THURSDAY, DECEMBER 15, 1887.

THE HORTICULTURAL SOCIETY.

THE Horticultural Society of London was founded in 1804, among the first members being Sir Joseph Banks. Its objects were "to collect every information respecting the culture and treatment of all plants and trees, as well culinary as ornamental," and "to foster and encourage every branch of horticulture, and all the arts connected with it." The Earl of Dartmouth was the first President. The Society was incorporated by Royal Charter in 1809. In 1820 the Society purchased 21 Regent Street, which was its London home for forty years. In 1822 it obtained a lease of the present Gardens at Chiswick, which have been cultivated and embellished under the Society's auspices for upwards of sixty-five years.

At the conclusion of the war in 1815 the Society began to import plants from abroad, and this country owes to its early exertions many of the beautiful camellias, azaleas, peonies, roses, and chrysanthemums which are natives of the East, and among other plants the *Wistaria* (*Glycine*) *sinensis*, a lovely creeper now quite at home in England. Indeed, one cannot take a day's ride anywhere through the country without meeting some of the beautiful introductions of the Society. Among the collectors sent out by the Society was Douglas, to whose energy the country owes *Pinus Lambertiana*, *P. insignis*, *P. ponderosa*, *P. nobilis*, *P. Douglasii*, &c.

Dr. Lindley, one of the most eminent botanists this country has ever produced, was appointed Assistant Secretary in 1822, and continued connected with the Society until his death in 1865. No account of the early days of the Society would be complete without a record of the fruits of Fortune's journeys, under its auspices, in China. Not only did he send innumerable valuable plants home, but his travels in the Chinese tea-country were the direct cause of the introduction of tea-cultivation into India.

In 1839 the Duke of Devonshire was elected President, on the death of Mr. Andrew Knight, who had been President for twenty-seven years, and to whom the Society owed much. In January 1858 the Duke of Devonshire died, and H.R.H. the Prince Consort graciously consented to succeed him. The establishment of the Society at South Kensington, under H.R.H.'s guidance and direction, is so comparatively recent an event that it is not necessary to refer to it at length. At first the prospect was promising, and had not the Prince Consort's life been cut short, the result might have been very different from what it has proved. But the money expended on the buildings and the gardens at South Kensington, from the funds of the Society, was little short of £100,000—a sum which, with the experience we now have, no one would dream of devoting to such purposes. This enormous expenditure hung like a millstone round the neck of the Society, which soon found itself unable to pay the interest on the money borrowed to meet it. The result was that, under a clause of the Society's agreement with the Commissioners of the 1851 Exhibition, the latter body resumed possession of the Gardens six years ago, and the money spent upon them by the Society was swept away at a blow.

Nevertheless the horticultural work of the Society has been carried on with undiminished energy. This surely is the proper and legitimate work of such a Society. Every departure it takes from its true functions alienates the sympathy and support of those to whom it properly looks, and to promote whose objects it exists. Since the Society has been established at South Kensington, its activity in horticultural work has been as marked as even in its most prosperous times. Many thousands of new plants, fruits, and vegetables have been submitted to the examination and the verdict of the Society's Fruit and Floral Committees, which consist of practical men, of the greatest knowledge and experience in their several departments. The value attaching to "First-Class Certificates" is shown by the care nurserymen take to record them in their catalogues. At Chiswick a long series of elaborate trials and experiments have been carried on with fruit, vegetables, and plants, whereby useful and profitable varieties have been selected and their qualities established, and inferior varieties ear-marked.

Although the Society has been unable to hold great shows owing to the loss entailed by them, it has held fortnightly shows in summer and monthly shows in winter, at which a vast number of new plants and new introductions have been seen for the first time. Such shows, though small, are often far more interesting to horticulturists than the big shows which were the fashion formerly.

It may well be asked why, if the Society can give so good an account of itself, it should be in any difficulty? The answer is that its troubles are due to its connection with South Kensington. It cannot be said that the Commissioners of the 1851 Exhibition have behaved with any conspicuous liberality to the Society. Perhaps they could not do so, as they have said that it was necessary for them to make an income out of the Royal Horticultural Gardens. But the connection with South Kensington has made it necessary for the Society to meet the views of local subscribers, who were not horticulturists; and, moreover, it has led to the Society being saddled with a charter, which prevents its expansion and adaptation to altered times and circumstances.

The views of the Council are set forth in general terms in the statement and appeal which we print elsewhere The interest in horticulture in the United Kingdom grows and spreads without check. Surely the horticulturists of the wealthiest country in the world will gladly provide the very moderate sum required for the maintenance of a Society which has done much for them, is still doing much, and has before it untold possibilities of usefulness.

BALBIN'S QUATERNIONS.

Elementos de Calculo de los Cuaterniones, &c. Por Valentin Balbin, Doctor en Ciencias, &c. (Buenos Ayres: imprenta de M. Biedma, 1887.)

ALL praise is due to the Argentine Republic for its institution of a University in which the Faculty of Sciences is endowed with a chair of the higher mathematics.

The book before us is the outcome of one of the courses of lectures which the holder of that chair, Dr.

Valentin Balbin, delivered to an audience comprising several of his colleagues. The volume, written in Spanish, has been printed at Buenos Ayres, and in size (xix. and 359 pages), and in quality of paper and print, presents a very handsome appearance.

In his preface the author informs us that in his opinion the calculus of quaternions is the best vehicle for the teaching of applied mathematics, and that therefore he has had recourse to Sir William Rowan Hamilton's beautiful invention. The author is aware of the fact that he is the first to introduce quaternions into the Spanish scientific literature, and for this reason he aims at presenting the theory from its very elements up to its higher branches of application.

In the matter of notations we are also informed that those of Hamilton and of Prof. P. G. Tait have been scrupulously adhered to, and that, in one word, the author has not found it advisable to follow those of M. Hoüel and of M. Laisant. It may not be known to everybody that these two French mathematicians have in their publications (1874, 1877, 1881) adopted a thorough reversal of Hamilton's lettering. In the place of the inventor's Greek letters, they use Roman characters (X for ρ, Y for σ, A for a, &c.); and in the place of the handy S, V, T, U, they put black-letter symbols, which are at once difficult to write, and tiring to the eyesight. These are what they call "slight alterations" or "improvements."

Again, they upset the rule about the relative appellation of the factors of a product. Our author (p. 40) states the Hamiltonian rule, and justifies it by the simple example drawn from $a + a = 2a$, where (according to everybody's ideas) the coefficient 2 is the multiplier, and a the multiplicand. According to the "innovated" rule one ought to write $a + a = a \times 2$.

The rule just named makes its influence felt more particularly in the establishment of the operator of conical rotation, and here we are sorry to find that our author falls a victim to a delusion. Instead of Hamilton's well-established $q(\ )q^{-1}$, he arrives at the inverse $q^{-1}(\ )q$ (at p. 296), and uses it under this form through several pages (up to p. 303). This comes from following M. Laisant's text, and forgetting his own rule. In M. Hoüel's opinion, "nothing is easier than to pass from one system (his own system) to the other"; nevertheless, such passage requires to be nicely managed, because by it the expression for the instantaneous axis is affected, and we might ask whether it be fair to introduce a source of confusion into a theory which in itself is difficult enough. Our author does not introduce us to the searching treatment which Prof. Tait has devoted to the question of the movement of a solid about its centre of mass ("Elementary Treatise," &c., second edition, §§ 383-400). M. Balbin's treatment of that question is very curtailed, and we might be inclined to attribute this shortness to a feeling of distrust, otherwise how could we understand his utterance, at p. 87, where he says forcibly, "Some simplifications, particularly in the physico-mathematical applications, must be made in the future as to the matter of symbols" (*se hagan*, imperative of *hacer*).

The more we consider the innovations, the more are we convinced that their proposer and his follower, publishing in 1874 and 1881, had not fully realized the extent and importance of the researches which, during many years, had been expressed in what we may term the Hamiltonian notations. In 1862 no less a Frenchman than M. Allégret set the example of following these last-named, and that precedent ought to have been adhered to. As it is, students of MM. Hoüel and Laisant will be hampered by the French notations when they approach those rich mines of information contained in such unique classics of the quaternion method as Hamilton's "Lectures" and "Elements," and the "Elementary Treatise on Quaternions," by Prof. Tait.

Let us now try to give some idea of the contents of the volume. For the English student these are all contained in the sources known to him. First "The Introduction to Quaternions," by Kelland and Tait. This work has been reproduced in its whole extent, with the exception of Chapter X., due to Prof. Tait alone. The author acknowledges in several instances (pp. 114, 120, 252) his special indebtedness to the English authors; and his translations are adequate. Perhaps, however, he knows them best through the medium of M. Laisant's reproduction of a great part of Kelland's work (with acknowledgments in the preface, tempered by the praise of the new notations).

In the second place, in the treatment of linear vector-functions and the resolution of equations involving them, which were originally given by Hamilton, there are clear indications that our author has taken his text from works where the innovated notations reign supreme; some traces of x (at pp. 183, 184, 193), for instance, are left standing in the place of ρ, and are contained concurrently with ρ in one and the same equation, in several cases; no explanation about the signification of x being given. A similar fate befell the vector ρ, at p. 138, where x is put into its place by being defined: $x = ix_1 + jx_2 + kx_3$. Under this form x is introduced into the operator ∇, which in its turn undergoes a little adaptation. But all this is not the promised adhering to Hamiltonian notations.

The solution of the vector-equation $\Sigma a S \beta \rho = \gamma$ is gone partially into; but the calculation of the coefficient m of the cubic (at p. 192) contains an inexact intermediate step, and the coefficient m_1 is given with the wrong sign. Finally the solution of the proposed equation (p. 193) is incorrect, owing to the absence of the factor γ in the first term of the second member. These three inaccuracies can be traced to one of the French texts.

In the third place, curves in space, and centres of curvature of those curves, and of plane sections of surfaces, subjects exhausted by Hamilton and by Prof. Tait, have been treated by our author with the help of Dr. Graefe's little volume on Quaternions (Leipzig, 1883). We might take exception to Dr. Graefe's deduction (p. 236 of Balbin's) of Meusnier's theorem, as well as of that of the curvature of a normal section of a surface. To replace a scalar, say $Sa\beta$, by $\frac{1}{2}(a\beta + \beta a)$, in order to procure an expression of the product $a\beta$ separately, seems to us to be forsaking the spirit of the method of quaternions; the expression for $Sa\beta$ being given, and that of $Va\beta$ being deducible from other considerations, it would have been far simpler to deduce $a\beta$ by forming the sum $Sa\beta + Va\beta$ straight forward. Some reticences (p. 236), and even some inaccuracies, in the text of Dr. Graefe, have been reproduced also by M. Balbin at pp. 136, 138, 247. Dr. Graefe, like other German authors on quaternions, reproduces a great part of the "Introduction to Quaternions" by Kelland and Tait, and also some parts of the "Elementary Treatise" by Prof. Tait; but after having once pronounced the name of Hamilton, he has done all in the matter of acknowledgment, and the name of Tait is not to be found in the little volume.

We now come to the fourth class of subjects treated by our Argentine author. This comprises kinematical, statical, and dynamical questions. Here we meet with the treatment, in good form, of questions included in Hamilton's "Elements," and in the second edition (1873) of Prof. Tait's "Elementary Treatise." Of this last source of information our author seems to have only a second-hand knowledge: he reproduces verbatim the contents of § 405 of the "Elementary Treatise" (second edition), but he attributes the authorship of it to M. Laisant. Evidently, M. Laisant reproduced this § 405, which treats of Foucault's pendulum, but the origin of the treatment is to be found in the Proceedings of the Royal Society of Edinburgh of 1869, *auctore* P. G. Tait. Again, by the small-print note at p. 303 we have another indication that our author was unacquainted with the contents of the two or three last chapters in the second edition of the "Treatise." Had he known them, he could not have withheld a more special acknowledgment of results worked out by the immediate follower of Hamilton.

Prof. Tait certainly can claim to have been the first to make quaternions intelligible, not alone to ordinary students, but to advanced mathematicians—"such as have the [rare] gift of putting an entirely new physical question into symbols." But the Edinburgh Professor has particular claims to the thankfulness of students of the first-named category (the writer amongst them), for, under the plea of teaching the quaternion method, he has given them an insight into those physico-mathematical questions which are so unapproachable when obscured by the apparatus of Cartesian co-ordinates. When these questions are expressed and solved in quaternion language, they acquire a clearness and a conciseness which might well astonish their original proposers—Green, let us say, Ampère, Poinsot, even Newton, not to name living workers. We cannot be expected to enumerate the list of the questions treated; we will allude only to those in which the operator ∇ is pressed into services of such marvellous fecundity, to those in which the linear vector-functions play an eminent *rôle*, and to those in which the operator of conical rotation is such a powerful auxiliary.

The last chapter of the volume contains a painstaking record of the history of quaternions. The English reader will find much of this, and even more, in the article on "quaternions" in the "Encyclopædia Britannica." We may say that the imaginaries of algebra having done good service during the process of discovery, can be safely now banished from the principles and practice of the quaternion method—unless bi-quaternions are under treatment. In the ordinary applications of the method the extraction of the square root of the members of an equation such as $\epsilon^2 = -1$ (ϵ being a unit-vector) is looked upon as impracticable, and the reason is clearly this: the combination $\epsilon\epsilon$, represented by ϵ^2, is a symbol *sui generis* just as much as ϵ itself, and cannot be decomposed or attacked—to speak the language of chemistry—by the algebraical operation of extracting the square root of it. To assimilate a unit-vector with $\sqrt{-1}$, the square root of negative unity, is as if, in the differential calculus, one were to assimilate a derivate, $\frac{dy}{dx}$, with the symbol $\frac{0}{0}$ of indetermination. We cannot resist the temptation of helping our author to preserve a little curiosity in the history of the subject. The author records the verdict of an unnamed French mathematician, who says: "Quaternions have no sense in them, and to try to find for them a geometrical interpretation is as if one were to turn out a well-rounded phrase, and were afterwards to bethink oneself about the meaning to be put into the words. . . ." This, after all, is rivalled by the verdict of a German mathematician, who simply declared the quaternion method to be "eine Verirrung des menschlichen Geistes" (an aberration of the human intellect).

GUSTAVE PLARR.

CABLE-LAYING.

On a Surf-bound Coast; or, Cable-laying in the African Tropics. By Archer P. Crouch, B.A. Oxon. (London: Sampson Low, 1887.)

IT is somewhat remarkable that the business of making and laying submarine telegraph cables—which hitherto has been a monopoly of Great Britain, and employs large numbers of skilled workmen of all kinds, of scientific men, and of sailors—should be so little understood by people not directly connected with it. Yet the daily history of any cable-laying expedition, if faithfully written, would contain matter of engrossing interest for all readers. To secure a contract on advantageous terms requires diplomatic talent of a high order. For, although the business is a British monopoly and there is no competition with the foreigner, there is all the keener competition between the rival British companies. Further, the negotiations are almost always with Government departments, either home, colonial, or foreign, and are necessarily of a delicate character. In the history of any particular cable the preliminary diplomatic details would no doubt have by far the greatest interest for most readers, but it would be obviously indiscreet and unadvisable to publish them. In tendering for a cable against powerful competitors it is important to have as accurate a knowledge as possible of the depth of water and the nature of the bottom where the cable is to lie, in order to know exactly the lengths of the different types of cable which will have to be employed, and so to estimate the cost. In obtaining this knowledge the cable-laying companies have been the chief contributors to the science of deep-sea research, or oceanography. The contract obtained, the cable made, and the route determined on, the operation of laying has to be undertaken. When it is merely a question of laying a length of cable between two points over smooth ground, this is in most cases a very simple affair; although if the shore-ends of the cable have to be landed on exposed beaches, as is only too often the case, there is plenty of opportunity for thrilling incident and hair-breadth escape. The expedition in which Mr.

Crouch was engaged had for its object to connect a number of settlements on the West Coast of Africa from Bathurst to St. Paul de Loanda, and belonging to the British, French, Spanish, and Portuguese. Although it is fixed beforehand what places are to be connected, it is only when the ship arrives on the ground that the exact place of landing, the amount of assistance to be got from the shore, and a host of matters of minute local detail, but of great importance, can be settled, and to do so satisfactorily, expeditiously, and without friction, requires qualities of a very high order in the chief of the expedition. How difficulties were overcome, dangers met, and accidents repaired, in the course of the laying of one portion of the West African Company's cables is told in a pleasant and readable way in "On a Surf-bound Coast." Mr. Crouch carries his descriptions only as far as Cutanu, a French settlement lying between Accra and Lagos. From this place the cable was taken to the Portuguese islands St. Thomê and Principe, the French settlement on the Gaboon, and the Portuguese town St. Paul de Loanda; but this part of the expedition is reserved for description in a possible future volume.

The narrative begins with the start of the s.s. *Thracia* and her consort the *Pioneer* from the Thames, under the chief command of Mr. White. The names of persons and ships are purposely altered. The work really begins with their arrival at Bathurst, the chief British settlement in the Gambia district. In the previous year the cable had been laid as far south as the French settlement Conakry, about 70 miles north of Sierra Leone; and outside of Bathurst the cable, coming from the Cape Verde Island of St. Jago, had been joined to it, forming a T piece. Their first job was to cut out this piece, and run the three ends, leading respectively northwards to Dakar, westwards to St. Jago, and southwards to Conakry, into Bathurst. This affords the author an opportunity of describing the operations of "picking up" in shallow water, also of laying shore ends in protected water, and of splicing cables. In this Mr. Crouch acquits himself fairly well; indeed, it is very difficult to make intricate mechanical operations of the kind quite intelligible to the uninformed without the use of drawings. In the course of these operations the two ships each passed a portion of their time on the sand-banks, which are here plentiful and almost completely unsurveyed.

The next piece of work was connecting the French settlement Conakry with Sierra Leone. Here, again, there was no dearth of incident, as the *Pioneer*, in landing the shore end, went on a rocky patch, and was with difficulty got off. During the laying the cable got round the propeller, and might have caused great delay but for the promptitude and courage of Mr. White, who, without hesitation, went overboard and dived straight down to the propeller, and on coming up ordered "three half turns more in the same direction," when the cable came free. There are many other instances scattered through the book of the resource, energy, and perseverance required for success in this kind of work.

The *Pioneer* was obliged to return home, and the *Thracia* left Sierra Leone alone and proceeded round the coast, landing shore ends at Grand Bassam, Accra, and Cutanu or Appi. The company's larger steamer, the *Copperfield*, meanwhile came out with the bulk of the cable, and connected these shore ends. Mr. Crouch was transferred to the *Copperfield*, and assisted at the laying of a portion of these cables, and he was landed at Accra, along with two other members of the staff, to attend that end of the cable, which, for the time being, had a blind end buoyed out at sea. It was the duty of these gentlemen to watch night and day the spot of light on the scale of the galvanometer, so as to be ready to answer whenever the ship picked up the end and "called" them. The fatigue and monotony of this weary work of waiting and watching is well described. There are also interesting descriptions of Accra and its inhabitants. Indeed, the latter half of the book is by far the more interesting; there is more business in it and less of the jokes and chaff of the quarter-deck, which, though useful and even amnsing at the time, seldom possess sufficient permanent value to justify their being printed at any length.

