THURSDAY, NOVEMBER 9, 1905.

STRENGTH OF MATERIALS.

Mechanics of Materials. By Mansfield Merriman. Tenth edition, re-written and enlarged. Pp. xi+507. (New York: Wiley and Sons; London: Chapman and Hall, Ltd., 1905.) Price 21*s.* net.

THE great development of engineering schools in the United States has led to the production of a considerable number of technical text-books primarily intended for students. It may at once be stated that, taken as a whole, these books are increasingly scholarly and sound; but they are largely compiled from similar European text-books, and often disclose a want of any serious independent investigation of the subject dealt with.

The present book is in some respects an excellent treatise, and as it has reached a tenth edition it must have been found useful. It deals with the elastic and, to a limited extent, with the plastic properties of materials of construction and the application of the laws of strength of materials to the simpler machine parts and structures. The treatment is essentially theoretical, and the book must be judged by the way in which it presents theory to students. The first point which strikes a reader is the great looseness of terminology. In the first two or three pages tension, tensile force, pull and axial force are all used as equivalent, which may not be wrong, but is confusing. Also a compression is a shortening, a sliding (in shear) is a detrusion, and the word strain does not appear in the volume, which is unusual. Young's modulus is termed throughout *the* modulus of elasticity; the condition that lateral contraction is unhindered is not explained. The coefficient of rigidity is referred to (p. 38) as the "modulus of elasticity for shear," but the relation of E and G is not discussed until p. 465. The volumetric modulus is described on p. 467, but these are the only elastic coefficients mentioned.

The author has an aggravating way of describing a thing at first very crudely and inaccurately, but without any reservations, giving a revised statement much later on and a further revision later still, and this in the case of quite simple matters. Take, for instance, the treatment of shear. On p. 38 the author takes as the typical example of shear a force P acting at the end of a T-shaped short beam. This is, of course, a case of shear and bending, and the rectangular elevation of the beam would not become a rhombus as the author states. The shear on horizontal planes is not referred to, and the unit stress is given as P/a without any caution that it is not uniformly distributed; and it is from this complex case that he deduces, as if it were a simple shear, the coefficient of rigidity. All this is inaccurate and confusing to students. It is not until p. 264 that it is explained that shear on one pair of planes is accompanied by an equal shear on a pair of planes at right angles, and on p. 465 the author goes back to representing shear as a single couple on a pair of parallel planes. In both Figs. 15 and 181 the deformation is so drawn that a student would infer a change of volume in shear, and nowhere, so far as can be found, is the constancy of volume in shear referred to. On p. 14 the end of a beam strained by a couple is used as an illustration of shear. The unit shearing stress is given as P/a, which is only the mean stress, and it is added that the bar will shear off when P/a is "equal to the ultimate shearing strength of the material," which is not the case. Can a more misleading statement for a student be imagined than (p. 14) "tensile and compressive stresses usually act parallel to the axis of a bar, but shearing stresses at right angles to it"? or this statement, p. 363, "it is best to consider shear as a signless quantity"? All these matters are elementary, and they are not so much wrong as slovenly and confusing—and similar faults occur constantly.

When the elastic limit is exceeded, the strains increase faster than the stresses. "Therefore the elastic properties of a bar are injured when it is stressed beyond the elastic limit." It would not be exact, but it would be more accurate, to say that the elastic properties are improved by straining beyond the elastic limit. "Accordingly it is a fundamental rule that the unit stresses should not exceed the elastic limit." The large deformation in ordinary materials beyond the elastic limit is the primary reason for limiting stresses to the elastic strength. It would be undesirable for a bridge to deflect several feet. The elastic limit is always assumed by the author to be a definitely fixed stress, and its variation under variation of loading is never referred to.

"The stresses are usually computed for dead and live loads separately regarding each as a static load. The live load, however, really produces greater stresses than the computed ones."

The live load undoubtedly may cause rupture when an equal dead load would not, but the author's statement is extremely doubtful, and the question is one of the most fundamental in applying the rules of strength of materials, and should on no account be slurred over in a text-book. The account of Wöhler's fatigue experiments (p. 352) is very brief and imperfect. American bridge builders have never fully accepted Wöhler's results, and have been disposed to explain the smaller working stress in members subject to great variation of stress as justified by the effect of impact. Practically it does not matter much whether the reduction of the working stress is termed an "allowance for impact" or "an allowance for fatigue," but it is a fundamental point, and the author's treatment of it on p. 358 will not much help a student. The author's theory that a live load produces more stress "because it is applied quickly," and the statement that the dynamic stress T can be expressed in terms of the static stress S by the relation $T=\phi(t)S$, where $\phi(t)$ is a function of the time of application, will require much more investigation before it is accepted. The effect of variation of stress in inducing fatigue, the effect of impact or of loads which have kinetic energy before deformation begins, and of loads which are unbalanced so that they acquire kinetic energy during deformation, require

careful discrimination. The effects should not be lumped together as due to suddenness.

