for all, of the complete resolution of the problem of the calorimetric study of a substance, and shows that the specific heat of saturated vapour is susceptible of direct experimental determination.—Determination of the molecular weight of liquids, by M. Ph. A. Guye. The author gives methods of determining molecular weights of substances from a knowledge of their critical coefficients and molecular refractions and from their critical coefficients only. The relationships for a number of hydrocarbons are given, and the deduction is drawn that these hydrocarbons have the same molecular weights in the gaseous state, in the critical state, and in the liquid state.—On active amylacetic acid and some of its derivatives, by Mdlle. Ida Welt. The rotatory powers of a number of these derivatives are given. Methyl amylacetate has a rotatory power $[\alpha]_D = +6{\cdot}71$; for the corresponding ethyl salt $[\alpha]_D = +6{\cdot}66$. The products of asymmetry calculated for the same compounds bear the ratio 375:

343.—On the campholenes and on the constitution of camphor, by M. A. Béhal.—Researches on the oxidation of alcohols by Fehling's solution, by M. Fernand Gaud. Methyl, ethyl, and propyl alcohols yield the corresponding aldehydes and salts of the corresponding acids when the alcohol is in excess; when the reagent is in excess and the heating is prolonged at a higher temperature, salts of the corresponding acids are obtained, but no aldehyde.—Biological observations made on *Schistocerca peregrina*, Olivier, during the invasions of 1891, 1892, and 1893 in Algeria, by M. J Künckel d'Herculais.—On the swarming of Termites, by M. J. Pérez.—On the assimilation of nitrates by plants, by M. Demoussy.

BERLIN.

Physical Society, October 19.—Prof. du Bois Reymond, President, in the chair.—The President referred to the loss the Society had sustained by the death of von Helmholtz.—Prof. Boernstein demonstrated an experiment of Messrs. Elster and Geitel on the influence of polarisation on the outflow of negative electricity which may be brought about by light. The most suitable metals for the experiment are sodium or potassium or their alloys. A liquid alloy of potassium was charged with negative electricity so that the leaves of an electroscope connected with it were widely divergent. As soon as the rays of an incandescent lamp were allowed to fall on the surface of the alloy, the room being previously darkened, the leaves of the electroscope approached each other as due to an outflow of electricity. When the light was polarised by a Nicol prism it now led to a discharge only when the plane of its vibrations coincided with that of its incidence; in the plane at right-angles to the above the action of the light was reduced to a minimum. —Prof. Koenig recounted the results of his researches on the significance of visual purple. (Previously communicated to the Physiological Society on July 20. See NATURE, No. 1298, p. 492.) A discussion followed, in which the President, Prof. von Bezold, Prof. Neesen, and Dr. Rubens took part. The last-named supported Prof. Koenig's view that the fovea centralis is colour-blind for blue, by pointing out that fine blue lines in the spectrum cannot be seen by absolutely direct vision, but only by indirect vision.

Physiological Society, October 26.—Prof. du Bois Reymond, President, in the chair.—The President dwelt on the recent deaths of their honorary President, von Helmholtz, and Prof. Pringsheim, and drew attention to the more important botanico-physiological researches of the latter.—Dr. Bendix spoke on the influence of sterilising milk on its digestibility. If milk is sterilised by prolonged boiling or the passage of steam through it, a series of changes take place. The sugar is turned into caramel, and the sweet taste changes correspondingly, and, further, on cooling the fat tends to form lumps, and thus destroy the emulsion. Three experiments had been made on children between the ages of one and two years, each experiment consisting of two series. In the first, the children received either fresh milk, or such as had only been once boiled-up, together with some white bread; in the second, the same amounts of sterilised milk and bread. A comparison of the nitrogen and fat in the food and fæces showed that the sterilised milk was just as completely utilised as the unsterilised.—Dr. Cowles spoke on his cardiographic researches carried out on mammals. In his earlier experiments he had found the frog's heart to be the most suitable object, lying firmly as it does in a depression of the liver. Working with this, he had observed that as long as the heart is normally filled with blood the apex remains at rest on the surface of the liver during systole, whereas when deprived of blood it is raised at each systole. Among mammals he had not as yet found a heart so suitable for the experiment. In the dog, rabbit, and cat, the heart lies on the lung-tissue, is hence easily pushed to one side, and is thus readily displaced by any levers or other apparatus brought to bear upon it. In monkeys, also, there is a fold of the lungs lying between the diaphragm and the heart, so that up to the present he had not been able to obtain any reliable cardiographic tracings by placing levers on the outside of the mammalian heart.

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (June–July 1894) contains the following papers of scientific interest:

June 9.—O. Wallach: On the relations of the carvon-series ($C_{10}H_{14}O$) and the properties of the oximes of cyclic ketones (III.). J. Hermes: On the division of the circle into 65,537 equal parts. A. von Koenen: On the geological survey of Southern Hanover.

June 23.—P. Drude: Studies on the electric resonator.

July 7.—David Hilbert: Outlines of a theory of Galois' *Zahlkörper*. K. Schering and C. Zeissig: New photographic method of registering the time and the position of the magnets in magnetometers and galvanometers. Ludwig Aschoff: Contribution to the subject of atypical epithelial proliferation and the origin of pathological glandular growths.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Nuellenkende: Prof. H. I. Haas (Leipzig, Weber).—A Laboratory Manual of Organic Chemistry: Dr. W. R. Orndorff (Boston, Heath). —Practical Methods in Microscopy C. H. Clark (Boston, Heath).—Life at the Zoo: C. J. Cornish (Seeley).—Alembic Club Reprints, No. 9: The Elementary Nature of Chlorine: Humphry Davy (Edinburgh, W. F. Clay). —Outlines of Biology; P. C. Mitchell (Methuen).—Radiant Suns: A. Giberne (Seeley).—By Vocal Woods and Waters: E. Step (Bliss).—Rhythmic Heredity: H. C. Hiller (Williams and Norgate).—Report of the Fifth Meeting of the Australasian Association, September 1893 (Sydney).—Practical Inorganic Chemistry: E. J. Cox, 3rd edition (Rivington).—Australasia, Vol. 2: Malaysia and the Pacific Archipelagoes: Dr. F. H. H. Guillemard (Stanford).—Cloudland: Rev. W. C. Ley (Stanford).—Primer of Psychology: Prof. J. T. Ladd (Longmans).—Psychology for Teachers: C. Lloyd Morgan (Arnold).

PAMPHLETS.—Notes on Tours along the Malabar Coast: E. Thurston (Madras).—In Defence of Pasteurism: Dr. M. B. Colah (Bombay).—Mitteilungen des Vereins für Erdkunde zu Halle a.S. 1894 (Halle a.S.).

SERIALS.—Psychological Review, November (Macmillan).—American Meteorological Journal, November (Ginn).—Journal of the Franklin Institute, November (Philadelphia).—Journal of the Anthropological Institute, November (K. Paul).—Royal Natural History, Part 13 (Warne).—Proceedings and Transactions of the Queensland Branch of the Royal Geographical Society of Australasia, 1893-94 (Brisbane).—Astronomy and Astro-Physics, November (Wesley).—American Naturalist, November (Wesley).—Le Monde des Plantes: P. Constantin, fasc. 1 (Paris, Baillière). English Illustrated Magazine, Christmas (198 Strand).

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