The book, taking it all round, is a useful and entertaining one, and as a first attempt is altogether creditable and full of promise. In any future work the author should not be afraid of tiring the reader by careful and detailed description of any operation of interest on which he may be engaged. Outside of those directly connected with the business or the profession, the general reader knows nothing of the methods of laying and working submarine cables. J. Y. B.

TEXT-BOOK OF GUNNERY.

Text-book of Gunnery, 1887. By Major G. Mackinlay, R.A. (London: Printed for Her Majesty's Stationery Office by Harrison and Sons, 1887.)

TO realize the great alterations which have taken place in artillery in the last twenty years it will be necessary to compare the present work with the corresponding "Treatise on Artillery" of 1866, prepared for the use of the Practical Class, Royal Military Academy, in which there is no mention of rifled artillery, iron armour, or electro-ballistic apparatus, and the Practical Class were expected to go forth fully equipped to compete with any foreign enemy with the smooth-bore gun, the spherical projectile, the formulæ for penetration into earth, and such information on velocity and resistance as the ballistic pendulum could afford. If twenty years can make such alterations in the science of artillery, imagination attempts to penetrate the future and to gather some information as to the view in which the present treatise of 1887 will then be held.

Official treatises, however, must not be criticized according to the irreverent sceptical rules of modern scientific inquiry. The authors are prevented by military discipline from expressing any opinion on the merits of the weapons they describe, even when of an experimental nature. Thus the Armstrong rifled gun had been in serviceable use for seven or eight years, and Mr. Bashforth had been experimenting with his chronograph on elongated projectiles and the resistance of the air to their flight for nearly two years, before the appearance of the 1866 edition of the "Treatise on Artillery"; and, coming to the present edition, we find little or no mention of such important matters as steel shields for the protection of the gunners in the field against bullets (*vide* reports on the Boer War), the importance of range-finders in lessening the amount of ammunition to be carried in the limbers, the dynamite gun for use in sieges, and other modern developments.

After the Battle of Waterloo we went comfortably to sleep on our laurels, and awoke to find ourselves engaged in the siege of Sebastopol with exactly the same weapons we had employed in the Peninsular War. Sebastopol with modern weapons could have been taken with one-tenth of the hundreds of millions that were lavished ; so it is important for the future that the taxpayer should take an intelligent interest in military preparations and see that we are provided with the very best weapons that money can procure. Such an intelligent public has been educated in the Volunteer force, and these "men with muskets" are not prevented by military discipline from criticizing their muskets, or equipment in general ; and it is to them that we owe the healthy criticism that has lately been exercised on our armaments and state of military preparation.

Hotspur's description of the regular military officer saying : "It was great pity, so it was, that villainous saltpetre should be digged out of the bowels of the harmless earth, which many a tall fellow had destroyed so cowardly ; but for these vile guns," &c., is true to this day ; for the modern artillery officer's pride in his gun varies inversely as the weight, for certain tangible reasons ; and generally a soldier looked upon his weapons as something to keep clean and to drill with until some recent warfare taught him the importance of the despised musketry instruction. The officer's attention is fully occupied in attending to the drill and discipline of his men according to the regulations ; and we find that the scientific development of methods of destruction is generally due to amateur civilians like Benjamin Robins, of Quaker extraction, the father of modern gunnery, and the Rev. Mr. Bashforth ; while the Gatling gun is a product of Philadelphia, the City of Brotherly Love. Clerk's "Naval Tactics," written by John Clerk of Eldin, a relative of Prof. Clerk Maxwell, and an Edinburgh barrister, was the treatise which put a stop to the ineffective naval engagements of the last century—ineffective because culminating in the failure of the fleet to relieve, and the consequent surrender of, Yorktown.

Major Mackinlay's treatise appears to be very carefully compiled, and taking into account the restrictions under which the author works, it is fully up to date with the development of our own artillery ; whether with the artillery of foreign countries is another question. We notice, however, with some regret that the guns illustrated in the text are all muzzle-loaders, as if breech-loading was the temporary fad which the rifled gun was considered in the time of the treatise of 1866.

A valuable chapter on steel, new in this edition of the treatise, reminds us that our authorities are now after thirty years' delay taking up the Whitworth method of construction of ordnance, omitting, however, the Whitworth hexagonal bore. An official Solomon gave decision in favour of Armstrong against Whitworth in their celebrated competition, with the effect of alienating the greatest steel manufacturer of the world from Government purposes. His great prototype would have encouraged now one and now the other, without committing himself to an absolute decision, and would thus have reaped for his country the benefit of the invaluable services of both competitors.

Major Mackinlay has done good service by collecting all the ballistic tables based upon the important experiments of Mr. Bashforth, and by showing how they are applied to the questions of artillery. We must be on our guard, however, against using ink instead of gunpowder, from economy, and against imagining that there is no further need of careful experiment and practice. It is of the greatest importance, too, that cadets should learn from this treatise that the science of artillery is not entirely comprised in guns of the smallest dimensions, manœuvred over rough country, and the doing of some snap shooting The history of recent wars teaches us that the field artillery of both sides is used up in the first two or three engagements, and that the conflict finally resolves itself into a vast siege, in which the whole army and navy are converted into garrison artillery.

The article by the author of "Greater Britain" in the *Fortnightly Review*, tells us of the immense pains now taken on the Continent in military preparations. Let us avoid in time the necessity of the dreary up-hill labours which the French have been compelled to undertake, now at length beginning to culminate in an organization which, it is important to keep in mind, might at any moment be tested by being brought to bear against this country.

ROMANTIC LOVE AND PERSONAL BEAUTY.

Romantic Love and Personal Beauty. By H. T. Finck. Two Vols. (London : Macmillan and Co., 1887.)

IN dealing with the subject, or, rather, the group of subjects, here indicated, Mr. Finck seems to have had before him a twofold object, scientific and practical. On the scientific side he deals with romantic love, showing (*a*) that it is a recent growth, (*b*) what are its conditions, and (*c*) what are the conditions of beauty as essential to romantic love. From a practical point of view he (*a*) gives rules for health, which is essential to beauty and therefore to romantic love, and (*b*) insists upon the necessity of free choice in love being left to young people. Let us see briefly what he has to tell us upon these points.

Goldsmith, in the "Citizen of the World," was wrong, Mr. Finck holds, in teaching that love proper existed in ancient Rome. "Romantic love is a modern sentiment, less than a thousand years old. . . . Of all personal affections the maternal was developed first, and the sentiment of romantic love last." Here Mr. Finck has certainly got hold of a truth, but he puts it much too strongly. There is nothing improbable in the growth of a new emotion, or (as we would rather say) in an old emotion receiving a new direction and a great expansion. Vol. I. (pp. 34–37) shows that parental and filial love have little or no existence among animals and among some savages ; and if civilization can develop these feelings to their present pitch of intensity, it might well do the same for the mental, as distinguished from the bodily, attraction between man and woman. But the modern form of love is not a new feature ; it is essentially a development. It was stunted and kept down at Rome and in most of Greece but still it was in existence ; and, if Mr. Finck will extend his classical reading, he will find more traces of it than those which he enumerates. Let him begin with the Greek novelists, and see whether Heliodorus's account of the loves of Theagenes and Chariclea will not come up to his standard.

But what are the conditions favourable to the growth of romantic love? Greece—by which Mr. Finck chiefly means Athens—was cut off from such love by three causes: the degraded position of women, the absence of direct courtship, and the impossibility of exercising individual preference (i. 126). The second and the third seem to us to run together, but still we see here some of the points on which romantic love depends; and to these may be added intellect (ii. 14), monogamy (i. 58), and a *long* courtship (i. 59). The old-fashioned plan which Goethe describes—

> "In der heroischen Zeit, da Götter und Göttinnen liebten,
> Folgte Begierde dem Blick, folgte Genuss der Begier,"—

has left us many a charming picture, and none more charming than the Homeric hymn to Aphrodite; but such prompt satisfaction of love no doubt did not give to a romantic passion sufficient time to grow. The feeling was there, but rudimentary. Now, that rudimentary feeling has so grown as to have largely pushed out of sight its physical basis, and men and women act (or think they act) upon other and higher impulses. To this change the agencies enumerated by Mr. Finck have doubtless contributed, and he would apparently acknowledge, too, that the general alteration in the position of women has affected the way in which their lovers regard them. But we should lay more stress than he does on the influence of poets and novelists; they have gone on painting unreal feelings until they have made them real; what a few characters felt at first has been worked by this agreeable sermonizing into the nature of all the readers.

But, after all, the starting-point of romantic love is beauty. Where the women are secluded, beauty cannot be seen. Where matches are made by the parents, beauty does not count. But, where free selection is left to young people, beauty takes its proper place. It is a sign of health, and "love in its primitive form urges animals to prefer those that are most healthy." Mr. Finck therefore goes on next to describe the causes which bring out beauty: "a climate tempting to outdoor life; a considerable amount of intellectual culture and æsthetic refinement; a mixture of nationalities, fusing *ethnic* peculiarities into an harmonious whole; and love, which fuses *individual* complementary qualities into an harmonious *ensemble* of beautiful features, graceful figure, amiable disposition, and refined manners" (ii. 25); or, more shortly, health, crossing, love, and mental refinement (ii. 73). Thus love and beauty act and react on each other; in connection with which point Mr. Finck makes a suggestion of some importance when he says (ii. 94-95):—

> "The artificial preservation of disease and deformity, in and out of hospitals, due to Christian charity, might in the long run prove injurious to the welfare of the human race, were it not for the stepping-in of modern love as a preserver of health and beauty. What formerly was left to the agency of natural selection, is now done by love, through sexual selection, on a vast scale."

It is even more difficult to persuade women than it is to persuade men to do what is good for them, and if the close connection thus pointed out between health and beauty will not induce women to take a little trouble to preserve or improve the former, we must give them up as hopeless. By insisting on this cardinal truth, Mr. Finck will do a useful work, though some day perhaps our descendants will wonder that it should have needed insisting. There is room enough for improvement in both health and beauty. Mr. Galton tells us that "our human civilized stock is far more weakly through congenital imperfection than that of any other species of animals"; while, as for beauty, it is likely that the world is but at the beginning of what sexual selection, unhampered and unthwarted by other agencies, can do for us. It is, Mr. Finck affirms, a moral duty for girls to defy parental tyranny "where money or rank are pitted against love. For the health and happiness of the next generation are at stake."

This is strong speaking; but still, if our author would always speak as seriously and soberly as this we should have but little quarrel with him. Unfortunately he has spoiled an interesting book, not only by a gossiping and confused arrangement of its matter, but also by an intolerably jaunty style, flavoured with Americanisms. A book which claims scientific value should not be disfigured by stupid jokes (as on Prior and priority), or by such phrases as "the female persuasion," "Schopenhauer's Will is an æsthetic sort of a chap," "a young animal that would risk its own life in defence of its mother or father is yet to be heard from."

F. T. RICHARDS.

OUR BOOK SHELF.

Earth-Knowledge: A Text-book of Elementary Physiography. By W. J. Harrison, F.G.S., and H. R. Wakefield. (London: Blackie and Son, 1887.)

THIS is a small text-book adapted to the somewhat remodelled syllabus of the Science and Art Department's elementary stage of physiography. There can be no doubt about the usefulness of the book, but it is to be regretted that more originality is not displayed in the treatment of the subject of matter and energy. Of the rest of the book no complaint can be made: it is excellent. That which deals with matter and energy, however, is meagre and unequal, and the arrangement is at times unnatural. Gravitation, for instance, is discussed without any direct reference to *weight*, although two pages are devoted to the methods of determining specific gravities. Then, again, one would scarcely expect nowadays to read a chapter on *energy* without finding some mention of the doctrine of the conservation of energy.

We are afraid, also, that the chapter on voltaic electricity will be rather misleading to beginners, as no mention whatever is made of the existence of any kind of battery beyond that consisting of a single copper-zinc cell, whilst effects are described which could only be produced by the current from many such cells. The definition of a stress as the "mutual action at the surface of contact between two bodies, whereby each exerts a force upon the other," is also rather misleading, since it does not include the stresses of gravitation, electricity, and magnetism.

Of course too much cannot be expected of an elementary text-book, but it is quite time that the modern ideas regarding force, energy, and matter should be introduced into such books.

A. F.

A Dictionary of Place-Names. By C. Blackie. Third Edition, revised. (London: John Murray, 1887.)

EVERY teacher of geography knows that the derivation of place-names never fails to excite the interest of intelligent scholars. It is satisfactory, therefore, that there should have been a demand for a third edition of Mr. Blackie's excellent book, in which he presents in plain and simple language many of the most suggestive results established by students of topographical etymology. The work has been carefully revised, and in its present form ought to be of service to many a "general reader" and tourist, as well as to schoolmasters and their pupils. Prof. J. S. Blackie contributes to the volume an introductory essay, in which he offers, in his lively way, many useful hints as to the spirit in which the study of topographical etymology ought to be pursued.

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. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*

The Supposed Earthquake in England.

FROM the inquiries which have been made it is now ascertained that the loud noise—as of an explosion—heard over so wide an area on the morning of November 20, and referred to by Mr. Worthington G. Smith in your issue of last week (p. 127), was due to the breaking up of a large meteor, which crossed the north of Herts from east to west, upon a line of which the extreme points are approximately Saffron Walden, in Essex, and Swindon, in Oxfordshire. The meteor was seen by one observer from Hertford, and probably it would have been generally noticed but for the foggy state of the atmosphere. I have undertaken to investigate this matter as far as Herts is concerned, and shall be very much obliged to any of your readers who can give me assistance if they will send a note of their observations, especially as to the direction from which the shock they experienced appeared to reach them. H. GEORGE FORDHAM.

Odsey Grange, Royston, Cambridgeshire, December 12.

The "Umbria's" Wave.

IN NATURE, vol. xxxvi. (p. 508) you published some details from Mr. W. Watson about the wave which struck the *Umbria* in mid-Atlantic. Having heard of two similar cases, and being in possession of the details of one, I have made the following comparison.

Comparison of the "Umbria's" and the "Faraday's" wave.

		Umbria.	*Faraday.*
Date		26.7.87	14.2.84
Hour		4.40 a.m.	6.45 a.m.
Position of ship	Long. W.	27° 8′	27° 53′
	Lat. N.	50° 5′	46° 11′
Ship's speed—knots		about 16	about 6
Ship's course		West (probably partly South)	E. 18° N.
The wave struck		the bow	the port beam.
Probable course of wave		East partly North.	South partly East.

These two courses if prolonged backwards would intersect at about 30° W. lat. and 50° N. long. This is the very point where the *Faraday*, while laying a cable in 1882, discovered a reef rising about 6000 feet above the bed of the ocean. The *Umbria* when struck was about 120 miles to the east of this position, and the *Faraday* about twice as far to the south-east.

The *Faraday's* wave was seen fully five minutes before it struck, and then like the *Umbria's*, it did considerable damage. Three life-boats, chart-house, deck-house, and part of the bulwarks were smashed and one of the large buoys carried away.

In his letter Mr. Watson doubts whether this wave was caused by an earthquake, but a few more similar occurrences in the neighbourhood of Faraday's Reef will possibly demonstrate it to be of recent and volcanic growth. C. E. STROMEYER.

Strawberry Hill, November 22.

The Planet Mercury.

THE atmosphere in this country is generally so unfavourable that it is a very rare occurrence to see the planet Mercury even at its greatest elongation from the sun, unless carefully looked for. My experience of the last few days may therefore be worth mentioning. The day before yesterday, at 10 minutes past 7 in the morning, I was in bed at some distance from a window, through which, without directing my attention to it, I saw a star shining with sufficient brightness in the twilight to attract my notice. I raised the window and made use of a large opera-glass, when any doubt I had would have been dispelled even if I had had no previous experience of Mercury, for there was to be seen a small planet with distinct disk some 15° above the horizon—Venus, a magnificent object, being of course visible also. The same thing happened this morning, when I again noticed Mercury, without having him in my mind, before leaving my bed; but this time I was better prepared, and in the course of the next quarter of an hour had shown the planet, in a 3¾-inch telescope, to several persons who saw it for the first time. G. F. P.

Hanworth, Middlesex, December 9.

Meteor.

ON Friday night, about 9.15, a fine meteor, as bright as a star of the first magnitude, was seen in the western sky. It made its appearance at an elevation of 35° west-south-west, and disappeared in the west, at an elevation of 20°, leaving no streak. Perhaps some other of your readers might be able to identify the meteor, and thus a clue to its course might be arrived at. If you think this worth inserting, it may interest some one.

Barrow-on-Humber, Hull, December 9. M. H. MAW.

"Fairy Rings."

YOUR article on "Fairy Rings" (November 17, p. 61) speaks of rings of 100 feet in diameter as wholly exceptional. In the parish of Stebbing, in Essex, there is a field containing numerous rings of *Paxillus giganteus.* The largest of these is incomplete, being broken in places by gorse bushes and stopped on one side by a hedge and ditch. Measurement is consequently difficult, but the diameter of the ring cannot be less than 120 feet. At Bunchrew, in Inverness-shire, I once saw the same fungus covering about a rood of ground. The grass all over this was very coarse and dark green in colour, being chiefly *Dactylis glomerata*, but there was no trace of a ring. J. SARGEAUNT.

Felsted, December 6.

Music in Nature.

IN NATURE (vol. xxxvi. pp. 343 and 605) reference was made to melodies of birds, &c. I have often heard in the provinces of New Brunswick and Nova Scotia a bird which sings as clear and accurate a melody as can be given forth by any human songster. It is a small gray bird with double lines of velvety white on the sides of its head. I do not know its name. The song varies somewhat in different individuals, but always has the same characteristics. The commonest form is as follows:—

Another variety often heard is thus:—

A rarer form is as follows:—

I have noticed that this latter form seems more difficult for the little musicians, one of whom in particular used to provoke me by singing the B most outrageously flat. I have been accustomed to imitate these birds by whistling, and they very readily answer my whistle. In this way the different forms of their theme have become fixed in my memory. W. L. GOODWIN.

Queen's University, Kingston, Canada, November 11.

Who was Mr. Charles King?