A good deal of space is devoted to what the author terms "true stresses." He takes the well known strain equations $E\epsilon_1 = S_1 - \lambda S_2 - \lambda S_3$, &c., and, because $E\epsilon_1$ is of the same form as stress in terms of extension, he calls $E\epsilon_1$ the "true stress" due to the "apparent stresses" S_1, S_2, S_3. This is to use the term "stress" in a totally new sense. The real stresses which balance the external forces are only "apparent stresses"; an imaginary stress which is greater is the "true stress." It is impossible here to follow the author to the curious results he arrives at, which involve a revision of all the ordinary formulas of strength. It is not difficult to see from what point he has drifted. He throughout implicitly assumes that the condition of security in a structure depends on the maximum stress. He nowhere discusses the other views which have been taken. Now one of these is that security depends, not on maximum stress, but on maximum strain. What the author does with his equations is to make security depend on the maximum strains ϵ_1, &c.; but this does not justify him in calling $E\epsilon_1$ a true stress.

A HANDBOOK OF FLOWER BIOLOGY.

Handbuch der Blutenbiologie. Vol. iii. Part ii. By Ernst Loew, assisted by Otto Appel, completing the work commenced by Paul Knuth. Pp. v+601. (Leipzig: Wilhelm Engelmann, 1905.) Price 18*s.* net, in paper cover.

THE work which the late Prof. Knuth projected and commenced—a "Handbook of Flower-Biology," to replace Hermann Müller's "Fertilisation of Flowers"—is now complete. It runs as follows:—vol. i., an advanced text-book of flower biology; vol. ii., an account of observations made in Europe (two parts); vol. iii., an account of observations made outside Europe (also two parts).

Ernst Loew, who, after Knuth's death, undertook the completion of the work, appends to the last part a review of the collected extra-European observations.

There can be no doubt of the preeminent fitness of Dr. Loew for his task; but the result on close criticism is found just a little disappointing on account of omissions, *e.g.* Willis's observations on Phacelia, Monarda, and Ixora, and Keeble's on Loranthus, incorrect citations—at the rate of one per page in the literature-list—an imperfect index, far too many printer's errors, and illustrations not always, I believe, drawn from the living flower.

Dr. Percy Groom (NATURE, vol. lxxi. p. 26) remarked on omissions and printer's errors in reviewing the preceding part of this work.

Of the body of the work, it is to be said that, besides abstracting all pertinent publications that have fallen into Dr. Loew's hands, it gives to the world a considerable number of original observations made by Knuth in Java, Japan, and California, and a few of Loew's made in the Berlin Botanic Garden, and that the names of North American insects have been subject to a revision by Prof. Robertson, of Carlinville, Illinois.

Of the review, it is to be explained that it centres on a discussion of the fertilising agents in countries outside Europe. I greatly appreciate the vast amount of labour which Dr. Loew has put into it. He could hardly have made greater use of the fragmentary material to hand. But the account of fertilisation in the tropics wants atmosphere; it is such as a man would write who had no particular experience of their vegetation. Twelve pages of the review are given to this account: first, Dr. Loew borrows from Prof. Warming a description of the vegetation of Lagoa Santa, in Brazil; then he goes on very successfully to discuss the part which birds play in fertilising flowers. In the place of the description of Lagoa Santa, one had hoped to find a more general description of tropical seasons. Nearly twelve pages are given to an account of fertilisation in New Zealand and the Antarctic islands—chiefly to a comparison of Arctic and Antarctic flowers, wherein Loew sees less agreement than does Delpino. Four and a half pages are given to South Africa with Madagascar—an ill-assorted union, three to the cactus region of N. America, six to the Arctic region including Spitzbergen, and twenty-six to the forest belt of N. America. I have here set down the number of pages devoted to each region because they rightly indicate the proportion in which the regions have been studied.

In dealing with the forest belt of N. America, Loew depends, of course, on Robertson's excellent work; there alone he really finds facts enough to enable him to work in the statistical methods which he has used so extensively in his writings regarding European flowers.

A time will come when the botanists of North America ask for a handbook of North American flower biology. Loew's work shows how far from readiness is material for it, and how very much further from readiness is material for a handbook of flower biology for any other part of the world. Until we get such handbooks, Loew's volume of Knuth's work will remain very useful on account of its suggestions, its references, its information, and especially as a companion in travel. I. H. B.

A FRENCH BOOK ON SPORT AND TRAPPING.

Chasse, Élevage et Piégeage. By A. de Lesse. Encyclopédie Agricole. Pp. xii+532; illustrated. (Paris: J. B. Baillière and Son, 1905.) Price 5 francs.

THE volume before us is one of a series dealing not only with subjects pertaining to agriculture in its proper and more restricted sense, but likewise with practically everything connected with country life which has any bearing at all on that pursuit. In the present instance, the subject of the trapping and snaring (*piégeage*) of animals, which, in the case of noxious species is, of course, a matter of considerable importance to the agriculturist, serves to establish a connection between sport (especially in the French sense of that term) on the one hand and agriculture on the other, and thus justifies the inclusion of the volume in the series. In connection

with the subject of trapping and snaring, we may take occasion to remark that the agitation which has been set on foot in this country against traps of an unduly cruel nature (indeed, against "gin-traps" of all kinds) does not appear to have reached the other side of the Channel, or, at all events, does not seem to have had any effect there. For in the present volume there is a cut of an unfortunate falcon ensnared in one of the abominable pole-traps, without a word of condemnation of snares of that description (unnecessarily cruel from the fact that they are in many cases only visited at long intervals).