AMONG the ingenious in many considerable parts of the world, of whose undertakings, studies, and labours the Philosophical Transactions of the years 1700 *sqq.* gave some account, an able microscopist suddenly appears, of whose life and work one would like to have more accurate information than seems to be current. Perhaps a member of the Royal, or the Royal Microscopical, Society may be able to supply some particulars about this "Anglois anonyme," as Trembley calls him, and willing to assist in rescuing his name from an undeserved oblivion. His first contribution to the Philosophical Transactions—of very little importance indeed—is to be found in No. 266, for September and October 1700, pp. 672–673, under the title, "A Letter from Mr. Charles King to Mr. Sam. Doudy, F.R.S., concerning Crabs Eyes;" it is dated, "Little Wirley, Decemb. 14," and subscribed, "Ch. King." In the copy of the Transactions I have before me, a contemporary, who seems to have been tolerably well informed, has inserted divers MS. notes, remarks, and corrections; he added here the words, "Staffordsh^{e}." to the locality, and "Student of Ch. Ch. Oxon." to the subscription, which, as far as I know, does not recur in any of the subsequent Transactions. But under the title, "Two Letters from a Gentleman in the Country, relating to Mr. Leuwenhoeck's Letter in Transaction, No. 283, Communicated by Mr. C." (in No. 288, for November and December 1703, pp. 1494–1501, with eight figures, text and illustrations being both equally remarkable for the period), the same hand has again inscribed the name of "Mr. Charles King," and filled up the blanks left on pages 1494 and 1495 by the initials "W." and "W. Ch. Esq." with the additions of "irley par. Com. Stafford." and "Walter Chetw... of Ingestry Staffords^{e}." (the rest has been cut off by the binder of the volume), so that there remains no reasonable doubt as to the truth of the identification. Now we read in the second of these letters from the country, dated "July 5, 1703," p. 1501, "But of those" (viz. animalcula) "(among other things) I last year gave an account to Sir Ch. Holt, which I hear will shortly be publish'd in the Transactions." I don't think it is bold to conjecture that the account here alluded to had already been published, and is, in fact, the article printed in No. 284, for March and April 1703, pp. 1357(*bis*)–1372 (with excellent figures on the plate accompanying that number), under the title of "An Extract of some Letters sent to Sir C. H. relating to some Microspocal" (*sic*) "Observations. Communicated by Sir C. H. to the Publisher" (H. Sloane); and no doubt these epistles may also be ascribed to the same anonymous gentleman.

In all the above-mentioned letters we have some early and first-rate contributions to microscopical science, the importance of which had been shortly before so evidently demonstrated by the wonderful discoveries made by the improved magnifying-glasses.

Quæritur: Who was Mr. Charles King? S.

The Hague, November 27.

NOTE ON A PROPOSED ADDITION TO THE VOCABULARY OF ORDINARY ARITHMETIC.[1]

THE total number of distinct primes which divide a given number I call its Manifoldness or Multiplicity.

[1] Perhaps I may without immodesty lay claim to the appellation of the Mathematical Adam, as I believe that I have given more names (passed into general circulation) to the creatures of the mathematical reason than all the other mathematicians of the age combined.

A number whose Manifoldness is n I call an n-fold number. It may also be called an n-ary number, and for $n = 1, 2, 3, 4, \ldots$ a unitary (or primary), a binary, a ternary, a quaternary, ... number. Its prime divisors I call the *elements* of a number; the highest powers of these elements which divide a number its *components;* the degrees of these powers its *indices;* so that the indices of a number are the totality of the indices of its several components. Thus, we may say, a prime is a one-fold number whose index is unity.

So, too, we may say that all the components but one of an odd perfect number must have even indices, and that the excepted one must have its base and index each of them congruous to 1 to modulus 4.

Again, a remarkable theorem of Euler, contained in a memoir relating to the Divisors of Numbers ("Opuscula Minora," vol. ii. p. 514), may be expressed by saying that *every even perfect number is a two-fold number, one of whose* components *is a prime, and such that when augmented by unity it becomes a power of* 2, *and double the other component.*[1]

Euler's function $\phi(n)$, which means the number of numbers not exceeding n and prime to it, I call the *totient* of n; and in the new nomenclature we may enunciate that *the totient of a number is equal to the product of that number multiplied by the several excesses of unity above the reciprocals of its elements.* The numbers prime to a number and less than it, I call its *totitives.*

Thus we may express Wilson's generalized theorem by saying that any number is contained as a factor in the product of its totitives increased by unity if it is the number 4, or a prime, or the double of a prime, and diminished by unity in every other case.

I am in the habit of representing the totient of n by the symbol $\tau n, \tau$ (taken from the initial of the word it denotes)

[1] It may be well to recall that a perfect number is one which is the half of the sum of its divisors. The converse of the theorem in the text, viz. that $2^n(2^{n+1} - 1)$, when $2^{n+1} - 1$ is a prime, is a perfect number, is enunciated and proved by Euclid in the 36th (the last proposition) of the 9th Book of the "Elements," the second factor being expressed by him in the sum of a geometric series whose first term is unity and the common ratio 2. In Isaac Barrow's English translation, published in 1660, the enunciation is as follows:—"If from a unite be taken how many numbers soever 1, A, B, C, D, in double proportion continually, untill the whole added together E be a prime number; and if this whole E multiplying the last produce a number F, that which is produced F shall be a perfect number."

The direct theorem that every even perfect number is of the above form could probably only have been proved with extreme difficulty, if at all, by the resources of Greek Arithmetic. Euler's proof is not very easy to follow in his own words, but is substantially as follows:

Suppose P (an even perfect number) $= 2^n$A. Then, using in general $\int$X to denote the sum of the divisors of X,

$$2 = \frac{\int P}{P} = \frac{\int 2^n . \int A}{2^n A} = \frac{2^{n+1} - 1}{2^n} . \frac{\int A}{A}.$$

Hence
$$\frac{\int A}{A} = \frac{2^{n+1}}{2^{n+1} - 1}, \text{ say } = \frac{Q+1}{Q}.$$

Hence $A = \mu Q$, and $\int A = 1 + \mu + Q + \mu Q + \ldots$ (if μ be supposed > 1).

Hence unless $\mu = 1$ and at the same time Q is a prime

$$\int A > \mu(Q + 1),$$

i.e. $\frac{\int A}{A}$ is greater than itself.

Hence an even number P cannot be a perfect number if it is not of the form $2^n(2^{n+1} - 1)$, where $2^{n+1} - 1$ is a prime, which of course implies that $n + 1$ must itself be a prime.

It is remarkable that Euler makes no reference to Euclid in proving his own theorem. It must always stand to the credit of the Greek geometers that they succeeded in discovering a class of perfect numbers which in all probability are the only numbers which are perfect. Reference is made to *so-called* perfect numbers in Plato's "Republic," H, 546 B, and also by Aristotle, Probl. I E 3 and "Metaph." A 5, which he attributes to Pythagoras, but which are purely fanciful and entitled to no more serious consideration than the late Dr. Cummings's ingenious speculations on the number of the Beast. Mr. Margoliouth has pointed out to me that Muhamad Al-Sharastani, in his "Book of Religious and Philosophical Sects," Careton, 1856, p. 267 of the Arabic text, assigns reasons for regarding all the numbers up to 10 inclusive as perfect numbers. My particular attention was called to perfect numbers by a letter from Mr. Christie, dated from "Carlton, Selby," containing some inquiries relative to the subject.

being a less hackneyed letter than Euler's ϕ, which has no claim to preference over any other letter of the Greek alphabet, but rather the reverse.

It is easy to prove that the half of any perfect number must exceed in magnitude its totient.

Hence, since $\frac{3}{2} \cdot \frac{5}{4}$ is less than 2, it follows that no odd two-fold perfect number exists.

Similarly, the fact of $\frac{3}{2} \cdot \frac{7}{6} \cdot \frac{11}{10}$ being less than 2 is sufficient to show that 3, 5 must be the two least elements of any three-fold perfect number; furthermore, $\frac{3}{2} \cdot \frac{5}{4} \cdot \frac{17}{16}$ being less than 2, shows that 11 or 13 must be the third element of any such number if it exists[1]—each of which hypotheses admits of an easy disproof. But to disprove the existence of a four-fold perfect number by my actual method makes a somewhat long and intricate, but still highly interesting, investigation of a multitude of special cases. I hope, *numine favente*, sooner or later to discover a general principle which may serve as a key to a universal proof of the non-existence of any other than the Euclidean perfect numbers, for a prolonged meditation on the subject has satisfied me that the existence of any one such—its escape, so to say, from the complex web of conditions which hem it in on all sides—would be little short of a miracle. Thus then there seems every reason to believe that Euclid's perfect numbers are the only perfect numbers which exist!

In the higher theory of congruences (see Serret's "Cours d'Algèbre Supérieure") there is frequent occasion to speak of "a number n which does not contain any prime factor other than those which are contained in another number M."

In the new nomenclature n would be defined as *a number whose elements are all of them elements of* M.

As τN is used to denote the totient of N, so we may use μN to denote its multiplicity, and then a well-known theorem in congruences may be expressed as follows.

The number of solutions of the congruence

$$x^2 - 1 \equiv 0 \pmod{P}$$

is $2^{\mu P}$ if P is odd,

$2^{\mu P - 1}$ if P is the double of an odd number,

$2^{\mu P}$ if P is the quadruple of an odd number,

and $2^{\mu P + 1}$ in every other case.

In the memoir above referred to, Euler says that no one has demonstrated whether or not any odd perfect numbers exist. I have found a method for determining what (if any) odd perfect numbers exist of any specified order of manifoldness. Thus, *e.g.*, I have proved that there exist no perfect odd numbers of the 1st, 2nd, 3rd, or 4th orders of manifoldness, or in other words, no odd primary, binary, ternary, or quaternary number can be a perfect number. Had any such existed, my method must infallibly have dragged each of them to light.[2]

In connection with the theory of perfect numbers I have found it useful to denote $p^i - 1$ when p and i are left general as the Fermatian function, and when p and i have specific values as the ith Fermatian of p. In such case p may be called the base, and i the index of the Fermatian.

[1] 3, 5, 7 can never co-exist as elements in *any* perfect number as shown by the fact that $\frac{1+3+3^2}{9} \cdot \frac{1+5}{5} \cdot \frac{1+7+49}{49}$; *i.e.* $\frac{26}{15}\left(1 + \frac{1}{7} + \frac{1}{49}\right)$ is *greater* than 2. Thus we see that no perfect number can be a multiple of 105. So again the fact that $\frac{5}{4} \cdot \frac{7}{6} \cdot \frac{11}{10} \cdot \frac{13}{12} \cdot \frac{17}{16} \cdot \frac{19}{18}$ is *less* than 2 is sufficient to prove that any odd perfect number of multiplicity less than 7 must be divisible by 3.

[2] I have, since the above was in print, extended the proof to quinary numbers, and anticipate no difficulty in doing so for numbers of higher degrees of multiplicity, so that it is to be hoped that the way is now paved towards obtaining a general proof of this *palmary* theorem.

Then we may express Fermat's theorem by saying that *either the Fermatian itself whose index is one unit below a given prime or else its base must be divisible by that prime.*[1]

It is also convenient to speak of a Fermatian divided by the excess of its base above unity as a Reduced Fermatian and of that excess itself as the Reducing Factor.

The spirit of my actual method of disproving the existence of odd perfect numbers consists in showing that an n-fold perfect number must have more than n elements, which is absurd. The chief instruments of the investigation are the two inequalities to which the elements of any perfect number must be subject and the properties of the prime divisors of a Reduced Fermatian with an odd prime index.

New College, November 28. J. J. SYLVESTER.

[1] So too we may state the important theorem that if *an element of a Fermatian is its index the component which has that index for its base must be its square.*

COUTTS TROTTER.

A GREAT calamity has fallen on the University of Cambridge and on Trinity College, and many men differing widely in their interests and callings are bearing together the burden of a common sorrow in the knowledge that the Rev. Coutts Trotter, the Vice-Master of Trinity College, was no more. Mr. Trotter suffered from a severe and prolonged illness during last winter and early spring, and though in the summer he seemed to have almost regained his health, he began as the year advanced once more to lose ground. When he returned from abroad in October his condition gave rise to great anxiety among his friends; as the term went on he grew worse rather than better; and an attack of inflammation of the lungs rapidly brought about the end, which took place in his rooms in College, in the early morning of Sunday, December 4.

During the last twenty of the fifty years of Mr. Trotter's life both the University of Cambridge and Trinity College have undergone great and important changes. In bringing about these changes Mr. Trotter had a great share, perhaps a greater share than any other individual member of the University; and while those changes are probably neither wholly good nor wholly evil, but good mixed with evil, no one hand, as the changes were being wrought, did so much good and so little evil as his. A wide and yet accurate knowledge of many different branches of learning, a genuine sympathy with both science and scholarship, a judicial habit of mind which enabled him to keep in view at the same time broad issues and intricate details, a clear insight into the strength and weakness of academic organization, and a singular skill in drafting formal regulations,—these qualities, aided by a kindly courtesy which disarmed opponents, and a patience which nothing except perhaps coarse rudeness could ruffle, enabled him in his all too short life to do for his College and for his University more than it seemed possible for one man to do.

The academic labours which thus year by year increased upon him, though they in many ways, both directly and indirectly, tended to the advancement of science, became, increasingly, hindrances to his pursuing actively any special path of scientific inquiry, as he had once hoped to do. His love of science began with his boyhood, while he listened to the Royal Institution lectures of Faraday. Having taken a degree, with honours in both classics and mathematics, and having obtained a Fellowship at Trinity, he gave up to scientific study much of the leisure thus afforded to him; and, in order more thoroughly to train himself, spent the best part of two years at Heidelberg, during a portion of which time he was engaged in physiological research under Helmholtz. He acquired a very considerable knowledge of chemistry and botany, but afterwards confined his attention more especially to physics, and lectured experimentally on this subject for several years in Trinity College. In his earlier days he was an enthusiastic Alpine climber, and this led him to direct his knowledge of physics towards the solution of glacial problems. He commenced a few years ago, in the ice-caves of Grindelwald, a series of observations on the physical properties of ice, some of the initial results of which were communicated to the Royal Society. He was never able, however, to continue, much less to complete, these observations, and perhaps the cruellest feature to him of his illness last winter was that it prevented him from spending the Christmas vacation at Grindelwald, as he had hoped to do, in carrying on measurements of ice, under the most natural conditions, in the depths of an ice-cave.

But the gain to science from Trotter's life is not to be measured by his formal contributions to scientific literature. He had a great unwillingness to write "papers." Though he served for several years as one of the secretaries, and at the time of his death was President, in the second year of office, of the Cambridge Philosophical Society, whose very life consists in scientific research, and though in the discussions at the meetings he frequently made his critical power felt, his name does not often appear in the Society's publications. He was especially interested in physiological optics, but, though he made many observations, was always disinclined to commit his results to paper. His real scientific usefulness is to be seen in his University and College work. The recent development of natural science (other than mathematical) at Cambridge is coincident in time with, and in great measure due to, Trotter's academic activity.

In the encouragement given at Trinity to natural science, in all the changes of University ordinances tending to encourage scientific research, and to place the teaching of science on a broader and firmer basis, it is easy to trace his hand. He did not always have his own way, and often thought it prudent to accept an arrangement the shortcomings of which he clearly saw; but his influence, becoming more and more powerful year by year, was always exerted to promote the growth of science in the University, for he at least had no doubt that he was thus working for the welfare both of the University and of his College. He had such a firm grasp of the dominant ideas, and was so wholly in touch with the spirit, of almost every one of the various branches of science, that each teacher and worker sought his help and trusted in his counsel. On the other hand, his conspicuous sympathy with literature and art enabled him to win from those who were strangers to science an assent which would have been denied to claims advocated by others. Happily, too, his singularly catholic mind and temper were made still more potent by a remarkable skill in handling details and conducting business. Were Maxwell now alive, he would be able to tell, as Rayleigh and Thomson can tell, how great a help Trotter was to the Cavendish Laboratory and to physics. The Regius Professor of Physic knows how often Trotter's great knowledge of the needs of medicine on the one hand, and of the capabilities of academic organization on the other, as well as his legislative ability, were of signal service in the difficult deliberations of the Board of Medical Studies. Liveing can say how much not only the very existence, but the details of construction, of the new Chemical Laboratory are due to Trotter's co-operation with himself, and Stuart will tell a like story about the Engineering School. Each science in turn brought its wants to Trotter, and seldom brought them in vain. He recognized Frank Balfour's powers as early as I did, and did more for him in his College and in the University than I could do. All my younger friends whom I am proud to think of as once my pupils, who are making their names known in physiology, in morphology, and in botany, have always looked up to him as a friend who never failed. And, as for myself, whatever I may have done at Cambridge has been done from first to last through him, and could not have been done without him: in him I have lost my oldest, truest, best helpmate.

I first came to know him a year or so before I received my appointment at Trinity College. Happening to pay a visit to Prof. Humphry, I was taken by him to call on "a young Fellow of Trinity interested in science, and especially in physiology, a capital fellow!" That "young Fellow" was Trotter. I saw, even in our brief interview, much in him to draw me to him, and he seemed to see something of the same kind in me, so that when, a year after, a sudden change in all my plans placed me within the walls of Trinity, he and I began a friendship which has ceased only with his death. All through the thirteen years during which, while working within the University, I was really outside the University, my every movement was made by and through Trotter; and since I have been Professor my every movement has been made with him. For seventeen years I have been able to make him a partner in my plans; he has shared in my hopes and soothed me in my failures; where I have been successful he has helped, and when I have refused or neglected his counsel I have generally gone wrong. When Balfour was taken I could feel that Trotter was left, and now he is gone too.

But I ought not to thrust these personal matters on the readers of NATURE, and indeed, great as my own loss is, that of Trinity College and of the University is far greater. Those who know the University and knew Trotter will feel at once how great a blow is his death at the present juncture. The University, both in its scientific and in its other work, is straitened for lack of funds: laboratories cannot be built, teachers cannot be adequately paid, research cannot be properly encouraged, because the necessary money is not at hand. At the same time the revenues of the several Colleges are suffering acutely from the depreciation in the value of land, and a movement has been set on foot with the view of diminishing the contributions of the Colleges to the University. If this movement is successful—and its success seems assured by the fact that the new Member for the University has, in his address to the electors, given a conspicuous pledge that he, with his commanding scientific authority, will support it in Parliament—it will need the wisest and most skilful handling of details to prevent the result proving disastrous to the cause of learning, and especially of scientific learning, in the University. So long as Trotter was alive we felt that we had one in whom devotion to his College was no less strong than his love for the University and for learning, and we looked to him as the man who, trusted alike by the Colleges and by the University, would be found to have skill to steer us in the difficult way before us. Now, in the darkness of his death, we seem to be driving, without a pilot, straight upon the rocks.

M. FOSTER.

H. C. F. C. SCHJELLERUP.

THE Danish astronomer Prof. Hans Carl Frederick Christian Schjellerup died at the Copenhagen Observatory on November 13 after a prolonged illness. He was born on February 8, 1827, at Odense, where his father was a jeweller, and was apprenticed to a watchmaker, but by private study he succeeded in supplementing the education he had received in his native town so well that he was able to pass the entrance examination at the Polytechnic School of Copenhagen in 1848. Here he distinguished himself by his mathematical ability, and was able to finish his studies in the course of two years, when he passed the final examination in applied mathematics and mechanics. In 1851 he was appointed observer in the old Observatory at Copenhagen, which had been built at the time of Longomontanus, on the top of a high tower, and was therefore, after the lapse of two centuries, greatly behind the times, both as to locality and instruments. A few years afterwards he was appointed Professor of Mathematics at the Naval Academy, and Instructor in Geometrical Drawing at the Polytechnic School. These appointments he retained till the time of his death, as well as his position at the Observatory, and though he was in 1875, after the death of Prof. D'Arrest, strongly urged by the Minister of Public Instruction to allow himself to be appointed Professor of Astronomy, he preferred remaining as he was, partly owing to the pecuniary loss the change would have entailed, partly because his scientific activity was untrammelled by routine duties, and left him leisure to pursue his studies in whatever direction he chose.

As long as Schjellerup had only at his disposal the instruments of the old Observatory, he chiefly occupied himself with the computation of orbits of planets and comets, among which his determination of the orbit of the comet of 1580 deserves to be specially mentioned. This was founded on a complete reduction of Tycho Brahe's original observations of the distance of the comet from stars, and of his time determinations by altitudes and azimuths of standard stars. In 1861 the new Observatory was finished, and furnished with an 11-inch refractor by Merz and a transit-circle by Pistor and Martins. With the latter Schjellerup commenced in September 1861 to observe zones of stars, chiefly of the eighth and ninth magnitudes, between $+15^{\circ}$ and -15° declination, and already in the beginning of December 1863 he had finished the observation of ten thousand stars, while the reductions had been pushed on with so much energy that the complete catalogue of mean places for 1865 was laid before the Royal Danish Society of Science a month after. When it is remembered that the author of this work during the greater part of the year had to spend three or four hours a day in teaching, it will be conceded that he made good use of his time. The star catalogue is so well known for its fulness and accuracy that it is unneccessary to dwell further on it in this place. After its completion, Schjellerup intended, and had already commenced, to continue the observations north of the limit of $+15^{\circ}$, as Bessel had done forty years before, but about this time his interests took a new direction, which made him discontinue systematic observations, while he may also have been influenced by the circumstance that the great undertaking of the Astronomische Gesellschaft, viz. the observing of all stars in the northern hemisphere down to the ninth magnitude, had just then been planned, whereby zone work on Lalande's plan became of less importance.

Schjellerup now with his usual energy threw himself into the study of Oriental languages, especially Arabic and Chinese. In the Royal Library of Copenhagen he found a manuscript of the description of the heavens by the Persian astronomer Abd-al-Rahman al-Sûfi, a work which up to that time had been very little known among astronomers. Finding that it contained a complete and careful uranometry from the tenth century, or in other words from an epoch nearly equidistant between Ptolemy and Argelander, he resolved to translate it and was fortunate enough to obtain the use of another manuscript from the Imperial Library of St. Petersburg. The work was published in 1874 by the Academy of St. Petersburg under the title, "Description des étoiles fixes composée au milieu du dixième siècle de notre ère par l'astronome Persan Abd-al-Rahman al-Sûfi." It has been found most valuable by the astronomers who of late years have studied the relative brilliancy of the fixed stars, and Sûfi's results have been systematically collated with their own by Messrs. Peirce, Pritchard, and Pickering.

The great value which this old work was found to possess for modern research induced Schjellerup to endeavour to make other observations of the ancient astronomers fruitful for the investigations of the present day. To the journal *Copernicus* he contributed three papers under the common title, "Recherches sur l'Astronomie des Anciens." The first shows that the time stars of Hipparchus had been so well selected that their culminations gave the correct time every hour of the night within a minute, the second discusses the Chinese observations of the total eclipses of the years -708, -600, and -548, while the third compares seven conjunctions of the moon with fixed stars recorded by Ptolemy, with Hansen's lunar tables. He further examined the occultations and conjunctions of planets observed by the Greek astronomers, and the principal eclipses of the Middle Ages, but these investigations appear to have been left unfinished at his death.

Among Schjellerup's minor publications should be mentioned his catalogue of red stars (first published in 1866, and in a revised edition in 1874), which appeared most opportunely at a time when the spectroscope had just commenced to be applied to the study of the physical constitution of the stars.

In addition to being a man of very extensive knowledge, both scientific and general, Schjellerup was a kind teacher and friend, always willing to assist with his vast store of learning anybody who consulted him. His memory will be gratefully cherished by those who had the good fortune to know him. J. L. E. DREYER.

NOTES.

DR. ASA GRAY, we are sorry to learn, has been stricken with apoplexy at his house in Cambridge, Massachusetts.

SIR GEORGE BURROWS, F.R.S., died on Monday. He was in his eighty-seventh year.

WE regret to have to announce the death, at the early age of thirty-four, of Prof. Humpidge, of the University College of Wales. Dr. Humpidge was educated at the Grammar School, Gloucester, was for some years in trade, and in spare time student in science classes, where he obtained a silver medal in geology from the Department. He afterwards studied at the School of Mines, and obtained one of the three Jodrell Scholarships. In the examination for B.Sc. at the London University he obtained the second place in the honours list, and the two years' £40 scholarship. After studying with Bunsen at Heidelberg, and teaching at Hofwyl in Berne, he was appointed in 1879 to the chemistry class at Aberystwith. At Kensington Dr. Humpidge carried on some researches on the coal-gas of the metropolis, under Prof. Frankland, and in Heidelberg he took up the study of the rare metals yttrium, erbium, and beryllium, results of which were published in the Journal of the Chemical Society, Philosophical Transactions, and Proceedings of the Royal Society. His later work was the preparation of several rare metals in a state of purity for the determination of their specific heats in his calorimeter. The fire which unfortunately destroyed the College in the summer of 1885 caused irreparable loss to Dr. Humpidge, all his papers and results and chemicals being burnt, and he had also a very narrow escape from the flames in endeavouring to rescue people and property. The shock of this accident undermined his health, and although he continued to teach in temporary premises for some time he was finally obliged to visit the South of Europe for a winter, but the relief was only temporary, and he succumbed, after three weeks of great suffering, on November 30. Dr. Humpidge translated Kolbe's "Inorganic Chemistry," which has reached its second edition. Unfortunately his long illness ran away with any provision that may have been made for his wife and family (two children of three and five years), and their sad condition calls for the consideration of his scientific colleagues.

In opening the exhibition, at the People's Palace, of the work of London apprentices, on Saturday, the Prince of Wales delivered an excellent speech on technical education. He was able to announce that, thanks to the generosity of the Drapers' Company and the Charity Commissioners, the People's Palace will soon be on a permanent footing. He also stated that the Ironmongers' Company and the Charity Commissioners are to co-operate for the establishment, in some other part of London, of an institution corresponding to the People's Palace—an institution for providing technical, scientific, commercial, and artistic education united with physical and social recreation.

A Committee, consisting for the most part of members of the two Commissions which presided over the Prehistoric and Ethnographic Sections in the Paris Exhibition of 1878, has been appointed by the French Minister of Commerce and Industry to preside over Section I. of Technological History at the Exhibition of 1889. This department, which will be located in the so-called Palais des Arts libéraux, will represent physical, or technical, anthropology, prehistoric archæology, and ethnography. The four other Sections connected with anthropological and ethnographic sciences will respectively illustrate the liberal arts, arts and trades, means of transport, and military arts. The President of the Committee is M. de Rozière, and the Acting Secretary M. P. Topinard, editor of the *Revue d'Anthropologie*, through whose pages an appeal is made to foreign as well as French anthropologists for contributions to this Section of the coming Exhibition, such, more especially, as casts of skulls and other parts of the body by which racial types can be best illustrated.

The Chief Signal Officer of the United States has issued his Report for the fiscal year ending June 30, 1887. The Report shows that there has been a growing demand for weather forecasts: as a rule, predictions are made for forty different districts. The system of cold-wave warnings continues in successful operation: these warnings imply that the temperature will fall below 45°, and that in twenty-four hours an abnormal fall of 15° or more will occur. Such predictions are valuable both as regards agricultural interests and personal comfort. A bulletin showing the effect of the weather for the previous seven days on important growing crops is now issued once a week. The State services play an important part in the meteorological organizations of the United States. These now number nineteen, in addition to the New England Meteorological Society. It is recommended that the attention of Congress be called to the propriety of making an appropriation for the service of telegrams now sent from the United States to Europe, in view of their importance to ship-masters of all countries.

At the meeting of the French Meteorological Society, on November 9, attention was drawn to the establishment of a meteorological station at Bagnères-de-Bigorre. This station is of importance from its position at the foot of the Pic-du-Midi, being about 7540 feet below the mountain observatory. M. Teisserenc de Bort submitted an atlas of maritime meteorology, which has just been published with the co-operation of the Central Meteorological Office of France.

On November 16, Dr. Buys Ballot, Director of the Royal Meteorological Institute of the Netherlands, was presented with a gold medal, at a banquet held in his honour, as a mark of respect on his completion of forty years of eminent services (1847-87). The meeting was attended by men of science from various countries.

Ciel et Terre of November 1 discusses an investigation of the surface temperature of the ocean, by Prof. O. Krümmel, in the *Zeitschrift für Wissenschaftliche Geographie*, containing charts for February and August, with coloured isotherms for each 2° C., over all oceans. The space occupied in latitude by water of 75° F. is calculated for the Atlantic and Pacific Oceans. Temperatures above 86° F. are found only at isolated points, as on the west coast of Central America, in August. Nearly 40 per cent. of the whole superficies of the ocean, both in February and August, has a temperature above 75°. The low temperature on the west coasts of Africa and South America is attributed by the author to the action of the winds instead of to the action of Polar surface currents, by which it has hitherto been explained.

During last autumn the German Fishery Association despatched the steamer *Holsatia* into the Baltic for scientific research, some of the results of which have just been made public. There were on board Prof. Hensen, Dr. Brandt, Dr. Oldenburg, and several officials connected with the German fisheries. The *Holsatia* left Memel on September 14, and, steering in a north-westerly direction, trawled over her course in order to ascertain what fish were most plentiful at that season. This proved to be herring. In the deep channel running to the north-west of Memel, between that city and the Hoberg bank, off the island of Gottland, it was found that the temperature of the sea, at a depth of 142 metres only, was 3° C., whereas at the surface it was 14° C. Several measurements were taken, but with the same result. This spot being one of the deepest in the Baltic, it has been suggested that this abnormal temperature may be caused by some cold under-current coming from the Gulf of Bothnia or the Bay of Finland. From this point the course was shaped for the island of Öland and the fishing-bank called "Mittelbank," soundings being taken throughout. Net-fishing was also carried on, particularly with a so-called "vertical" net, employed for the purpose of ascertaining the nature of the food of fish in certain waters. Some trawling resulted in the bringing up of boulders of a very curious shape, as well as mussels and other marine animals. All the objects brought up were photographed.

In the December Bulletin of Miscellaneous Information, issued from the Royal Gardens, Kew, there is an interesting account of cubebs, the value of which has risen rapidly during the last few years. There are also excellent papers on Sabicu wood, Mexican fibre or istle, the food-grains of India, broom root or Mexican whisk, Contrayerva, the introduction of the Brazil nut to the East Indies and Australia, and the Castilloa rubber of Central America.

Another comprehensive application of the well-known reaction of Messrs. Friedel and Crafts, which has played so remarkable a *rôle* in organic chemistry, has recently been made by M. Léon Roux. In a long but highly interesting communication to the *Annales de Chimie et Physique*, M. Roux describes how he has been enabled, with the aid of that wonderful substance, chloride of aluminium, to extend the bounds of chemistry still further, by preparing a large number of higher homologues of naphthalene. In fact, he has been successful in building up from the heavier molecule of naphthalene an entirely new series of hydrocarbons, analogous in many respects to the series derived, by the earlier use of this reaction, from the lighter molecule of benzene. The insertion of the CH_3 groups, however, is a much more difficult operation in the naphthalene than in the benzene series, and requires a much higher temperature; the homologues themselves, moreover, are much more interesting, inasmuch as two isomeric kinds, α and β, of each are possible. Thus the methyl naphthalene $C_{10}H_7 . CH_3$ formed by the new method was found to consist of a mixture of the α and β isomers, which could be partially separated by taking advantage of their different points of solidification. Ethyl naphthalene, $C_{10}H_7 . C_2H_5$, was most readily obtained by warming, in a flask connected with an inverted condenser, a mixture of 200 grammes naphthalene, 200 grammes ethyl iodide, and 20 grammes of aluminium chloride, added gradually as the reaction proceeded. The fraction of the product boiling between 249° and 254° was isolated as a colourless highly refractive liquid, exhibiting violet fluorescence, and was shown by analysis, and by the nature of its oxidation products, to consist of almost pure β ethyl naphthalene mixed with a minute quantity of the α compound. In a similar manner, propyl, butyl, amyl, and benzyl naphthalene have been prepared; indeed, there appears to be no limit to the number of naphthalene derivatives possible to be obtained in this manner, and there can be no doubt that M. Roux is perfectly warranted in applying the somewhat exclusive term "classical" to the work of Messrs. Friedel and Crafts, which has led to the synthesis of so large a number of carbon compounds.

At the meeting of the Helvetic Society of Sciences this year Prof. Weber described a very sensitive micro-radiometer made in the following way:—One arm of a Wheatstone's bridge is formed by a thin tube, which is filled in its middle part with mercury, and at its ends, for about 5 mm., with a solution of zinc sulphate. To each end of the tube is fitted a metallic case, one side of which consists of a plate of rock salt. This case is filled with air, which dilates under the influence of radiation forces back the zinc-sulphate solution in the tube, and thus greatly increases the electric resistance on that side. The apparatus is made symmetrical, to eliminate variations of temperature and pressure. This radiometer will indicate 100-millionths of a degree. The moon's radiation gives a galvanometric oscillation of about five divisions.

It is estimated that the air in a room becomes distinctly bad for health when its carbonic acid exceeds 1 part in 1000. An apparatus has been recently patented by Prof. Wolpert, of Nürnberg, which affords a measure of the carbonic acid present. From a vessel containing a red liquid (soda-solution with phenolphthalein) there comes every 100 seconds, through a siphon-arrangement, a red drop on a prepared white thread about a foot and a half long, and trickles down this. Behind the thread is a scale beginning with "pure air" (up to 0·7 per 1000) at the bottom, and ending above with "extremely bad" (4 to 7 per 1000 and more). In pure air the drop continues red down to the bottom, but it loses its colour by the action of carbonic acid, and the sooner the more there is of that gas present.

Some interesting experiments on the reciprocal influence of organs of sense have been recently made by Herr Urbanschitsch, of Vienna. His general conclusion is that any sense-excitation has for result an increase of the acuteness of other senses. Thus, sensations of hearing sharpen the visual perceptions. If coloured plates are placed at such a distance that one can hardly distinguish the colours, and various sounds are then produced, the colours become generally more distinct the higher the sounds. Similarly, one can, while a sound affects the ear, read words which one could not read before. Again, the ticking of a watch is better heard when the eyes are open than when they are closed. Red and green increase auditive perceptions; but blue and yellow weaken them. Several musicians, however, were agreed that red, green, yellow, and blue caused an intensification of sound about one-eighth; while violet had a weakening effect. Taste, smell, and touch are under like laws. Light, and red and green colour, increase their delicacy; while darkness, blue, and yellow diminish it. Under the influence of red and green, taste extends from the anterior border of the tongue to the whole surface. On the other hand, a strengthening of smell, taste, or touch, exalts the other sensitive perceptions. Specially interesting is the reciprocal influence of touch and the sense of temperature. If one tickle the skin with a hair, and plunge the hand in hot water, the tickling sensation ceases; on the contrary, if the hand be placed in cold water, and a part of the body tickled, the temperature is felt more vividly. Herr Urbanschitsch finds in this reciprocal action an explanation of supposed double consecutive sensations on excitation of one sense.

Prof. Lindeman contributes to the last two issues of the *Bulletin de la Société des Naturalistes de Moscou* (1887, Nos. 2 and 3) two very elaborate papers on the Hessian fly. He points out that there can be no universal remedies for this pest, because the manner of life of the Hessian fly, and the conditions of its multiplication, vary to some extent in different climates. His study of the Hessian fly in the neighbourhood of Moscow has enabled him to describe at length the conditions which are, and those which are not, favourable for its development in that district. About Moscow it never propagates on any of those plants —Gramineæ or others—which grow amidst the crops of the Russian corn-fields. Of the three generations which develop there—the spring generation, from the beginning of May to the beginning of June (old style), the summer one, from June 19 to the beginning of August, and the autumn one, to the end of August—each must find for its propagation green stems of rye, wheat, or barley; and these stems must remain green and succulent throughout the twenty-eight days that the larva is living. Of insects which hunt the larvæ of the Hessian fly, *Geophilus*, the larva of a *Cantharid*, and one mite are noticed. The parasitic Pteromalines of the fly have been described by the same author in the first number of this year's *Bulletin*.

We have received the last number of the Transactions of the Asiatic Society of Japan (vol. xv. Part 1), in which the well-known Chinese scholar Mr. E. H. Parker discusses in two papers the relation between the Japanese language and the languages of the neighbouring continent. He comes to the conclusion, after an elaborate examination of a list of a thousand Japanese words, that a great part of the modern Japanese language may be traced back to a language common with that language from which the modern dialects of China have all been derived. Mr. Walter Dening gives an abstract of the rules, an account of the general work, and a list of the papers published in the Proceedings of a Japanese Society established for the discussion and elucidation of various educational questions; or, in the words of its rules, "to raise the standard of scholarship and supply the wants of the teacher and reformer." Amongst the papers which have been published by the Society we select the titles of a few in order to show its scope:—"Female Education"; "An Account of the Origin and Development of Natural History in Japan"; "The Compilation of a Japanese Grammar"; "On Sending Students of Natural History to China and Corea"; "The Connection of Clothing and Health"; "Iron Ore"; "The Origin of Certain Customs"; "The Five Races of China." So far, eight parts of the Society's magazine appear to have been published, and these contain about a hundred papers by Japanese scholars of eminence, many of them, like Ito Keisuke, the veteran botanist, bearing names known in Europe.

We have received Nos. 31–45 of "Länderkunde des Erdteils Europa," a valuable and most interesting work, edited by Prof. Alfred Kirchhoff, which is being issued in "Lieferungen." Prof. Kirchhoff is aided by many eminent writers. The publishers are F. Tempsky, of Vienna and Prague, and G. Freytag, of Leipzig.

Two papers just printed in the Philosophical Transactions of the Royal Society have been sent to us—"Some Anomalies in the Winds of Northern India, and their Relation to the Distribution of Barometric Pressure," by S. A. Hill; and "Studies on some New Micro-organisms obtained from Air," by Grace C. Frankland and Percy F. Frankland.

MR. F. MOORE, having completed the "Lepidoptera of Ceylon," has now in preparation a much more extensive work comprising the Lepidopterous insects of the entire Indian region. It will be issued in monthly parts, to subscribers only, by the publishers of his previous work, Messrs. L. Reeve and Co.

MR. H. T. OMMANEY, C.S., of Karwar, has sent to the Bombay Natural History Society a full-grown live specimen of the Hamadryad, or King Cobra (*Ophiophagus elaps*). The reptile, which measures about 12 feet in length, is jet black, with faint cream-coloured bars across its back. The throat is of a golden-yellow colour.

A NEW "Catalogue of Mathematical Books," including many of the works of the old mathematicians, has been issued by Messrs. Macmillan and Bowes, Cambridge.

DR. OVERBECK, who owns part of the collections that originally belonged to Alexander von Humboldt, has sent a report about them to the Saxe-Thuringian Naturalists' Society at Halle. He enumerates 290 objects. Dr. Overbeck intends to present Humboldt's collection of minerals to the Mineralogical Museum of Halle University.