The volume commences with a series of chapters pointing out the commercial importance of "la chasse," first as a source of revenue to the State, then as a source of food-supply, next in connection with rendering unfertile tracts profitable, and finally in relation to the rural population. The second section of the volume is devoted to game protection and the natural and artificial rearing of game birds, in the course of which the English and French methods of pheasant breeding are contrasted and their relative merits compared. Sporting dogs—other, of course, than hounds—form the subject of the third section, which is illustrated with a number of cuts (not by any means always of the best) of some of the chief breeds, and the manner of training dogs for their special duties. Then comes a dissertation on the various methods of destroying animals commonly classed as injurious to the game-preserver and the agriculturist, in the course of which, as already mentioned, every kind of trap and gin, no matter how cruel, is described in detail, while the reader is also instructed in the various methods of employing fire-arms and poison for the same end. The more legitimate forms of sport, including, however, small-bird-shooting and rabbit-netting, together with an account of the legislation connected with the subject, form the concluding sections of the volume. The whole subject of "la chasse" or "le sport" is viewed so differently by our French neighbours and by ourselves, that it is somewhat difficult to give an unbiased opinion on the merits of the volume before us. Probably, however, it is thoroughly well suited to the class of readers for whom it is specially intended, although we cannot but regret that an attempt was not made to inculcate more humane views in the matter of the destruction of so-called noxious animals.

R. L.

OUR BOOK SHELF.

Ergebnisse und Probleme der Elektronentheorie. By Prof. H. A. Lorentz. Pp. 62. (Berlin: J. Springer, 1905.)

THIS book contains a lecture given by Prof. H. A. Lorentz before the Elektrotechnischen Verein at Berlin, December, 1904, to which certain additions have been made. It is a most interesting semi-popular account of the present position of the electron theory, which is due largely to the author.

The lecturer begins with a short historical introduction, and then goes on to discuss the properties of kathode rays, which, of course, are negative electrons. He describes the methods by which the ratio of the mass to the charge of these rays has been determined, and Kaufmann's beautiful research on the β rays from radium, which, in conjunction with J. J. Thomson's and Abraham's theoretical investigations, has led to the conclusion that the mass of these rays or electrons is entirely electromagnetic in its origin.

The most interesting part of the lecture now follows, where a description is given of the electron theory of the conductivity of metals. The beginnings of the electron theory of metallic conductivity we owe to Weber and Kohlrausch, and its recent developments to Riecke, Drude, and J. J. Thomson. Lorentz here adopts J. J. Thomson's view, that the conductivity of metals is entirely due to the presence in them of freely moving negative electrons, and that the positive electrons are practically fixed, and so do not contribute to the conductivity. Riecke and Drude have so far supposed that both the positive and negative electrons move. The lecture contains an interesting discussion of the special difficulties of these rival hypotheses, neither of which has yet been made to fit in with all the facts.

According to the electron theory of metallic conduction, the electrons move about between the metal atoms so that they are practically in the gaseous condition and the results of the kinetic theory of gases can be applied to them. On these assumptions the ratio of the conductivity for heat to the electrical conductivity can be calculated, and the result is that

$$\frac{k}{\sigma}=\frac{4}{3}\left(\frac{\alpha}{e}\right)^2 T,$$

where k = heat conductivity, σ = electrical conductivity, T = absolute temperature, e = charge carried by one electron, and α = the gas constant. According to this equation, k/σ should be the same for all metals and proportional to the absolute temperature. The experimental results so far obtained agree on the whole very well with these conclusions, and form a striking confirmation of the general truth of the theory. The observed absolute value of k/σ also agrees fairly well with that calculated by means of the formula just given.

The electron theory also gives a fairly satisfactory explanation of the phenomena of thermoelectricity and contact potential difference, but it is very difficult to reconcile completely with the facts on the Hall effect. H. A. Lorentz's lecture shows that many problems of the electron theory still await a solution, but it also shows the immense progress which has recently been made, and suggests the idea that very soon nothing but ether and electrons will be retained in our conception of the physical universe. H. A. WILSON.

Die elektrischen Bogenlampen, deren Prinzip, Konstruktion und Anwendung. By J. Zeidler. Edited by Dr. G. Benischke. Pp. x+143. (Brunswick: Friedrich Vieweg und Sohn, 1905.) Price 5.50 marks.

THE book published under the above title forms the sixth pamphlet of "Elektrotechnik in Einzel-Darstellungen." The author divides the contents into four parts. In the first one he shows great ingenuity in classifying lamps; he also explains the actions of series, shunt, and differential arcs, and describes the precautions which are necessary to ensure steady burning.

In the second part we find the constructions of various types of arc lamps, the sizes of carbons to be used, the advantages and disadvantages of flame and enclosed arcs, and an article on inverted lamps.

The third part deals with the distribution and calculation of light. It describes the construction of polar and Rousseau curves, the meaning of hemispherical intensity, the power-factor of alternate current flame

arcs, the calculation of light for interior and exterior places, and concludes with tables giving the reflecting powers of various surfaces, and the horizontal illumination required for different places.

The last part illustrates the construction and application of auxiliary plant, including steadying resistances, choking coils, transformers, safety appliances, &c.

The book is intended chiefly for students. As such it might be improved by including a little more of the theory of the arc, of which the author says practically nothing. Very few engineering students will find sufficient time to study works such as "The Electric Arc," by Mrs. Ayrton, unless they make the study of arc lamps their speciality.

The second part will form a good advertisement for the A.E.G. Company's lamps, as most of the diagrams represent designs made by this firm. But although it is quite easy to deduct the principles of action of other lamps from the diagrams given, one does not like to see in a text-book the productions of one manufacturer only, as it reduces the work almost to a catalogue. Of great interest is Foster's hot-wire arc lamp, although its commercial value has yet to be proved.