THE additions to the Zoological Society's Gardens during the past week include three American Flying Squirrels (*Sciuropterus volucella*) from Florida, presented by Mr. Henry D. Harrison; two Great Eagle Owls (*Bubo maximus*), European, deposited; two Common Wolves (*Canis lupus* ♂ ♀), European, received in exchange.

OUR ASTRONOMICAL COLUMN.

THE NATAL OBSERVATORY.—Mr. Neison, Superintendent of this Observatory, has issued his Report for 1886, and it appears from it that the astronomical work during that year was almost wholly confined to routine observations with the transit instrument, though the meteorological observations were carried on as usual. This partial suspension of activity was due to the fact that only one assistant is now on the staff, and that, through the severe illness of the Superintendent during the first part of the year and his enforced absence in England during the latter part, the assistant, Mr. Grant, was left practically single-handed. The present year will probably show better results, as Mr. Neison returned to his post before the close of 1886, and several needed instrumental improvements and repairs had been successfully carried out. Mr. Neison had commenced an important work connecting the fundamental declinations of the star catalogues of the northern and southern observatories, by means of observations of the differences in zenith distance between 32 selected stars which cross the meridians of the great northern observatories near their zeniths on the one hand, and a set of corresponding southern circumpolar stars on the other.

OLBERS' COMET, 1887.—The following ephemeris for Berlin midnight for this object is in continuation of that given in NATURE of December 1, p. 37:—

1887.	R.A. h. m. s.	Decl. ° ′	Log r.	Log Δ.	Brightness.
Dec. 17	16 7 41	2 47·2 N.	0·1990	0·3593	0·63
19	16 12 21	2 18·4			
21	16 16 56	1 50·5	0·2090	0·3645	0·59
23	16 21 25	1 23·5			
25	16 25 48	0 57·3	0·2190	0·3695	0·55
27	16 30 6	0 31·9			
29	16 34 19	0 7·4 N.	0·2290	0·3741	0·51
31	16 38 27	0 16·2 S.			
1888.					
Jan. 2	16 42 30	0 39·0	0·2389	0·3783	0·48
4	16 46 27	1 1·2			
6	16 50 20	1 22·7 S.	0·2486	0·3821	0·45

PROBABLE NEW CLASS OF VARIABLE STARS.—The Rev. T. E. Espin considers that a number of our variable stars possess characteristics which justify their being formed into a separate class. They are irregular both in period and variation, the latter being usually about 1½ mag., and they show spectra of Secchi's fourth type, *i.e.* like No. 152 Schjellerup. Their changes in brightness are rapid and uncertain. Mr. Espin names 19 Piscium, Birmingham 277, 521, 535, 541, and Espin 116, 154, as belonging to this new class, which perhaps embraces also Birmingham 85, 120, 121, 240, 290, 418, 464, 483, and 502.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1887 DECEMBER 18–24.

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on December 18

Sun rises, 8h. 4m.; souths, 11h. 56m. 45·5s.; sets, 15h. 50m.: right asc. on meridian, 17h. 43·9m.; decl. 23° 24′ S. Sidereal Time at Sunset, 21h. 38m.

Moon (at First Quarter on December 22, 7h.) rises, 10h. 48m.; souths, 15h. 23m.; sets, 20h. 4m.: right asc. on meridian, 21h. 10·7m.; decl. 16° 43′ S.

Planet.	Rises. h. m.	Souths. h. m.	Sets. h. m.	Right asc. on meridian h. m.	Declination on meridian ° ′
Mercury	6 35	10 44	14 53	16 31·1	21 4 S.
Venus	3 48	8 48	13 48	16 34·5	12 16 S.
Mars	0 38	6 39	12 40	12 25·6	0 37 S.
Jupiter	5 17	9 44	14 11	15 30·8	18 9 S.
Saturn	18 59*	2 47	10 35	8 32·8	19 16 N.
Uranus	1 43	7 16	12 49	13 2·5	5 58 S.
Neptune	14 16	21 56	5 36*	3 44·3	18 1 N.

* Indicates that the rising is that of the preceding evening and the setting that of the following morning.

Occultation of Star by the Moon (visible at Greenwich).

Dec.	Star.	Mag.	Disap. h. m.	Reap. h. m.	Corresponding angles from vertex to right for inverted image. ° °
18	ι Capricorni	4½	17 58	18 59	103 350

December 22.—Sun at greatest declination south; shortest day in northern latitudes.

Variable Stars.

Star.	R.A. h. m.	Decl. ° ′		h. m
U Cephei	0 52·3	81 16 N.	Dec. 21,	23 44 *m*
λ Tauri	3 54·4	12 10 N.	,, 18,	22 54 *m*
			,, 22,	21 46 *m*
ζ Geminorum	6 57·4	20 44 N.	,, 19,	22 0 *m*
			,, 24,	22 0 *M*
R Canis Majoris	7 14·3	16 11 S.	,, 19,	2 19 *m*
			,, 20,	5 35 *m*
S Cancri	8 37·5	19 26 N.	,, 21,	23 57 *m*
δ Libræ	14 54·9	8 4 S.	,, 18,	22 2 *m*
U Coronæ	15 13·6	32 4 N.	,, 21,	18 29 *m*
R Serpentis	15 45·5	15 29 N.	,, 21,	*M*
β Lyræ	18 45·9	33 14 N.	,, 18,	2 0 *m*
Y Cygni	20 45·6	34 10 N.	,, 20,	21 51 *m*
			,, 23,	21 45 *m*
δ Cephei	22 25·0	57 50 N.	,, 23,	2 0 *M*

M signifies maximum; *m* minimum.

Meteor-Shower.

	R.A.	Decl.
Near λ Ursæ Majoris	130°	49° N.

GEOGRAPHICAL NOTES.

THE new number of *Petermann's Mitteilungen* contains a letter from Dr. Hans Meyer, written from Taveta, at the foot of Kilimanjaro, giving some details of his ascent of that mountain, and the results of his observations; it is accompanied by a sketch-map. Dr. Meyer, with one white companion and twenty-two natives, started from Mareale's village, at the south foot of the mountain, in the beginning of July, and proceeded to mount the southern slopes. At 1800 metres the last bananas were passed, and at 2000 metres the saturated forest belt was entered, which on the second day was left behind. Immediately above this stretches a broad belt of grass, and here a north-west line was struck, and for two days the upper edge of the forest was skirted. On the second day Johnston's old camp was reached, where in the water-courses an abundance of large Ericaceous plants was found growing. Here the two beautiful peaks were seen for the first time, and thenceforth only partial glimpses were obtained through the prevailing clouds. Only eight men would go further than this, and when the snow-line was reached five of them refused to go further. On the third day a northerly route was taken over grass-covered lava-fields, with snow-streams sometimes cutting their channels 50 metres deep into the lava. Dr. Meyer made for the saddle which joins the two peaks of Kibo on the west and Kimawenzi on the east. After 6000 paces a level spur of the saddle was reached, where between the great blocks of lava the green meadows marked the upper course of the snow-streams. Here the last traces were seen of *Senecio Johnstoni* in the bed of a brook about 4000 metres high. About 2000 paces further up great cliffs of lava were met with, and here at the snow-line the tent was pitched. Thence, with his companion and three natives, photographic apparatus, and provisions for three days, Dr. Meyer proceeded to ascend to the Kibo crater. After 3000 paces a wild and shattered hill of lava, whence the lava-stream proceeded, was met with; this was the first of a series of such hills, between which the snow lay thick. Turning to the north-west the party made direct for Kibo over the old lava-streams, and at about 5000 metres reached the last cone of ashes before the ascent to the summit itself. Here the two white men encamped (the natives going back), with a night temperature of $-11°$ C. Early next morning they made directly for the east side of the mountain over debris-covered lava, and came on great snow-fields in the spaces between the lava-hills. After a time sleet came on, and, as the sun got higher, clouds covered the mountain, and the temperature fell from $+8°$ C. to $-3°$. Dr. Meyer's companion became so exhausted he had to drop behind, and he himself suffered greatly. Proceeding onwards, he met with more extensive snow-fields, and higher still with great ice-blocks, and a less steep stretch covered with ice-debris. Some 20 metres beyond this point he saw a great blue wall of ice rise before him to about 34 or 40 metres high, and evidently stretching all round the crater. In Dr. Meyer's exhausted condition, and without ice-axes, to ascend this wall, which evidently surrounded the crater, was impossible. So, after taking some hasty observations and notes, he began his descent, which was accomplished safely. As the wall seems to extend round the east, south, and west sides of the crater, Dr. Meyer concludes that probably the crater itself is filled with ice. It is remarkable that no snow seems to exist at all on the north side. Dr. Meyer promises to give full details on his return home to Leipzig, and these may render his account more intelligible to Alpinists.

OTHER articles in the new number are on "Temperature Abnormalities on the Earth's Surface," by Herr Rudolf Spitaler, accompanied by a map illustrative of the paper; and "Production of Tin in the Riouw-Tongga Archipelago," by Dr. Posewitz.

LIEUT. WISSMANN, whose health is not good, has given a preliminary account of his journey across Africa to the Berlin Geographical Society. He began with a very brief sketch of the first part of his journeyings, which consisted of his first voyage up the Kassai. By his last journey up the Kassai he has determined that its largest tributary is the Kwango. The Sankuru has only half the volume of water possessed by the Kassai above the confluence of the two rivers. From Luluaburg, Wissmann began his great forward march to the north of the Sankuru and Lomami. A lengthened stay was made on the Lubi, and after crossing the Sankuru the party entered the region of virgin forests. These were found partially peopled by the savage Batetela and the Batua, the latter being the pygmies described in a previous number. Turning south, Wissmann passed through the territory of the marauding Ben Mona, and where on a former journey he found gigantic villages he now found the place depopulated by war and small-pox. From Nyangwe, Wissmann reached the East Coast by Lakes Tanganyika and Nyassa, and the Zambesi. The latter part of the route was through hitherto unexplored territory. Lieut. Wissmann has been compelled to go to Madeira on account of his health, but we believe there is some likelihood of his appearing at the Royal Geographical Society some time next spring.

FROM the full report of recent explorations in Tierra del Fuego, to which we have recently referred in these notes, we have some further information as to the real character of the region. The reports refer chiefly to the main island, which, instead of being a mountainous region of eternal snow, presents great diversity of surface—high mountains, deep valleys, rolling table-lands, fertile plains, numerous lakes, and frequent water-courses. Occupying a large portion of the extreme north, and extending from one extremity to the other of the straits, are continuous chains of mountains, running into peaks several thousand feet high. Adjacent to these mountains on the south is a wide belt of high and rather barren plain, running the entire width of the island. Then succeed lofty table-lands quite covered with forests. South of this is another chain of sierras, and still further south the country opens into an extensive plain, which occupies all the central portion of the island, and is quite desolate of trees except small patches here and there of hardwood and shrubs. The plain is covered in some parts with an abundance of rich grasses. The extreme south is also mountainous, some of the peaks being volcanic, with numerous glaciers and dense forests. The geological formation of Tierra del Fuego exactly corresponds to that of Patagonia. The broken and disjointed mountains, with wide seas running where they have been depressed, are but the continuation of the Andes; while the plains and uplands partake of the same geological characteristics as the Patagonian steppes.

AT Monday's meeting of the Royal Geographical Society the paper read was by Mr. D. D. Daly on his explorations in British North Borneo, in 1883–87. Mr. Daly's paper consisted mainly of an itinerary with minute details of the economic character of the country through which he travelled, and of the people. He gives some interesting information about the numerous bird-nest caves which he met with, and on the methods of collecting the nests. Most of the people are eager head-hunters, but Mr. Daly made treaties with several of the tribes in which they undertook to give over the practice. Mr. Daly went in both from the east and the west side. In the former journey he went up the River Kinabatangan to the centre of North Borneo; in the latter he went a long distance up the Padas River.

ON THE METEORIC IRON WHICH FELL NEAR CABIN CREEK, JOHNSON COUNTY, ARKANSAS, MARCH 27, 1886.[1]

THE Johnson County meteoric iron, the tenth whose fall has been observed, is of more than ordinary interest, because its fall is so well substantiated, because it is the second largest mass ever seen to fall, and, again, because it fell within five months of the date of the ninth recorded fall, that of the Mazapil. It is almost an exact counterpart of the Hraschina (Agram, Croatia) iron, the first of the recorded falls. The Agram iron fell in two fragments, one weighing about 40 kgm., and the other about 9 kgm., the combined weight being about equal to that of the Johnson County iron.

This mass fell about 6 miles east of Cabin Creek, Johnson County, Arkansas, in longitude 93° 17′ W. of Greenwich, latitude 35° 24′ N., within 75 yards of the house of Christopher C. Shandy. Mrs. Shandy states that about 3 o'clock on the afternoon of March 27, 1886, while in her house, she heard a very loud report, which caused the dishes in the closet to rattle, and which she described as louder than any thunder she had ever heard. At first she thought it was caused by a bombshell, and ran out of the house in time to see the limbs fall from the top of a tall pine-tree, which, she says, stands about 75 yards from her dwelling. She did not investigate the matter until her husband came home, about 6 o'clock in the evening, when, in company with John R. Norton, their hired man, they went out to find the cause of the noise that had so startled Mrs. Shandy. They discovered that a large hole had been made in the ground by some falling object. The iron had buried itself in the ground to the depth of 3 feet, and the earth around it to the thickness of 1 inch seemed to be burned. The ground was still warm when the iron was taken out, and the iron itself was as hot as the men could well handle.

The noise was heard 75 miles away, and was likened to a loud report, followed by a hissing sound, as if hot metal had come in contact with water. It caused a general alarm among the people, and teams of horses 25 miles distant, becoming frightened, broke loose and ran away; and in Webb City, Franklin County, on the south side of the Arkansas River, a number of bells kept on sale in a store are said to have been

[1] From the *American Journal of Science*, vol. xxxiii., June 1887.

caused to tinkle. Cabin Creek is on the north side of the Arkansas River.

Mr. B. Caraway says it was heard by fully 1000 people, and that he heard two loud reports at Alma, Crawford County, 75 miles away, at 3 o'clock on March 27, 1886. The report was also heard at Russellville, and in the adjoining county of Pope.

Prof. H. A. Newton, who has kindly interested himself in this matter, says that the data furnished indicate that the mass must have fallen nearly from the zenith. This was the direction

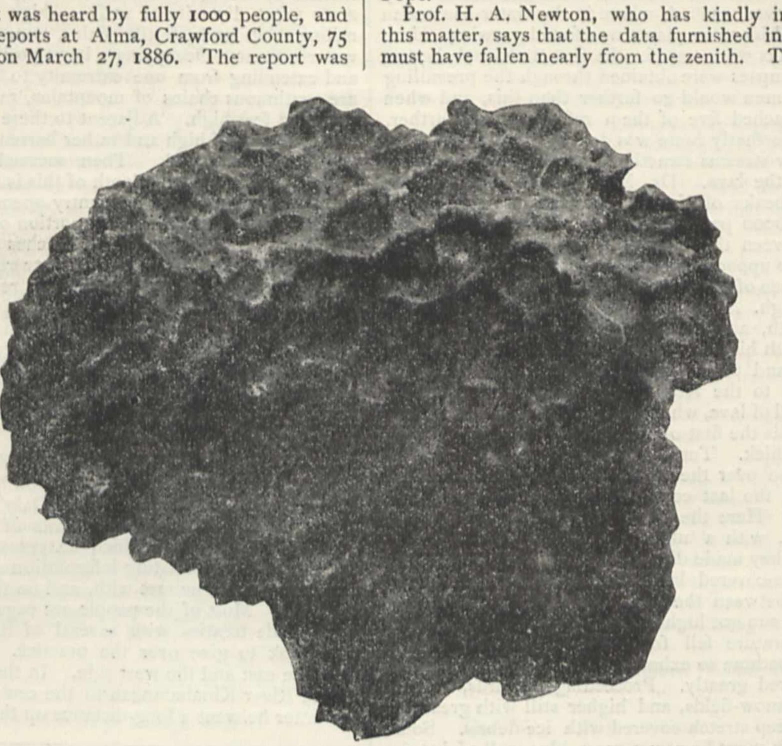

FIG. 1.—Upper Side.

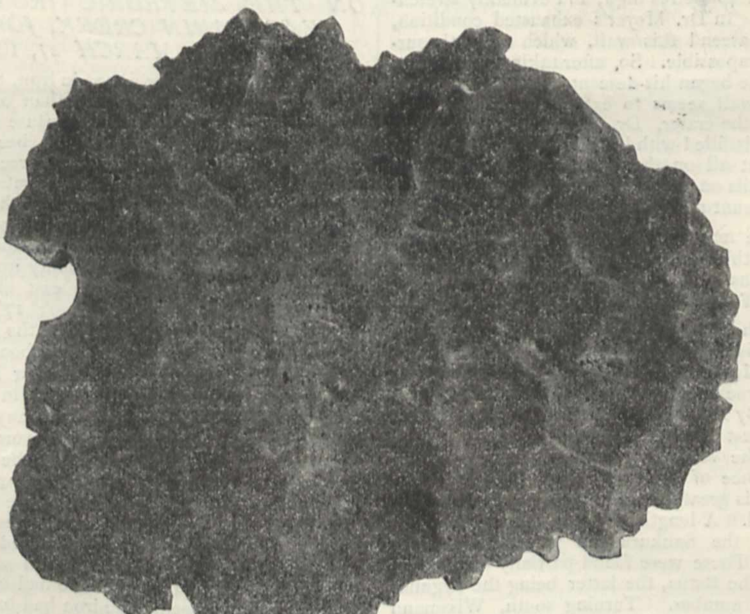

FIG. 2.—Lower Side.

Johnson County, Arkansas. (Scale two-ninths.)

of the end of its path, the earlier portion being more inclined to the vertical, as the path must be affected by gravity and the resistance of the air. The earlier direction must have been from the north-east, and more nearly from the east than the north.

The mass is in general quite flat and very irregular, resembling strongly a mass of molten metal thrown on the ground and then pitted. The illustration of the Agram[2] mass figured

[2] "Beiträge zur Geschichte und Kenntniss Meteorischer Stein- und Metall-massen," by Dr. Carl von Schreibers. Wien, 1820, folio, plate viii.

by Von Schreibers could be mistaken for the upper side of this, were it not that this is larger. It measures 17½ inches (44 cm.) by 15½ inches (39 cm.), while the Agram measures 15½ by 12 inches. A high ridge, 5 inches high at the highest point (12·5 cm.), runs through the centre. One half of the mass is not over 3 inches (7·5 cm.) thick, part of it is only 2 inches (5 cm.), and around the edge it is only 1 inch, or less. It is only exceeded in size, among the irons seen to fall, by the Nejed, Central Arabia, now in the British Museum, which fell in the spring of 1865, and weighs 59·420 kgm. The weight is 107½ lbs. (48·750 kgm.), and it is intact with the exception of three small points, weighing not more than 2 ounces in all, which were broken off. One of these is seen in the etched figure, another was sent to Prof. Clarke by Colonel Betten to be analyzed, and the third piece was lost.