The most useful part of the book is the third one, which will be welcomed by many students who are able to read German. Also the fourth part contains much useful matter.

The book is practically free from printer's errors. The few which occur may easily be detected by even the most elementary reader.

Taken as a whole, the pamphlet will be found a useful addition to electrical engineering literature.

H. BOHLE.

Transactions of the South African Philosophical Society. Vol. xv. Part v. Catalogue of Printed Books, Papers, and Maps relating to the Geology and Mineralogy of South Africa to December 31, 1904. By Miss M. Wilman. Pp. 283–467. (Cape Town, 1905.) Price 12*s.* 6*d.*

THIS excellent bibliography represents months of patient labour spent on a bewildering but necessary task, and now happily carried to a successful termination. The whole civilised world appears to have had something to say on African geology. The labour entailed in drawing up these lists, which easily supersede all others, will therefore be obvious. The author has had, indeed, to exercise considerable acumen in discarding numerous papers, &c., often containing mere references to geology, in order to bring the lists even within their present compass. As it is, a few works, since they are mentioned in earlier lists, have had to be included, although they add little to geological literature. The title is generally sufficient to warn the inquirer.

Part i. deals with works on the general geology of South Africa, part ii. contains a list of geological maps, while part iii. is exclusively devoted to works on meteorites. The print is clear, and the names of authors are distinctly marked in Clarendon type.

W. G.

Problems in Practical Physics. By F. R. Pearson, M.A. Pp. 30. (Edinburgh and London: Oliver and Boyd, 1905.) Price 6*d.*

THESE problems are intended to accompany practical work in a laboratory, and should serve to give practice in working out results. The subjects on which examples for solution are set include the parts of physical science studied in a first year's course. Teachers of mathematics may find the booklet useful, as it will provide interesting applications of simple mathematical principles to practical problems coming within simple laboratory experience.

LETTERS TO THE EDITOR.

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

Terminology in Electro-physiology.

MY attention has been directed to a letter in your columns (p. 5) commenting upon the ambiguous use made in physiological literature of two opposed terms, "negative" and "electropositive."

To me also it seems a misfortune that this ambiguity has ever arisen, nor do I see any necessity why it should be allowed to persist. There is no obvious reason why, in scientific papers, the terminology of the physicist should not be adhered to. The "negativity" of a point is detected by means of the current which flows towards it, or tends to flow towards it, through some form of external indicator connecting it to the point which is spoken of as "positive." These terms, and these terms alone, adequately express the facts of all the experimental observations made. Any other terminology differing from this is necessarily based upon some inference as to the mode of causation of the currents detected. Since it is the causation of these currents which is the main crux of the research work undertaken in this subject, the admission of such an inference seems a certain road to the confusion of ideas.

In all cases where an effort has to be made to carry home to an audience the more exact ideas existing in the author's brain, in all cases where parables are not only admissible but necessary, I think the terms suggested by Dr. Waller are of extreme value. Anyone acquainted with the explanatory use he has made of them in his "Animal Electricity" will agree. Whilst sincerely admiring his profoundly clever method of administering large doses of knowledge by means of this and similar parables, I have observed two things. In the first place, that duller wits, hugely mistaken, sometimes assess his knowledge as mainly one of parables. In the second place, that less expert persons are apt to carry conclusions derived from parables to a bitter and unjustifiable extremity.

Sheffield University. J. S. MACDONALD.

The Leonid Meteors, 1905

THE remarkable displays of these meteors observed in 1903 and 1904 may naturally raise the expectation as to whether the approaching Leonid epoch will exhibit an abundant fall of shooting stars. Observers, it is true, will have to contend against the impediment offered by the light of the gibbous moon; but, it may be remarked, this can only affect the smaller class of meteors, as the brilliant apparitions of 1866, 1867, and 1886 were witnessed at a similar phase of our satellite.

The Leonid events of the past two years afford striking illustrations of the meteoric cycle of nineteen years, being associated respectively with the Leonid meteor displays of 1865 and 1866, and the present November gives ample promise of furnishing another example of the same period.

Unlike the Leonid falls of 1865 and 1866, that of November 14, 1867, was brilliantly reproduced on the first completion of this cycle on the morning of November 15, 1886, the spectacle being of extraordinary splendour (NATURE, vol. lxi., p. 491).

The Leonid maximum of 1905 will fall on the night of November 15, and, according to calculations by the present writer, will be visible both over Europe and America. The shower will be of second-class order, that of 1866 being regarded as of first, and will commence early in the night, the first maximum occurring on November 15 11h. G.M.T. From this hour up to about three o'clock on the morning of November 16 the Leonids will probably gradually increase in numbers, the second maximum of the night becoming due on November 15, 15h. 10m. The final maximum on November 15 occurs at 21h., and will consequently be visible to American observers only.

Dublin. JOHN R. HENRY.

Border occasionally seen between Light and Dark Regions on Photographic Plates.

THE reason mentioned by Sir Oliver Lodge (p. 5) for the border seen between light and dark regions on photographs is not the only one. In the denser regions of a negative the developer gets more exhausted or restrained than in the thinner regions, and this affects the adjacent parts. At the junction of a dense and a thin area the edge of the thin part is made thinner by the restraining compounds (bromide, oxidised pyrogallol, &c.) derived from the denser part, while, on the contrary, the edge of the denser part is made denser by the less exhausted developer flowing from the thin area. This effect is apt to be the more marked when the developer is already well restrained, as by staleness or the addition of much bromide.

Cambridge, November 4. F. J. ALLEN.

THE explanation of a well known phenomenon in photography, given by Sir Oliver Lodge in his letter to you last week (p. 5), does not take into consideration the following facts :—

(1) The "perceptible difference in thickness" between the acted-on and unacted-on portions of a negative is only perceptible to our unaided senses when certain developers are employed containing substances which act powerfully on the gelatin. Most modern negatives certainly have no *perceptible* difference in thickness, certainly not enough difference to give rise to so marked an effect as that referred to.

(2) The difference in thickness is most marked in the "carbon" transparencies from which many enlarged negatives are made. Here it can be both seen and felt; in the other case it cannot. We might therefore expect this cylindrical lens effect to be most marked when using such a transparency, but the careful comparison of a number of enlarged negatives made in these two methods reveals not the slightest difference between them.

In my own mind I have always accounted for the phenomenon in the following way :—The sensitive film ordinarily can only be approached by the developer from its outward face, hence the action over an area where the light action has been the same is uniform. But if that area is bordered by one where there has been little or no light action, the developer absorbed by such parts is not spent in doing any or much work in those parts, and, so far as any lateral diffusion is concerned, is practically fresh developer. Hence the borders of an exposed portion, where it comes against an unexposed portion, are attacked by fresh developer diffusing both from the front and from the unexposed part, and we should therefore expect to find a border line of greater density there, as in fact we do. For a similar reason we should expect to find a less dense line on the border of the more transparent portion, as is the case, though it is not often so noticeable as the former.

That this is the true explanation is, I think, made manifest by the fact that the line in question can be quite easily distinguished on plates exposed in Spurge's actinometer, where there is certainly no opportunity of a "cylindrical lens effect," and especially when development has been pushed far. R. CHILD BAYLEY.

20 Tudor Street, London, E.C., November 6.

The Use of Gasoline in Chemical and Physical Laboratories.

EXPERIMENTAL work has so thoroughly established its claims to a reasonable share in the curriculum of every secondary school that very few schools are now without proper laboratories. No inconsiderable number of these schools are, however, beyond the limits of the ordinary gas supply, and the question of providing a substitute for coal-gas has presented no little difficulty. The matter became urgent some time ago at the Llanberis Intermediate School, mainly for heating purposes, but also for lighting. Investigation seemed to point to two possible substitutes—acetylene and gasoline. Both have been used, but not to any very large extent, in this country. An account was given in the *School World* for January 1902, of the use of acetylene in Felsted School.

For a small installation, where light is the first consideration, it would probably be admitted that acetylene is highly satisfactory, but even for lighting the use of mantles has rendered gasoline a very severe rival. The problem is different when heat is the chief factor. In most cases of schools the gas is required to meet both demands, and gasoline seems to possess the advantage.

The questions for consideration are cost and efficiency.

In reference to cost, estimates were obtained to supply the chemical and physical laboratories and to light the whole building, and showed that the initial cost of plant and fitter's work would be about fifty per cent. higher for acetylene than for gasoline, and the estimated cost of maintenance for the former was also much higher.

Efficiency may be considered under the following heads :—(*a*) The relative simplicity of the generating plant; (*b*) the ease of manipulation; (*c*) the nearness to which the gas approaches in use to coal-gas; (*d*) the risk of explosion.

(*a*) The plant used in the Llanberis School was supplied by the Walworth Manufacturing Co., of Boston, U.S.A., and consists essentially of three parts :—(1) A large shallow cylindrical copper tank, holding 250 gallons, buried some 30 feet or more from the building, which is filled with gasoline through a pipe and closed air-tight by a screw cap. Two other pipes, an inlet and outlet, are fitted into the top of the tank and pass under ground to the cellar of the building. (2) In the cellar a pump, worked by a weight on pulleys, forces air through the inlet pipe on to the surface of the gasoline in the tank. Evaporation is rapid (gasoline boiling from about 35° C. to 70° C.), and the mixture of vapour and air is driven through the outlet pipe into (3) an automatic mixer, by which a definite and known amount of air can be added, so that the proper proportion for burning may be constantly maintained. The whole plant is extremely simple, and was easily put up by a local gas-fitter under my direction.

(*b*) It requires very little attention. The weight has to be wound up about once a week; the mixer adjusted, by moving a small wheel along a rod, about once every two or three months; and the tank filled about every twelve or eighteen months. The frequency of the recurrence of these operations clearly depends on the size of the plant relative to the demands upon it.

(*c*) The burners differ slightly from the ordinary coal-gas bunsens, but give an excellent flame for ordinary laboratory purposes. The most noticeable difference is that the flame is more easily blown out. This gives a little trouble with an ordinary foot blowpipe, but a slight modification, which I hope to carry out, suggested by my friend Mr. B. B. Turner, of Storrs Agricultural College, Connecticut (who has used gasoline for some years, and who brought it to my notice), will probably get over the difficulty. The plant supplies enough gas to light the whole building as well as for laboratory purposes.

(*d*) The risk of explosion is very slight, as any escape is at once detected by the strong smell, and the limits of explosion are narrower than those of coal-gas and very much narrower than those of acetylene. The absence of any heating arrangements to aid the evaporation, such as are proposed by some makers, considerably reduces the risk of explosion. J. R. FOSTER.