The two sides are wholly dissimilar (see Figs. 1 and 2[1]). In fact, one would scarcely suppose that they belonged to the same mass. The upper side is ridged and deeply dented, while the lower side is flat and covered with shallow but very large pittings. On top the colour is in many places almost tin white without any coating whatever, and the pittings are very deep, and usually quite long, like finger depressions made in potters' clay. These depressions measure from 2 cm. to 4 cm., and from 1 cm. to 4 cm. This side is remarkable for striæ showing the flow and burning, and all running from the centre toward the edge, identical with those in the Rowton, Nedagolla, and Mazapil irons, but on a larger scale. Some of them are thinner than a hair, and yet twice as high (like a high knife-edge), and they are from 1 to 4 inches long. In one space of 5 cm. twenty are arranged side by side, and on one small part which is black, there are fifty lines in 1 inch of space (25 mm.), all running in the same direction. Near all the pointed edges the fused metal has flowed and cooled, so as to hang like falling water. The striæ and marks of flowing are around the edges of the upper surface (Fig. 1). On the under side pittings are very shallow,

FIG. 3.

but much broader, one depression, apparently made up of four pittings, being 20 cm. long, and 9·5 cm. wide. The whole side is coated with a black crust, 1 mm. thick, and having minute round bead-like markings. On one of the indentations of the lower edge the crust has a strikingly fused appearance, as if a flame had been blown on it from the other side. In reality this edge is undoubtedly the place where a greater amount of burning took place when the body was passing through the air. Seven small, bead-like lumps, from 5 mm. to 10 mm. in size, which are visible on this side, are drops of metal that were entirely melted, and flowed and cooled so that they resemble drops of a thick liquid. There are also to be seen what appear to be cracks, fifteen in number, and nearly as thin as a hair. One of these is 10 cm. long, and extends from the highly-fused edge above mentioned towards the centre. The others are from 3 cm. to 5 cm. long. These are so evenly arranged that they are without doubt *Reichenbach lamellen*, in which the inner troilite has been burnt out. If such is the case, they are as abundant as in the Staunton (Va.) meteoric iron.

On the upper side ten nodules of troilite are exposed, measuring from 33 mm. in diameter, to 55 mm. long, and 25 mm. wide. On the lower side there are twelve such nodules exposed, 13 mm. in diameter, while the largest measures 19 mm. by 39 mm. On the upper side these nodules are coated in spots with a black crust, similar to that found on the mass, but on the lower side the crust extends completely around the side of the nodules, showing the fusion very plainly. The troilite is very bright and fresh, like a newly broken mineral, and on the upper side one of the nodules shows deep striation, suggesting that the entire nodule is one crystal, and the exposed part is only one side of it. In some cases where the nodules were broken, they were found to be iridescent. This is one of the octahedral irons showing the Widmanstätten figures beautifully on etching (see Fig. 3), and is one of the Caillite groups of Stanislas Meunier and of the *mittlere lamellen* of Brezina. The lamellæ are 1 mm. wide, and the markings more closely approach the Rowton[1] and Mazapil[2] irons. Fig. 4 shows the etching on the surface of the unpolished exterior, there being no crust. The lower end of the figure, which is flat, was produced by the hammering off of the piece; but the etching was really finer where it was done on the natural surface of the iron. The specific gravity of the small piece figured is 7·773. Troilite, as before stated, is very abundant in the mass. Schreibersite and carbon have also been found

FIG. 4.

between the laminæ. Chlorine is present only in slight quantity, as scarcely any deliquescence has been observed.

The following is a comparative table of analyses of meteoric irons most nearly approaching this in composition:—

	Cabin Creek (Whitfield).	Estherville (Smith).	Mazapil (Mackintosh).	Rowton (Flight).	Charlotte (Smith).
Iron	91·87	92·00	91·26	91·25	91·15
Nickel	6·60	7·10	7·845	8·582	8·05
Cobalt	trace	0·69	0·653	0·371	0·72
Phosphorus	0·41	0·112	0·30	—	0·06
C, S, &c.	0·54	99·902	100·038	100·203	99·98
	99·42				

GEORGE F. KUNZ.

THE ROYAL HORTICULTURAL SOCIETY.

THE Council of the Royal Horticultural Society request the horticulturists of the United Kingdom to read and consider the following statement and appeal:—

1. The grounds at South Kensington, known as the Gardens of the Royal Horticultural Society, having been devoted to the Imperial Institute, the Council endeavoured, in obedience to the wishes so graciously expressed by Her Majesty the Queen, the Patron of the Society, to obtain from the Royal Commissioners of the 1851 Exhibition such a site as would justify them in advising the Fellows to remain at South Kensington.

2. The Royal Commissioners were, however, unable to offer any adequate site, and gave the Council distinctly to understand that the erection of offices, committee-rooms, &c., on their land would not be held to confer any claim whatever, either legal or moral, to the use of the Conservatory and Gardens for the purposes of the Society. The negotiations consequently came to an end. An informal offer has since been made by the Royal Commissioners to let a portion of the Gardens and the Conservatory to the Society at a guaranteed rent of £1000 a year, which with rates, taxes, and maintenance would involve an expenditure of £2000 a year at least, a sum far beyond the resources of the Society.

3. The Society has been in existence for eighty-three years, having been founded in 1804, and incorporated by Royal Charter in 1809. It has done much to advance the interests of practical and scientific horticulture, and it is the recognized authority on all horticultural questions. In addition to the valuable work of the Scientific Committee, presided over by Sir J. D. Hooker, K.C.S.I., C.B., F.R.S., new and rare plants, fruits, and vegetables, collected abroad or raised at home, have been continually submitted, in large and increasing numbers, to the judgment of the Fruit and Floral Committees, whose verdicts are accepted without question. The Society has also continuously carried on valuable trials of plants, fruits, and vegetables, at Chiswick. It has published during the last three years the following, viz.:—"Report of the National Apple Congress held at Chiswick, October 1883," "Report of the Orchid Conference held at South Kensington, May 1885," "Report of the National Pear

[1] These figures were made by the Ives process, and are faithful reproductions direct from the photograph.

[1] "Meteoriten Sammlung des k.k. mineralogisches Hofcabinet in Wien." Wien, 1885, 8vo, Plate 2, Fig. 2.

[2] *American Journal of Science*, III. vol. xxxiii. p. 225, Fig. 2.

Conference held at Chiswick, October 1885," "Report of the Primula Conference held at South Kensington, April 1886, and of the Orchid Conference held at Liverpool, June 30, 1886," "Report on the Effects of Frost on Vegetation during the Severe Winters 1879-80, 1880-81, published in 1887."

4. The Council are of opinion that the connection of the Society with South Kensington, however promising at first, has proved adverse to its true interests and permanent welfare. They recognize that altered circumstances require a complete re-organization of the Society on a more popular basis. They believe that, while local Horticultural Societies attract local support, a central Metropolitan Society (to which local Societies may be affiliated) is, in the interests of horticulture, indispensable. Under analogous circumstances the Royal Agricultural Society prospers, although there are local Societies in every county of the Kingdom.

5. The Council do not believe that the Society can be carried on any longer under the trammels of the existing Charter, which was granted in 1860 in view of a wholly different state of things; nor do they think a Charter will be requisite for its future working. They believe that the numbers of the Council should be considerably increased and their mode of election modified and made popular, and that the ordinary work of the Society should be carried on by Committees, under powers delegated to them by the Council. They hold that the Society should henceforth devote itself strictly to the advancement of practical and scientific horticulture.

6. The view of the Council is that the expenditure of the Society should be reduced as much as possible, and its resources devoted to the following objects:—

(1) The maintenance of the Chiswick Gardens and the conduct of plant, fruit, and vegetable trials there; and possibly the establishment of a School of Gardening.

(2) The immediate engagement of such premises in a convenient and central situation as may suffice for office requirements, the safe housing of the Lindley Library, the meetings of the Society's Committees, and its fortnightly shows, to the maintenance of which they attach great importance.

(3) The publication of periodical Reports of the work done at Chiswick, and by the Society's Committees, and on horticultural subjects generally.

7. For many years the nature of the accommodation which the Society has been able to obtain at South Kensington has virtually prevented meetings being held for the discussion by the Fellows of points of interest in the practice of horticulture. It is essential that these meetings should be resumed, and it is believed that they will be of great value in bringing together those who take an active part in British horticulture. It is also hoped that such meetings would give an opportunity for the consideration of the numerous directions in which the rural economy of the country seems likely to be modified by the substitution of horticultural for agricultural methods.

8. The Council would recommend that the subscription should be in future £2 2*s*. for Fellows, and that a grade of Member or Associate, at £1 1*s*., should be created for professional and practical gardeners, who have rarely hitherto belonged to the Society. They calculate that the maintenance of Chiswick will cost £1500 a year, and that for the other purposes of the Society a further sum of not less than £1500 a year will be required. During 1887, 150 Fellows have paid £4 4*s*., and 623 Fellows £2 2*s*., making a total of £1938 6*s*., a sum altogether insufficient for the working and requirements of the Society.

9. In conclusion, the Council believe that the extinction of the Royal Horticultural Society would be regarded by all interested in horticulture as a national loss. The history of the Society, and the good work it has done and is doing, entitle it to the consideration and support of the horticultural world, to whom the Council make this appeal. They address it with equal confidence to amateurs and to the trade, in the belief that their interests are identical, and that for the protection and advancement of these interests the maintenance of the Royal Horticultural Society is essential. The Council have had difficult duties to perform. While they are willing to continue to discharge these duties, if desired, they believe that the best course would be for them to place their resignations in the hands of the Fellows, at the end of the year, so as to leave the Society entirely unfettered. But they consider it due both to the Fellows and to themselves to say that, unless they receive assurances of adequate support, in response to this appeal, the Society must necessarily come to an end.

10. The favour of an early answer is requested on the inclosed form. The Donations would be devoted to the cost of establishing the Society in its new home and to similar purposes.

On behalf of the Council,

TREVOR LAWRENCE, *President*.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Thurston Prize at Caius College, value £54, for the best original investigation by a member of the College in the past three years in physiology, pathology, or practical medicine, has been adjudged to Mr. C. S. Sherrington, M.A., M.B., Fellow of the College.

The Sedgwick Memorial Committee having declined to assent to the building of rooms for teaching purposes with the Sedgwick Fund, while waiting the building of a complete museum; and other proposals having been made, a syndicate has been appointed to plan out the entire disposal of the sites surrounding the new museums, so as to satisfy as many scientific requirements as possible.

Mr. E. C. Dowson has been appointed Demonstrator of Mechanism and Applied Mechanics in succession to Mr. Ames.

Next term the General Board of Studies will nominate a University Lecturer in Pure Mathematics, in consequence of the resignation of Mr. Macaulay. The stipend is £50 per annum, and the appointment will be for five years. A preference will be given to a lecturer who would take subjects not at present represented. Among these are theory of equations, theory of numbers, and projective geometry.

Scholarships in Natural Science will be competed for this month or next at Gonville and Caius, King's, Jesus, Christ's, St. John's, Trinity, Emmanuel, and Sidney Sussex Colleges. The tutors will give full information.

A Clothworkers' Exhibition for Natural Science, tenable at Oxford or Cambridge for three years, will be awarded next July by an examination under the Oxford and Cambridge Schools Examination Board. Particulars may be obtained from the Censor of Non-Collegiate Students, Cambridge.

Another general modification of examinerships in natural science is proposed, which we shall refer to when it has been discussed by the Senate.

SCIENTIFIC SERIALS.

American Journal of Science, November.—On the relative motion of the earth and luminiferous ether, by Albert A. Michelson and Edward W. Morley. A complete and satisfactory explanation of the aberration of light is given by Fresnel's undulatory theory, which assumes, first, that the ether is supposed to be at rest except in the interior of transparent media; secondly, that in this case it moves with a velocity less than that of the medium in the ratio $\frac{n^2 - 1}{n^2}$, where n is the index of refraction. The second hypothesis having been fully established by Fizeau's celebrated experiment, the first alone is dealt with in this paper. From the delicate researches here described, which have been carried out by the aid of the Bache Fund, it is inferred that, if there be any relative motion between the earth and the luminiferous ether, it must be small, quite small enough entirely to refute Fresnel's explanation of aberration. It is further shown that the theories of Stokes and Fresnel also fail, and that it would be hopeless to attempt to solve the question of the motion of the solar system by observations of optical phenomena at the surface of the earth.—On the existence of carbon in the sun: contributions from the physical laboratory of Harvard University, by John Trowbridge and C. C. Hutchins. Without discussing the well-known observations of Abney on the absorption-bands in the solar spectrum at high altitudes, or Siemens's hypothesis of the presence of carbon vapour in interplanetary space, the authors here study the remarkable character of the carbon spectrum formed by the voltaic arc in air between carbon terminals, drawing attention to the evidence presented by the juxtaposed solar spectrum of the existence of carbon in the sun. They conclude that at the point of the sun's atmosphere where the carbon is volatilized, the temperature of the sun approximates to that of the voltaic arc.—History of the changes in the Mount Loa craters, by James D. Dana. A recent visit of ten weeks to Hawaii has enabled the author to carry out the purpose expressed in his communication of last August. Here are presented only such facts as bear on the history of Kilauea since 1832, the general summary and conclusions being reserved for future numbers of the journal. The subject is illustrated with plates of Kilauea Crater, its lava floor, and the Halema'uma'u basin.—Is there a Huronian Group? (continued), by R. D. Irving. For the extensive region stretching from the north side of Lake Huron to the Mississippi it is here concluded that the succession of rocks in ascending order is from the great complex of crystalline schists, gneiss, and granite through the Huronian Group, mainly of detrital rocks, to the Keweenaw, of interleaved detrital and eruptive beds and the Potsdam, or Upper Cambrian Sandstone, with great structural breaks between the first and second, and second and third groups. The Huronian series itself, traceable throughout the Lake Superior province, is shown to be of clastic and sedimentary nature, of great volume, and structurally and chronologically separated from all other rock formations. The term *Agnotozoic*, originally suggested by Chamberlain, is proposed to cover the whole geological interval lying between the base of the Cambrian and the summit of the Archæan crystallines.—Description of an iron meteorite from St. Croix, County Wisconsin, by Davenport Fisher. This specimen, discovered in 1884 on a farm in Hammond Township, weighed 53 pounds, and yielded, on analysis: iron 89·78, nickel 7·655, cobalt 1·325, phosphorus ·512, silica ·562, with traces of carbon, copper, and tin.—The Rockwood meteorite, by J. Edward Whitfield. Picked up in March 1887 in a field in Cumberland County, Tennessee, this meteorite yielded, on analysis: iron 87·59, nickel 12·09, with traces of cobalt and copper.—Principal characters of American Jurassic Dinosaurs, by O. C. Marsh. This paper, forming Part 9 of the whole series, deals with the skull and dermal armour of Stego aurus, a nearly complete skeleton of which has lately been discovered. The specimen here described constitutes a new and very distinct species, for which the name of *S. duplex* is proposed.

The *Journal of Botany* for September commences with an important paper, by Mr. Geo. Massee, on the growth and origin of multicellular plants. He describes the structure and mode of formation of the gelatinous membrane exterior to the true cellulose-wall, and extending continuously over the whole plant, which is not uncommon in Algæ, and nearly universal in the Florideæ. It can be easily shown that the formation of the cellulose-wall never precedes that of this mucilaginous sheath, and its function is rather a supporting than a protecting one. The mucilaginous sheath is composed of protoplasm, or of a substance very nearly allied to protoplasm. It is usually homogeneous, even after the appearance of the cell-wall; but in *Pandorina* the innermost portion consists of parallel rods placed end to end on the cell-wall. The portion composed of rods stains readily with methyl-violet and other aniline dyes, while the homogeneous portion does not. The remainder of the space in this number, and in those for October and November, is chiefly occupied by monographs or descriptive papers on new exotic species, or to others mainly of interest to English botanists. It is a remarkable evidence that the old-fashioned species-botany is not altogether dead in this country, that no fewer than three species of flowering-plants have been added to the flora of these islands during the past year—all in Scotland.

We have received the numbers of the *Botanical Gazette*, published at Crawfordsville, Indiana, for August-November 1887. They furnish satisfactory evidence of the activity of botanical science in the Western States of North America. The articles and shorter paragraphs, where they are original, chiefly concern the flora of the district; but we may mention as of more general interest:—Vegetable parasites and evolution, by W. G. Farlow; development of the Umbellifer fruit, by J. M. Coulter and J. N. Rose; and plant odours, by A. J. Stace. The first of these papers is the Presidential Address given by Prof. Farlow before Section F of the American Association for the Advancement of Science. In it he treats specially of the phenomenon of "symbiosis" in lichens, and of "mycorrhiza." As to the former he doubts whether there is any sufficient evidence of the usual statement that the lichen-gonidia derive benefit from their association with the fungus.

The *Nuovo Giornale Botanico Italiano* for October contains two papers only—on the Muscineæ of the Island Giglio, off the coast of Tuscany, by Signor A. Bottini; and an enumeration of plants gathered in the Balearic Islands in 1885, by Signor P. Porta. To the latter is prefixed an account of the physical geography and natural productions of the islands, and a *résumé* of previous botanical explorations.