THE AEGER IN THE RIVERS TRENT AND OUSE.

HAVING had an opportunity of witnessing the bore, or aeger as it is locally called, in the River Trent at Gainsborough during the recent high equinoctial tides, which did so much damage all along the east coast, I send you the following description, which may interest some of your readers, more especially as I am not aware of any trustworthy account of this bore that has yet been published.

The Trent is a tributary of the Humber, and joins that river about 16 miles above Hull and 40 miles from the North Sea. The width of the Trent at the junction is from 2500 feet to 3000 feet at high water, diminishing to 700 feet 1½ miles from the

junction. This wide space is encumbered with a mass of sand banks. The width of the Humber below the junction averages about 4500 feet, and this channel also feeds the Ouse, which is a continuation of the Humber. This width is double that of the Trent and Ouse combined. The rise of ordinary spring tides at Trent mouth is 15 feet, increasing at equinoctial tides to 19 feet. The tide has a run of 47 miles up the Trent, and reaches to 87 miles from the North Sea, the flood lasting three hours and the ebb nine hours.

The bore, or aeger, is caused by the check of the tidal flow through the shoal water of the sand banks and the contraction of the waterway, the tidal current overrunning the transmission of the foot of the wave. It first assumes a crest somewhere between Burton Stather, 3 miles from the mouth of the Trent, and Amcotts, 2 miles further on, depending on the condition of the tide, the water rising almost simultaneously 3 feet. In ordinary spring tides the bore does not extend more than 7 or 10 miles above Gainsborough. In high spring tides it diminishes

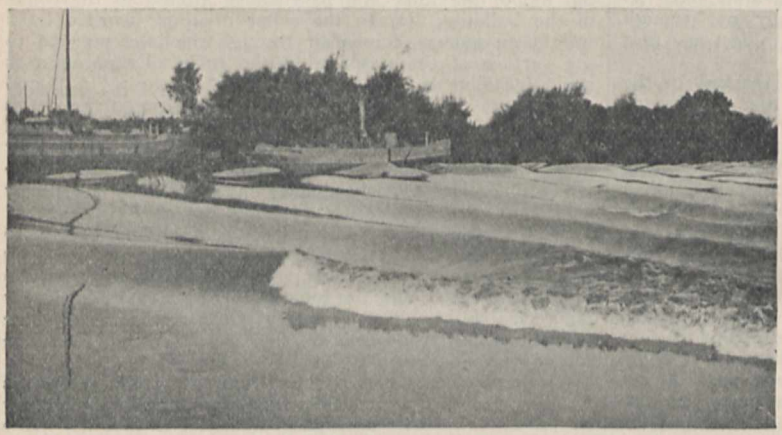

FIG. 1.—The Aeger in the Trent.

to 1 foot in height at Torksey, 35 miles from the mouth of the river, and then gradually dies out.

The bore was to be seen under exceptionally favourable conditions on September 30 and October 1 last, being the second and third days after the new moon. The tides were laid down in the Admiralty tide tables for the Humber as the largest of the year. The moon was in perigee on September 29, and had 11·21 degrees south declination. The wind was from N.E. to N.W., a direction which brings the largest tides, and was blowing at Spurn with a force of from 6 to 7. Inland the force was only about 3 on the Beaufort scale. There was a limited quantity of fresh water running down the river, the velocity at low water being 2 miles an hour. The depth in the channel between Gainsborough and the Humber is now about 6 feet, but there are several shoals with not more than 2 feet to 2½ feet over them. The tide was exceptionally high, rising in the Humber at Hull nearly 3 feet higher than ordinary spring tides, and within 10 inches of the record tide of March, 1883.

The bore could be heard approaching about half a mile from the place of observation, and passed with a crest in the middle of the river of from 4 feet to 4½ feet extending across the full width of the river, which is here about 200 feet at high water. At the sides the breaking wave rolled along the banks 6 feet or 7 feet high. The crest was followed by five or six other waves of less height, terminating in a mass of turbulent broken water for a distance of 100 yards. The velocity of the wave, as nearly as it could be measured, was about 15 miles an hour, the current running up after the bore had passed at the rate of 4¼ miles an hour, and at its maximum, about half flood, 5 miles an hour. The tide rose 4 feet in the first four minutes after the arrival of the bore, 5 feet in the first half hour, and 8 feet in two hours, when it attained its maximum height and commenced to fall; but the tide continued running up the river for another hour after this, at the reduced velocity of 2 miles an hour. There were some steamers and barges lying at the wharves, and a row-boat in the middle of the river. These rose with the wave and suffered no harm.

These bores were considered by the men on the river as fair specimens of those which come with high tides, and as never exceeded in height to any extent. When the river is full of fresh water and the ebb is heavy the bore is less pronounced, and does not show at all on neap tides. It was reported that at Owston Ferry, which is 8 miles nearer the Humber than Gainsborough, the crest of the aeger was 8 feet, but this was probably at the side of the river. A boat which was in the middle of the river when the wave came was for an instant completely out of sight of a spectator on the bank.

The photograph from which the illustration is taken is by Mr. E. W. Carter, of Gainsborough, and is copyright.

In the Ouse during spring tides there is a less pronounced bore. In ordinary spring tides it commences at a shallow reach in the river at Sand Hall, 2 miles above Goole, attains its greatest height 4 miles above Selby, and then gradually dies out. The crest of the bore is from 2 feet to 3 feet, and the breaking wave at the sides 6 feet or 7 feet. In summer, when the ebb current is low, the aeger reaches Naburn with a crest 1 foot 6 inches high. Since the improvement of the channel of the river below Goole these aegers have become smaller.

W. H. WHEELER.

SURVEY OF THE SIMPLON TUNNEL.

WE have appreciated many of the difficulties the engineers encountered in the construction of the Simplon Tunnel and have offered our congratulations on the successful completion of the work. But the difficulties that have been most readily apprehended have been those arising from the outburst of water from the hot springs in the track, the high temperature, and the mechanical boring and removal of the rock. In the happy completion of a task of great magnitude, which at one time threatened to end in a catastrophe, people are apt to forget the onerous preliminary work necessary to set out the line of the tunnel, to arrange the gradient so as to provide not only for efficient drainage at either end, but to secure the continuity of the separate tunnels at the point of junction, and so render it possible to work simultaneously at both ends. We are therefore glad to see an article by Prof. C. Koppe in *Himmel und Erde* for August [1] bringing these matters forward, and making us familiar with the work which has

[1] "Die Vermessungs- und Absteckungs-Arbeiten für den Simplon Tunnel."

been so efficiently carried out by Prof. Rosenmund of Zurich.

Before the work of boring and perforation can be begun, there are three elements which have to be determined with an accuracy which must be greater in proportion to the difficulties of construction. These are the direction, the length, and the altitude above sea-level. Assuming that the places of entrance and exit of the tunnel have been marked by suitable pillars, the determination of these three elements begins; and that of the level is the least difficult, because the surveying engineer trusts to direct measurements. By the aid of accurate levelling instruments, it is possible to derive the difference in altitude of two stations 50 kilometres apart with no greater error than 3 cm. This is effected by the use of the levelling staff, which is read by means of an accurate level, the staff being placed vertically at two stations a convenient distance apart, and the sum of the differences of each pair of readings being taken. The surveyor apparently trusts entirely to the accuracy with which his theodolite can be levelled. Several determinations of the difference of level of the two ends of the tunnel were made, but between the two last there was a discrepancy of only 2 cm., a more than sufficient degree of accuracy. The actual difference of level between the two ends was 52·439 metres.

The second element, that of the length of the tunnel, is to be derived indirectly from triangulation, the length being reckoned from the same points that have served for the determination of difference of level, and, as a matter of fact, these points are at some distance from the actual openings. A base line being given, the construction and the solution of the triangles present little difficulty, for here great accuracy is not required, and the probable error that Prof. Rosenmund was content to leave in his work amounted to ±0·7 metre. The distances measured are as follows :—

	metres
The length between the columns marking the axis of tunnel...	20,091·33
Distance of northern column from tunnel opening	317·78
Distance of southern column from tunnel opening	44·84
Actual length of tunnel	19,728·71

The third element, that of direction, at all times presents some difficulty, and, in the case of mountains, where local attraction enters as a disturbing factor, the problem requires very delicate treatment. In a tunnel 20 kilometres long, an error in direction of one minute, which is usually the limit of accuracy sought in technical work, would produce an error of 6 metres, and the tenth part of such an error would be too great. Recourse is necessarily had to triangulation, and the angular measurements must be made with the greatest care. Well-defined signal posts must be erected to mark the angles of the selected triangles, and the points of reference in these pillars defined with the utmost accuracy. The form which Prof. Rosenmund preferred consisted of cylindrical towers of brick about eight feet high, of which the axis was an iron tube the upper edge of which reached the top surface of the tower. A wooden pole carried this iron tube vertically upwards, and the whole was surmounted by a conical tin covering, the highest point of which was vertically over the centre of the iron axis. Eleven of these piers were erected, and when signals were made from any pillar the conical top was removed, and the theodolite was placed centrally over the middle of the iron tube in the cylindrical tower, which afforded a solid support for the instrument and permitted accurate observation of the other stations. With the care exercised, it might have been anticipated that the sum of the angles of any triangle would differ from 180° by the known amount of the spherical excess, within the errors of observation. But the discrepancies were much larger, varying from 4 to 8·5 seconds, and these deviations could be explained only by attributing to the mountain an attractive force, which sensibly displaced the direction of the plumb-line. In other words, the theodolite was not placed horizontally. The amount of the deviations from the vertical, with the azimuths in which they occur, is shown in the following table :—

Station	Deviation from vertical	Azimuth
	"	° ′
North point of axis... ...	13·9 ...	248 26
Oberried	19·1 ...	195 12
Birgischwald	16·4 ...	188 5
Rosswald	23·6 ...	262 56
Spitzhorn	17·5 ...	314 18
Monte Leone...	0·0 ...	0
Hüllehorn	8·2 ...	244 3
Seehorn	5·6 ...	75 28
Alpe Wolf	11·4 ...	36 46
Genuina	9·1 ...	192 3
South point of axis... ...	5·8 ...	139 11

Assuming these deviations from the vertical to arise from the attraction of the mountain mass, an hypothesis which was confirmed by rigorous astronomical observation, it was found possible to reduce the closing errors of the triangles very materially. The solution of the whole network of triangulation showed that the tunnel's axis was fixed with a probable error of ±0″·7, and that the direction of the tunnel could be fixed with sufficient accuracy by pointing the telescope, placed on one of the piers at the entrance of the tunnel, to any other signal tower, and revolving the telescope through a known angle.