Revue d'Anthropologie, troisième série, tome ii., sixième fasc., 1887 (Paris).—On the stature of the ancient inhabitants of the Canary Islands, by Dr. R. Verneau. The writer draws attention to the discrepancies to be found in the narratives of older chroniclers and travellers as to the stature of the islanders at the time of the discovery of the Canarian Archipelago. Thus while the Portuguese explorers sent out by Alphonso IV. of Portugal in 1341 described the natives as of the same medium height as the Portuguese, some of the Spaniards who took part in the conquest of the islands 200 years later maintained that they had seen the skeleton of a man 24 feet long, and spoke of living men who were respectively 9 and 14 feet in height. Setting aside the obvious absurdity of such estimates, Dr. Verneau is of opinion that in regard to some of the islands, as Lancerotte and Fortavente, it may be fairly assumed that the Guancho natives of pre-Spanish times were a tall, well-developed race, since such is still the character of the people in isolated villages in those islands which have been the least exposed to contact with strangers and invaders, while he found that the bones recovered from ancient local burying-grounds of the latter island indicated a mean height of 1·84 metre for men, and 1·60 for women. Amalgamation with invading races of lower stature seems to have lowered the mean height of the people, more especially in the south-east of the archipelago. Dr. Verneau finds that in regard to cephalic characteristics, the ancient Guanchos closely resembled the Cro-Magnon type, and he believes he has found incontrovertible proof that Numidian, Semitic, and other North African races were among the earliest invaders of the Canaries.—On criminal anthropology, by M. Topinard. This is virtually a review of the Italian writer C. Lombroso's work on "Criminal Man," to whose theory of the physical and atavic character of criminality he is strongly opposed. Signor Lombroso believes that the criminal is born with irrepressible tendencies to crime, and that certain physical anomalies characterize the born malefactor. M. Topinard disputes not merely his mode of reasoning, but the facts which he adduces in support of his theories, and the accuracy, or applicability, of his numerous statistical tables. In conclusion, he not only shows the unscientific methods of inquiry followed by Lombroso, but he attacks the use of the denomination of "criminal anthropology," since the term implies the possibility of grouping together as fixed characteristics a number of phenomena which depend upon endless complications of psychical and social causes whose varied action on physical conditions does not admit of strict scientific determination.—Contributions to the sociology of the Australians, by M. Elisée Reclus. In this continuation of a series of papers which appeared in this journal last year, M. Reclus treats of spirits and sorcerers. The author uses his materials dexterously, and has compiled a highly interesting memoir on the superstitions and mythological fancies of these races, but as the greater part of the narrative has been derived from English sources it has little novelty or interest for English readers, who will find few facts in it with which they are not already familiar through the writings of Taplin, Woods, Grey, &c. —On lacustrine and lake-villages and pile-dwellings, by M. Pompeo Castelfranco. After a general consideration of the subject, more especially in regard to Italy, and the references bearing on it in the writings of Italians from the middle of the sixteenth century to the present times, the author gives the history of the discovery of lacustrine dwellings in Northern Italy which was made in 1862. Since that period almost all the lakes of that region have supplied rich yields of flints and pottery and bronzes, although none more so than Lake La Garda. The most interesting of these pile stations is that of La Lagozza, whose area of 2400 square metres was not wholly revealed till 1880. On examining the various piles which he had caused to be extracted from the superincumbent peat, Signor Castelfranco recognized that some were of birch (*Betula alba*) and others of fir and pine (*Pinus picea*, *P. silvestris*). Various flint and polished stone implements were found, but with the exception of a bronze fibula, which probably belongs to a later age than the original pile-dwellings, not a vestige of metal has been discovered at Lagozza. Potsherds and shreds of linen fabric have been found, but the most remarkable thing is the complete absence of bones, or any other animal remains; and while the abundance of seeds, grains, nuts, acorns, &c., plainly indicates the vegetable character of the diet of these lake-dwellers, the appearance of masses of husked wheat and barley proves that they practised agriculture, and understood how to thrash and winnow the grain. Considerable interest attaches to the discovery below the peat, in what is characterized as the archaic bed, of large masses of seeds, determined by Prof. Sordelli as identical with those of the cultivated so-called Indian poppy (*Papaver somniferum*). Heer has recorded in the Swiss pile-dwellings the presence of poppy seeds which he referred to *P. seligerum*, but whether the Italian and the Swiss remains belong to the same or different species of poppy, the use to which they were put by primæval men in the two countries remains an unsolved problem.—On the Polynesians, their origin, migrations, &c., by MM. Lesson and Martinet. The purpose of this work is to refute the three most generally accepted theories regarding the origin of these races, viz. whether they are survivals from an almost wholly submerged continent, or whether they are of American, or of Asiatic descent; and to maintain the novel hypothesis that they are descendants of Maoris of the Middle Island of New Zealand. These views the authors endeavour to support by showing close analogies of language between the two peoples, affinities between certain names of places and of deities used by both, and frequent identity in forms of belief, rites, and superstitions. They further point out that the natives of the Marquesas, who are regarded as of the purest Polynesian race, use the same word, Havaiki, as the Maoris to denote their original ancestral home. From these and numerous other linguistic affinities the writers conclude that the Maoris are the autochthonic ancestors of the Polynesians, and that the Maori language is the mother speech of all the Polynesian dialects.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 24.—"On the Motion of a Sphere in a Viscous Liquid." By A. B. Basset, M.A. Communicated by Lord Rayleigh, D.C.L., Sec.R.S.

The determination of the small oscillations and steady motion of a sphere which is immersed in a viscous liquid, and which is moving in a straight line, was first effected by Prof. Stokes in his well-known memoir "On the Effect of the Internal Friction of Fluids on the Motion of Pendulums" (Camb. Phil. Soc. Trans., vol. ix. part 2, p. 8); and in the appendix he also determines the steady motion of a sphere which is rotating about a fixed diameter. The same subject has also been subsequently considered by Helmholtz and other German writers; but, so far as I have been able to discover, very little appears to have been effected with respect to the solution of problems in which a solid body is set in motion in a viscous liquid in any given manner, and then left to itself.

In the present paper I have endeavoured to determine the motion of a sphere which is projected vertically upwards or downwards with given velocity, and allowed to ascend or descend under the action of gravity (or any constant force), and which is surrounded by a viscous liquid of unlimited extent, which is initially at rest excepting so far as it is disturbed by the initial motion of the sphere.

In solving this problem, mathematical difficulties have compelled me to neglect the squares and products of velocities, and quantities depending thereon, which involves the assumption that the velocity of the sphere is always small throughout the motion; and I have also assumed that no slipping takes place at the surface of the sphere. The problem is thus reduced to obtaining a suitable solution of the differential equation—

$$D\left(D - \frac{1}{\mu}\frac{d}{dt}\right)\psi,$$

where

$$D = \frac{d^2}{dr^2} + \frac{\sin\theta}{r}\frac{d}{d\theta}\left(\operatorname{cosec}\theta\frac{d}{d\theta}\right).$$

ψ is Stokes's current function, and μ is the kinematic coefficient of viscosity. The required solution is obtained in the form of a definite integral by a method similar to that employed by Fourier in solving analogous problems in the conduction of heat; the resistance experienced by the sphere is then calculated, and the equation of motion written down and integrated by successive approximation on the supposition that μ is a small quantity. The values of the acceleration and velocity of the sphere to a third approximation are found to be

$$v = f\epsilon^{-\lambda t} \cdot \mathrm{V}\lambda\epsilon^{-\lambda t} - fka\sqrt{\frac{\mu}{\pi}}\{(\tfrac{1}{2} - \lambda t)\phi(t) + \sqrt{t}\} + fk^2a^2\mu t\epsilon^{-\lambda t}(1 - \tfrac{1}{2}\lambda t),$$

$$\dot{v} = \frac{f}{\lambda}(1 - \epsilon^{-\lambda t}) + \mathrm{V}\epsilon^{-\lambda t} - fka\sqrt{\frac{\mu}{\pi}}\left\{\left(t + \frac{1}{2\lambda}\right)\phi'(t) - \frac{\sqrt{t}}{\lambda}\right\} + \tfrac{1}{2}fk^2a^2\mu t^2\epsilon^{-\lambda t},$$

where

$$f = \frac{(\sigma - \rho)g}{\sigma + \frac{1}{2}\rho}, \quad k = \frac{9\rho}{a^2(2\sigma + \rho)}, \quad \lambda = k\mu, \quad ;$$

$$\phi(t) = \int_0^t \epsilon^{-\lambda\tau}(t - \tau)^{-\frac{1}{2}}\,d\tau,$$

ρ being the density of the liquid, σ that of the sphere, and a its radius.

It thus appears that, after a very long time has elapsed, the acceleration will vanish and the motion will become steady. The terminal velocity of the sphere is $f\lambda^{-1}$, which is seen to agree with Prof. Stokes's result.

If the sphere were projected with velocity V, and compelled by means of frictionless constraint to move in a horizontal straight line, the values of the acceleration and velocity would be obtained from the preceding formulæ by expunging the terms $f\epsilon^{-\lambda t}$, $f\lambda^{-1}(1 - \epsilon^{-\lambda t})$, in the expressions for $\dot{v}$ and v respectively, and then chang'ng f into $-\mathrm{V}\lambda$.

The preceding results can only be regarded as a somewhat rough representation of the actual motion, for (1) the square of the velocity has been neglected; (2) no account has been taken of the possibility of hollow spaces being formed in the liquid; (3) if the velocity of the sphere became large, the amount of heat developed would be sufficient to vaporize the liquid in the immediate neighbourhood of the sphere, and the circumstances of the problem would be materially changed.

In the latter part of the paper I have considered the problem of a sphere, surrounded by a viscous liquid, which is set in rotation with given angular velocity, Ω, about a fixed diameter, and similar results are obtained. To a first approximation the angular velocity is equal to $\Omega\epsilon^{-\lambda t}$, where λ is a positive constant, which shows that the motion ultimately dies away.

December 8.—"The Sexual Reproduction of *Millepora plicata*." By Dr. Sydney J. Hickson.

Considerable attention has of recent years been paid by naturalists to the phenomena connected with the sexual reproduction of the Hydromedusæ. Stimulated by the brilliant results obtained by Allman and Weismann, several naturalists have investigated the structure of the various Medusæ and medusoid gonophores found in the group, the origin of the sexual cells, and the development of the embryo. These results have, on the whole, been so interesting and important that it was confidently anticipated that an investigation of the phenomena connected with the sexual reproduction of Milleporidæ would yield results of considerable interest. The systematic position of this family has always been a doubtful one, and naturalists were agreed that until the sexual reproduction was described, the position assigned to them could only be considered a temporary one.

It was my good fortune when in Talisse Island, North Celebes, to find on the reef just opposite my hut a fine specimen of *Millepora plicata* in vigorous growth. I visited it whenever the tide allowed, in the hopes of seeing the polyps fully expanded, and of being able to search them for any form of gonophore they might possess. In this, however, I was disappointed. Notwithstanding all my precautions, I never succeeded in finding the polyps more than partially expanded, and I could find no gonophores.

Having collected some specimens and dissolved the calcareous skeleton in strong acid, I discovered in the canals of the cœnosarc both the ova and the spermospores; but the unforeseen difficulties to be met with in working in a hot little bamboo hut in a tropical island prevented me from making any satisfactory series of sections, and I was reluctantly obliged to leave the further investigation of the subject until I returned to a laboratory in Europe.

Since my return home I have made a large number of preparations, and the results I have obtained may be summed up as follows:—

Both the male and female sexual cells arise in the ectoderm of the cœnosarcal canal system. At an early stage they perforate the mesoglœa and take up a position in the endoderm.

The ova at an early stage become stalked. The stalk of the ovum, which is simply a modified pseudopodium, serves to keep the ovum attached to the mesoglœa. The stalk is sometimes completely withdrawn, and the ovum by amœboid movements migrates along the lumen of the canals to a more favourable locality.

Maturation and impregnation occur while the ovum is still in the canals.

The mature ovum is very small (1/100 mm. in diameter), and is alecithal; nevertheless, it does not segment.

The germinal vesicle of the fertilized ovum splits up into a number of fragments, which, after a curious series of movements in the ovum, are eventually scattered over its substance.

By the time these fragments are thus scattered over the ovum, they have reached a considerable size, and, from faint markings in the substance of the ovum, no doubt can be retained that they are in reality the true nuclei of a morula stage in the development of the embryo. The embryo next assumes the form of a solid blastosphere, and its subsequent history is lost.

It will be a very interesting point to determine the precise mode of discharge of the embryo. I am very strongly of opinion that the embryo is discharged by the mouth of the gastrozooid, but I was, of course, unable to observe this in the living state. Whether this is correct or not, the fact remains that I have been unable to find in any of my preparations any trace of a free or fixed gonophore, containing either embryos or ova.

In the development of the spermatoza, a similar phenomenon is found to that in the development of the embryo. The spermospore does not divide into a sperm-morula, the nucleus alone fragments, and the subsequent formation of spermoblasts does not occur until a very late stage. When the spermoblasts are mature they are found in simple *sporosacs* on the dactylozooids. The sporosacs exhibit no traces of any medusoid structure.

These researches tend to prove that the Milleporidæ belong to a separate stock of the Hydrozoa from the Hydromedusæ, a stock which probably never possessed free-swimming medusiform gonophores.

There seems to be no true relationship between Millepora and Hydractinia. The absence of segmentation in the developing embryo may probably be accounted for by the amœboid movement which it exhibits after development has commenced. The evidence before us does not support the view that the ovum of Millepora formerly contained much yolk, and has subsequently lost it.

Physical Society, November 26.—Dr. Balfour Stewart, President, in the chair.—Mr. Asutosh Makhopadhyay was elected a member of the Society.—The following communications were read:—On the analogies of influence-machines and dynamos, by Prof. S. P. Thompson. The author pointed out that in nearly all influence-machines there are two stationary parts ("inductors") electrified oppositely, which are analogous to the field-magnet of dynamos, and a revolving part carrying "*sectors*" which correspond to the "*sections*" of an armature. To prevent ambiguity Prof. Thompson proposes to call the inductors "*field plates*," and the revolving parts as a whole an "*armature*." In the Wimshurst machine both field plates and armature rotate, and each acts as field plates and armature alternately. In the two field plate influence-machines there are four and sometimes six brushes. Two of these act as potential equalizers, two as field plate exciters, and the remaining two (if any) are generally placed in the "discharge" or external circuit. The Holtz machine having only four brushes, two serve the double purpose of potential equalizers and discharge circuit, and this machine excites itself best when the discharging rods are in contact. In this respect it resembles a series dynamo which only excites itself when the external circuit is closed, but on opening the circuit (say by inserting an arc lamp) produces remarkable effects. So in the Holtz machine on separating the discharging knobs a shower of sparks results. The Toepler machine (made by Voss) having six brushes resembles a shunt dynamo, and excites itself best on open external circuit. Analogies were traced between Thomson's replenisher and the Griscom motor. Armatures of influence-machines, as in dynamos, can be divided into ring, drum, disk, and pole armatures, and examples of each kind were mentioned. The "Clark Gas Lighter" is a good example of a drum armature, and a diagram showing the internal arrangements was exhibited. An example of an analogue to the compound dynamo was mentioned as existing at Cambridge, in the form of a Holtz machine believed to have been modified by Clerk Maxwell. Another analogue with dynamos is found in the displacement of the electric field when the armature is rotated, just as the magnetic field of a dynamo is shifted round in the direction of rotation. Further analogies were traced between "critical velocity" of dynamos (which depends on the resistances in the circuit) below which they do not excite themselves, and a similar critical velocity of influence-machines; *e.g.* in a Wimshurst or Voss machine, the potential equalizing circuit should have a low resistance if they are to excite themselves readily. Self-exciting dynamos excite better when the iron is bad and retains the magnetism, and influence-machines excite better when the field plates are made of paper or such substance as can well retain a residual charge. Finally an apparatus analogous to Thomson's "water-dropping accumulator" was exhibited, in which an electric current was generated by mercury falling down a tube between the poles of a magnet.—On the effect produced on the thermo-electric properties of iron when under stress or strain by raising the temperature to a bright red heat, by Mr. Herbert Tomlinson. In June last the author described some remarkable "effects of change of temperature on twisting and untwisting wires which have suffered permanent torsion," of which the present paper is a continuation. It is found that at or about the critical temperature (a bright red heat) mentioned in the previous paper, a sudden E.M.F. is generated at the junction of two iron wires, one of which is under stress or has suffered permanent strain, and the other in an unstrained state. By suddenly bringing a red-hot iron wire in contact with cold iron, an E.M.F. of about 1/20 volt is produced. If copper be used the E.M.F. is about ¼ volt. The author also showed that if one part of an annealed iron wire is heated to a bright red by a bunsen flame, an E.M.F. is generated if the position of the flame is slightly altered, the direction of the E.M.F. depending on the direction of the displacement. Prof. Ayrton believed the high E.M.F. exhibited by hot and cold copper was really due to oxide of copper; and Prof. S. P. Thompson said that different effects could be produced by using the oxidizing or reducing parts of the flame in heating the wire.—On the method of discriminating real from accidental coincidences between the lines of different spectra, with some applications, by Mr. E. T. J. Love.

December 10.—Prof. W. E. Ayrton, Vice-President, in the chair.—Mr. E. A. C. Wilson, and Mr. W. E. Sumpner were elected members of the Society.—Mr. H. G. Madan described the optical properties of phenyl-thio-carbimide. This body, derived from aniline, is a colourless liquid, density 1·35° C., and of high boiling-point 222° C. The refractive indices for the A and G lines are 1·639 and 1·707 respectively. It is thus seen to be a highly refractive liquid, and to have about the same dispersive power as carbon-bisulphide, whilst its use in prisms is unattended by many of the risks and inconveniences experienced with carbon-bisulphide. The dispersion at the blue end of the spectrum is very marked. Being less mobile than carbon-bisulphide, it is less affected by convection currents. The "refractive equivalent" calculated from its chemical constitution differs considerably from the observed value, and this difference the author believes due to the presence of the phenyl radicle and sulphur atom. A polarizing prism made on Jamin's plan, but using phenyl-thio-carbimide as the liquid, gives a fairly wide angular field (about 25°). Mr. Hilger stated that there was no great need of liquid prisms now, for very dense flint glass could be obtained with mean index of about 1·8. Dr. Perkin has recently supplied him with Canada balsam perfectly colourless, and which does not tarnish the polished faces of spar; hence one of the greatest objections to the use of Canada balsam in spar polarizing prisms has been removed. Dr. Gladstone pointed out that the constants for the phenyl radicle and for sulphur atoms had been determined, and thought the calculated "refractive equivalent" obtained by including these would be much nearer the observed value than the one given by Mr. Madan.—On the recalescence of iron, by Mr. H. Tomlinson. If an iron bar which has suffered permanent strain be heated to a white heat and allowed to cool, the brightness at first diminishes and then reglows (recalesces) for a short interval. Under favourable circumstances as many as seven reglows have been observed during one cooling. Generally two decided ones are observed, one between 500° and 1000° C., and the other below 500° C. The effects the author believes due to "retentiveness" of the material, somewhat similar to the causes of residual magnetism and residual charge of a Leyden jar. A table of experimental results, giving the torsional elasticity and internal friction at different temperatures, for iron wire, showed sudden increases in internal friction at temperatures of about 550° and 1000° C. The table also shows that the torsional elasticity slowly decreases as the temperature increases, whereas the internal friction increases enormously. This explains why bells cease to emit musical notes when heated. The author finds that the recalescence at the higher temperature is not appreciably accelerated by mechanical vibration such as hammering, &c., but those occurring at lower temperatures are greatly influenced by such treatment and by magnetic disturbances. Prof. Forbes believed the explanation of recalescence given by himself about 1873 is sufficient to account for the effects observed. This explanation postulates a sudden increase in thermal conductivity about the temperature at which recalescence occurs, which permits the heat from the inside to reach the outside more readily, and thus raise the temperature of the surface. The subsequent reglows observed by Mr. Tomlinson he believes due to convection currents of air. Prof. Rücker suggested that calorimetric experiments might determine which view was the true one, and Prof. Ayrton thought the question might be decided by having two half-round bars nearly in contact at their flat sides, heated up and allowed to cool, and noting whether any sudden change in the bending of each bar (due to unequal temperature at the inner side and outer sides) took place about the critical temperature.—On the rotation of a copper sphere and of copper wire helices when freely suspended in a magnetic field, by Dr. R. C. Shettle. The author exhibited the apparatus with which his experiments "on the supposed new force" were made, the results of which were published in the *Electrician*, vol. xix. Dr. Hofford has recently made similar experiments, using brass disks, and his results seem to point to "diamagnetic non-uniformity" of the disks as the cause of the phenomena he observed.

Linnean Society, December 1.—W. Carruthers, F.R.S., President, in the chair.—There was exhibited for Mr. O. Fraser, of Calcutta, a specimen supposed to be a weather-worn seed of a palm, picked up on the Madras coast. Opinions given at the meeting referred it to the consolidated roe of a fish, doubts being thrown on its vegetable nature.—Sir John Lubbock read a paper, an account of which we have already printed, on the habits of ants, bees, and wasps.—A paper was read by Mr. C. B. Clarke, on a new species of *Panicum* with remarks on the terminology of the Gramineæ.

Geological Society, November 23.—Prof. J. W. Judd, F.R.S., President, in the chair.—The following communications were read:—Note on a New Wealden Iguanodont, and other Dinosaurs, by R. Lydekker.—On the Cae Gwyn Cave, by Prof. T. McKenny Hughes, who contended that the drift outside the cave was a marine deposit *remanié* from older beds of glacial age, but was itself post-glacial and of approximately the same date as the St. Asaph drift. He maintained that the marine drift was deposited before the occupation of the cave by the animals whose remains have been found in it; that at the time of the occupation of the cave the upper opening now seen did not exist, but the animals got in by the other entrance; that against the wall of the cave where it approached most nearly to the face of the cliff, the drift lay thick as we now see it; that by swallow-hole action the cave was first partially filled, and then the thinnest portion of its wall gave way gradually, burying the bone-earth below it, and letting down some of the drift above it, so that some of it now looks as if it might have been laid down by the sea upon pre-existing cave-deposits. The reading of this paper was followed by a discussion, in the course of which Dr. Hicks argued strongly against the author's conclusions.

Mathematical Society, December 8.—Sir J. Cockle, F.R.S., President, in the chair.—Messrs. W. B. Allcock, J. W. Mulcaster, and I. Beyens, Cadiz, were elected members.—The following communications were made:—The algebra of linear partial differential operators, by Capt. Macmahon, R.A.—On a method in the analysis of ternary forms, by J. J. Walker, F.R.S.—Confocal paraboloids, by A. G. Greenhill.—Note on the solution of Green's problem in the case of the sphere, by A. R. Johnson.—Uni-Brocardal triangles and their inscribed triangles, by R. Tucker.

Chemical Society, November 17.—Mr. William Crookes, F.R.S., President, in the chair.—The following papers were read:—Zinc-copper and tin-copper alloys, by A. P. Laurie.—The halogen substituted derivatives of benzalmalonic acid, by C. M. Stuart.—Note on a modification of Traube's capillarimeter, by H. S. Elworthy.—The formation of hyponitrites: a reply, by Edward Divers, F.R.S.—Reply to the foregoing note, by W. R. Dunstan.

Royal Microscopical Society, November 9.—Rev. Dr. Dallinger, F.R.S., President, in the chair.—Mr. E. M. Nelson called attention to a suggestion for supplying a want which many had felt of a really good achromatic single lens or loupe for microscopic purposes, of ½-inch focus. He had found that the want was met by a Seibert No. III. objective, having its adjusting screw removed.—Mr. Nelson further said that, having lately obtained an improvement in optical power, he had been able to do a little more in the matter of resolution, and one of the first objects he had tried was striped muscular fibre. In the early days of microscopy a muscular fibril used to be represented as a series of light and dark bands, the dark band being about twice the diameter of the white band. In 1854 Messrs. Huxley and Busk discovered a dark stripe in the middle of the bright band, and subsequently Hensen placed a similar darker stripe in the middle of the dark band. With his latest optical appliances he had been able to see a faint white stripe on either side of Hensen's dark stripe. He estimated the diameter of the stripes to be all equal. Although he saw evidences of longitudinal breaking up, he could see nothing of Schäfer's "beads."—The third point noticed by Mr. Nelson was Mr. Francis' method of improving definition of such an object as *Amphipleura pellucida* by using the analyzer. He had tested the plan, and found that it did intensify the resolution in a very marked degree.—Mr. Nelson also exhibited and described a new portable microscope made by Messrs. Powell and Lealand from his drawings, and the new photomicrographic camera designed by Mr. C. L. Curties and himself.—Mr. Nelson further exhibited a new eye-piece which he had devised. Having for some time past made a great many experiments with achromatic eye-pieces of double, triple, and other forms, he had not succeeded in producing any combination whose defining power surpassed that of the Huyghenian. The best results were obtained by achromatizing the eye-lens—*i.e.* by making it of a biconvex and a plano-concave, with its convex side towards the eye. The aperture of the diaphragm was reduced until the diameter of the field was equal to that of the Abbe compensating eye-piece. This eye-piece, with the achromatized eye-lens, gives the sharpest images he had seen. It works perfectly well with the 24 mm. and 3 mm. Zeiss apochromatic objectives.—Mr. C. R. Beaumont then exhibited and described his new form of slide for observing living organisms, and read a paper on the metamorphoses of *Amœbæ* and *Actinophrys*, in which he claimed to have observed the development of an *Amœba* into an *Actinophrys*, and then into a *Difflugia* and an *Arcella*.—Mr. H. B. Brady's paper, a synopsis of the British recent Foraminifera, was communicated to the meeting by Prof. Bell.

PARIS.

Academy of Sciences, December 5.—M. Janssen in the chair.—Letter to M. Bertrand in connection with his previous note on a theorem relative to errors of observation, by M. Faye. It is pointed out that, if we consider all the combinations of errors, the relations of the sums corresponding to the greatest and smallest of these errors are comprised between the extremes 1 and 3·915. Both of these are infinitely improbable in themselves, while their mean, 2·457, differs little from the number 2·414 given by M. Bertrand.—Reply to M. Mascart on the subject of the deviation of the winds on the synoptical charts, by M. Faye. The author insists that he has nothing to modify in what he has written during the last thirteen years on the descending spiral motion of cyclones. The synoptical charts, which have been multiplied during the last few years, when properly interpreted, are shown to be in no way opposed, but, on the contrary, lend additional support, to his theory.—On the synchronism of accurate time-pieces, and on the distribution of time, by M. A. Cornu. A description is given of the construction and properties of a very simple electric appliance, which is applicable to all kinds of oscillating apparatus, and which realizes the theoretic conditions under which the problem of synchronism has been solved. This system has already been at work for several years in the École Polytechnique, and has been applied with complete success in the Paris Observatory for the synchronizing of the two clocks in the Department of Longitudes. The problem of the distribution of time with a precision approaching the hundredth part of a second is thus satisfactorily solved. The apparatus is extremely simple and easily regulated, and may be worked with feeble currents.—Remarks in connection with a work entitled "Les Ancêtres de nos Animaux dans les Temps géologiques," presented to the Academy by M. Albert Gaudry. In this work the fossil mammals are tabulated in the ascending order according as they appeared on the earth from the Lower Miocene through all the intervening geological epochs up to the present time. A concluding chapter is devoted to an historic survey of palæontology in the Paris Museum.—On magnetizing by influence, by M. P. Duhem. The questions here discussed are: the quantity of heat liberated in the transformation of a system including magnets, and the heat liberated in the displacement of a magnetic mass.—New nebulæ discovered at the Paris Observatory, by M. G. Bigourdan. The right ascension and polar distance, with miscellaneous remarks, are given of the nebulæ consecutively numbered 51 to 102. Observations are appended on thirteen other nebulæ previously discovered.—On the division of an arc of a circle, by M. A. Pellet. The approximate division of an arc in a given relation is determined by means of rule and compass.—On the expansion of compressed fluids, and especially on that of water, by M. E. H. Amagat. The compressibility and expansion of water, ordinary ether, methylic, ethylic, propylic, and allylic alcohols, acetone, chloride, bromide and iodide of ethyl, sulphide of carbon, and chloride of phosphorus, have been studied between zero and 50°, and from the normal pressure up to 3000 atmospheres. For all except water, which behaves exceptionally, the coefficient of expansion diminishes with increased pressure, the decrease being still very perceptible at the highest point. The coefficient of water increases very rapidly at first, but afterwards diminishes gradually, disappearing altogether towards 2500 atmospheres.—On a new method of quantitative analysis for carbonic acid in solution, by M. Léo Vignon. By the process here described the presence may be detected of 1 cubic centimetre of carbonic acid in 1 litre of water.—Influence of natural or superinduced sleep on the activity of the respiratory combustions, by M. L. de Saint-Martin. It is shown that, apart from the state of fasting, natural sleep lowers by about one-fifth the quantity of carbonic acid exhaled, and by only one-tenth the quantity of oxygen absorbed; also, that in sleep brought about by morphine the proportion exhaled falls to one-half, and in sleep caused by chloral or chloroform to one-third, of the quantity exhaled during the same lapse of time in the normal state.—On the absence of microbes in the human breath, by MM. J. Straus and W. Dubreuilh. These researches fully confirm the conclusions already arrived at by Lister and Tyndall regarding the freedom of exhaled breath from the presence of pulmonary or other microbes.

BERLIN.

Physical Society, Nov. 11.—Prof. von Helmholtz, President, in the chair.—Dr. Weinstein spoke on the determination of the electrical resistance of tubes of mercury. He employs two methods for measuring the length of the tubes, one in which the tube is completely filled with mercury, the other in which it is only partially filled, and in which the convexity of the ends of the column of mercury is taken into account. The first method is the more exact, but is less simple; the difference between the methods is small. The measurement of the diameter of the tube is of great importance, and is made under the assumption that the tube is either a cylinder or a cone; the latter is the more correct assumption when the tube is long, and necessitates calibrational corrections, for which Dr. Weinstein deduced the formulæ. Taking into account the want of accuracy in the constants involved in the above, he considers it far better to determine the volume from the heights of the capillary rise of fluids in the tube.—Prof. Pictet, who was present as a guest, gave a detailed account of the experiments he has made with his ice-machines, which have led to results which do not agree with Carnot's theories as far as the second law of thermodynamics is concerned. He described the action of a perfect ice-machine, consisting of a refrigerator, pump, and condenser. In the refrigerator a quantity of heat is taken from the salt-water bath surrounding it, which causes some of the fluid to evaporate; this vapour, at the temperature of the surroundings, passes unchanged into the pump, where it is compressed, and forced, at high pressure, into the condenser, where it at once becomes a liquid, and gives up all its heat to the surroundings. This condensed fluid then flows back to the refrigerator. In a real machine of finitely small dimensions, the temperature in the refrigerator falls, the vapour meets with resistance in passing over into the pump, and in passing from the latter into the condenser, and there is a fall of temperature as the heat passes out into the surroundings from the liquid formed in the condenser. The speaker determined by careful experiments the tension of the vapour with which he worked between − 20° C. and + 30° C., and then he measured the temperatures in the several parts of the working machine by means of manometers which registered the pressures in the several parts, and from this he arrived at the result stated above. The measurements were made when the pump was working both rapidly and slowly, and also when it was stopped. Prof. von Helmholtz drew attention to two sources of error which cannot be avoided in Prof. Pictet's experiments, and which might account for the results obtained being in opposition to Carnot's law. In the first place, the vapour might contain air; this would influence the pressure existing in the machine, without itself undergoing any condensation, and hence it is impossible to determine the temperature of the vapour accurately from measurements of its pressure. The second source of error is, however, still more important. In Pictet's ice-machines, the liquid used is a mixture of liquefied carbonic acid gas and sulphur dioxide. From such a mixture as this the more volatile carbonic acid gas must pass over into the refrigerator in larger quantities than the less volatile sulphur dioxide. Hence both the vapour and the liquid resulting from its condensation have a composition markedly different from that of the original liquid. Now the calculations are made on the assumption that the liquid undergoes no change of composition, hence the temperatures determined from the pressures cannot correspond to those really existing in the several parts of the apparatus. Prof. Helmholtz hence considers that the temperatures in the refrigerator and condenser should be measured with thermometers, in which case only it would be possible to test the truth of Carnot's laws on the basis of the heat-values obtained in the experiments.

November 25.—Prof. von Helmholtz, President, in the chair.—Dr. Stapff spoke on his measurements of the temperature of the earth in South Africa. From his observations on the temperature in the St. Gothard Tunnel, and a comparison of these with the temperatures observed at the earth's surface, he had deduced an empirical formula for the difference of temperature between the air and the earth: according to this formula, the difference is greater the lower the temperature of the air, and disappears when the temperature of the air rises to 11° C. It hence became a matter of interest to determine whether the difference is negative when the temperature of the air is very high. Dr. Stapff had made use of a sojourn in South Africa, near Whale Bay, while engaged in geological studies, for the purpose of carrying out observations on the temperature of the earth. The district in which he worked lies in the Tropic of Capricorn, about in the same meridian as Berlin, and the soil is sandy with a current of water running beneath it towards the sea. The observations were made in borings with English mining-thermometers, which were allowed to remain about twelve hours at the depth where the temperature was to be determined, thus insuring that they had taken up the temperature of the surroundings. The measurement of the temperature at the earth's surface presented very great difficulties, and was only rendered possible by covering the bulb of the thermometer with a layer of sand 5 cm. thick. The greatest depth at which the temperature of the earth was measured was 17 metres. From the determinations thus made it appeared that the temperature diminished down to that depth, a result undoubtedly dependent upon the fact that the measurements were made during the hottest time of the year. The speaker found that the depth down to which the temperature varies with that of the air is about 13·6 metres, the temperature at this depth being about 25° C. The changes in temperature of the earth were very considerable, greater than those of the air, amounting in the sand to some 30° to 40° C. His measurements, however, did not show any negative value for the difference in temperature of the air and earth.—Dr. Sieg gave an account of his experiments for the determination of the capillary constants for large drops and bubbles. On account of the marked divergence in the results obtained by Quincke as compared with the older measurements, the speaker was led to subject Quincke's method to a detailed examination. He found that the determination of the height of the drop is exact, but that the measurement of its width by means of the micrometer is too uncertain. Instead of this method, he therefore employed the reflection of a flame from the side of the drop in order to determine the convexity of the same, and using Poisson's method of calculating the results instead of that of Quincke, he obtained as the value of the capillary constant, not 54 as given by Quincke, but 44·5, thus agreeing with the older determinations. The mercury was purified and examined by Quincke's method. In addition Dr. Sieg has determined the capillary constants for water, alcohol, oils, and a series of salt-solutions of varying concentrations. One result may be mentioned as shown by these experiments, that the capillary constant of mercury sinks to forty-two when the mercury has stood for some time, and that the same fall is observed if the mercury is put to earth; the constant is also altered if the drop is electrified or is impure. With salt-solutions the constants were dependent upon both composition and concentration. Water was also found to be very sensitive to the presence of any impurities, and while the solution of salts in water was not found to alter its capillary constants, the solution of gases produced a very appreciable alteration

Physiological Society, November 18.—Prof. du Bois Reymond, President, in the chair.—After the statutory election of the Council, Dr. Benda demonstrated a malformation as occurring in a three-months' embryo, in which two strongly marked prominences on the lower portion of the forehead gave to its countenance a curiously contemplative appearance.—Prof. Kossel next spoke on adenin. The most recent researches on the importance of the nucleus to the life of the cell, especially the knowledge that when unicellular organisms are artificially cut into pieces only those parts exhibit a complete regeneration which contain a portion of the nucleus, and the importance of the nucleus in impregnation have given an increased importance to the chemistry of the nucleus. Among the chemical substances which compose the nucleus, adenin, which has recently been discovered by the speaker, appears to possess a special importance, since, on account of its composition, $C_5H_5N_5$, it belongs to the cyanic group of bodies. This substance was obtained from tea-leaves in large quantities, and from it a series of compounds were obtained, which were exhibited as extremely fine preparations; namely, the salts with hydrochloric, sulphuric, and nitric acids, as also some compounds with platinum. Adenin was found to be extremely resistant to feebly oxidizing agents, but on the other hand to be easily acted upon by reducing agents. The substances which are produced by these means were not very well characterized from a chemical point of view. The speaker however thinks that, owing to the ease with which it can be reduced, adenin plays an extremely important part in the physiological action of the nucleus. When adenin is reduced in presence of oxygen, a brownish-black substance is obtained, which appears to be identical with the azocuminic acid which is produced when hydrocyanic acid is exposed to the air for a long time. In conclusion, Prof. Kossel pointed out that adenin makes its appearance in large quantities under certain pathological conditions, and that he has succeeded in detecting it in the urine of persons suffering from leuchæmia. —Dr. Rawitz gave an account of his investigations on mucous cells in Invertebrates. He has found in the mantle of mussels goblet-cells, of which some are small with a large central nucleus and granular protoplasm; others are large with a small central nucleus, the rest of the cell-contents being uniform in appearance; and others again are large, with a small nucleus situated at the base of the cell, the protoplasm having oily granules scattered throughout itself. This last kind of cell allows the oily granules and mucous contents to pass out at the apex of the cell into the surrounding water. A careful investigation has shown that the above three different kinds of cells are merely different stages in the secretory activity of the mucous cells, and that during this activity the cell-contents not only undergo a change of minute structure, but also of chemical composition, the latter being evidenced by the changed reactions which they give with staining agents. During secretion the cell itself is not broken down, but only a portion of its protoplasm is excreted, in the form of oily drops and mucous threads, the nucleus remaining intact. Dr. Rawitz considers that special importance must be assigned to the nucleus in connection with the nutrition of the cell, as during the secretory activity of the cell it undergoes changes not only in its shape, but in its behaviour towards taining reagents.

STOCKHOLM.

Royal Academy of Sciences, November 9.—Plantæ vasculares Yenessenses inter Krasnojarsk urbem et ostium Yenisei fluminis tractenus lectæ, by Dr. N. J. Scheutz.—On additive characters of diluted solutions of salts, by Dr. S. Arrhenius.—On the theory of the unipolar induction, by Dr. A. Rosén.—Some formulæ of electrodynamics, by the same.—The phænogamous plants of Bergjum, enumerated in the sequence of their inflorescence, by the Rev. B. Högrell.—On hyalotekit from Långbau, by G. Lindström, Assist. Min. Cab. State Mas.—On the scientific results of the expedition of the *Vega*, by Baron Nordenskiöld.—Contributions to the theory of the undulatory movement in a gaseous medium, by Prof. A. V. Bäcklund.—Contributions to the knowledge of the exterior morphology of the Acridioideæ, especially with respect to the specimens found in Scandinavia, by Dr. B. Haij.—Generalization of the functions of Bernouilli, by Dr. A. F. Berger.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Les Ancêtres de Nos Animaux: A. Gaudry (Baillière et Fils).—British Journal Photographic Almanac, 1888 (Greenwood).—The Elements of Chemistry: Ira Remsen (Macmillan).—British Discomycetes: W. Phillips (Kegan Paul).—Vaccination Vindicated: J. C. McVail (Cassell).—Flower Land, an Easy Introduction to Botany: Rev. R. Fisher (Heywood).—A Course of Quantitative Analysis: W. N. Hartley (Macmillan).—Teneriffe and its Six Satellites, 2 vols.: O. M. Stone (Marcus Ward).—Annual Report on the Working of the Registration and Inspection of Mines and Mining Machinery Act during the year 1886 (Melbourne).—Digging, Squatting, and Pioneering Life: Mrs. D. D. Daly (Low).—China; its Social, Political, and Religious Life: from the French of G. Eug. Simon (Low).—Through the West Indies: Mrs. G. Layard (Low).—A Text-book of Paper Making. Cross and Bevan (Spon).—Proceedings of the Linnean Society of New South Wales, vol. ii. part 2.—Quarterly Journal of the Geological Society, vol. xliii. pt. 4, No. 172 (Longmans).—Annals of Botany, vol. i. No. 11 (Clarendon Press).

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