It would be interesting to enter into the details by which the path of the tunnel was checked as the work progressed, more especially as curious refractive effects, akin to those seen in "mirage," occurred to render the observations somewhat difficult and uncertain. These disturbing effects were more noticeable when observing towards the north end of the tunnel, where the difference of temperature between the internal and external atmosphere was greatest. On the southern side, the external air being warmer than on the north side, the "mirage" was not so conspicuous. But we have only space to refer to the degree of success which resulted from the care bestowed on this difficult undertaking—a success which could not be adequately tested until the junction of the engineering parties in the middle of the tunnel was effected. To take the three elements in order, it was found that the level agreed within 0·1 metre of the calculations. The length as measured differed 2 metres from the calculated value, but, as mentioned, this was a factor in which great accuracy was not needed, because, if the direction were given correctly, it was only necessary to continue the borings until the engineers from the south and north sides met in the middle. The direction was most satisfactory. The wall of one tunnel was absolutely continuous with the wall of the other; an attempt was made to compare the opposite walls of the tunnel for confirmation, but this attempt was frustrated by a projecting piece of rock. No better result could have been anticipated, and the utmost credit attaches to Prof. Rosenmund and his assistants.

W. E. P.

BURSARIES AT THE ROYAL COLLEGE OF SCIENCE.

SCIENCE scholars selected from the whole of Great Britain for their ability and promise, maintaining themselves on 17*s.* 9*d.* per week, were this year saved from much privation by secret gifts of small bursaries—see the subjoined audited account. I have no right to ask for help from the generous men who helped me last year, but I have all the sturdiness of a chartered beggar—I ask in a good cause.

It was originally intended that these bursaries should be given only to such National Scholars as required assistance, but some of the subscribers have given me power to assist other students of the college. Also one of the two City Companies has given me power to grant an occasional bursary of more than ten pounds. It is understood that every student is morally bound to repay this money to the fund at some future time.

JOHN PERRY.

October.

ROYAL COLLEGE OF SCIENCE.

BURSARIES 1904–1905.

BALANCE SHEET.

Moneys Received and Paid by Prof. Perry.

RECEIVED				PAID			
Balance from last year	£24	2	0	*Dec.* 16 *to Feb.* 28. 25 students received half bursaries, £5 each ...	£125	0	0
August, 1904.							
Dr. Sprague	20	0	0				
R. Kaye Gray, Esq..	10	0	0				
September, 1904.				*January* 31, 1905. 1 student received a half bursary of £7 10*s.*	7	10	0
Prof. J. Perry (slide rules)	1	6	0				
November, 1904.							
Returned half bursary	5	0	0				
Sir Andrew Noble...	10	0	0				
December, 1904.				*February* 15. 1 student received the second half of his bursary	5	0	0
The Drapers' Co. ...	100	0	0				
Prof. J. Perry (slide rules)	2	19	0	*March* 24 *to June* 15. 22 students received second halves, £5 each...	110	0	0
January, 1905.							
J. Drinkwater, Esq.	1	1	0				
The Goldsmiths' Co.	100	0	0				
April, 1905.				*June* 5. 1 student received second half ...	7	10	0
Prof. J. Perry (slide rules)	3	11	0	2 students refused their second halves			
				Balance in hand	22	19	0
Total	£277	19	0	Total	£277	19	0

Twenty-three students received 10*l.* each, two received 5*l.* each, and one received 15*l.*

Audited and Signed by JOHN W. JUDD.

Dated June 22, 1905.

DR. RALPH COPELAND.

ASTRONOMERS will have learned with profound regret that Dr. Ralph Copeland, Astronomer Royal for Scotland, died on October 27 at the Edinburgh Observatory in the sixty-eighth year of his age. Dr. Copeland enjoyed a more varied life than generally falls to the lot of astronomers. The love of travel and adventure seemed with him to be only second to his desire to advance the interests of astronomy.

Born in Lancashire, he early went to Australia, where, on the somewhat uncongenial soil of a sheep-run, he acquired his first telescope and diligently used it. Then he was for a short time attracted by the excitement of the gold diggings, but he forsook these to return to England, having determined to devote himself to astronomy. He matriculated at the University of Göttingen, and enjoyed the advantages of instruction from Prof. Klinkerfuss. For a while he took part in the routine work of the Göttingen Observatory, but the love of adventure still possessed him, and we find him in 1867 taking part in an expedition to explore the east coast of Greenland, climbing mountains and otherwise distinguishing himself, so that on his return he was awarded the Order of the Red Eagle by the German Emperor. Shortly after his return to Europe he came to England, and though he was connected with both the observatory of Lord Rosse at Birr Castle and with that at Dunsink, he is better known for his work in connection with both expeditions of 1874 and 1882 to observe the transit of Venus. In the first he was a member of Lord Lindsay's (now Earl of Crawford) unsuccessful expedition to Mauritius, but on the occasion of the second transit he was more fortunate at Jamaica. Before returning to England he spent some time in the Andes of Peru and Bolivia, at altitudes varying from 10,000 feet to 15,000 feet above sea-level, where he carried out a series of researches on the transparency of the atmosphere, the spectra of planetary nebulæ and of certain classes of stars.

In 1889, when the Earl of Crawford presented his instrumental equipment to the Edinburgh University, Dr. Copeland became regius professor of astronomy and Astronomer Royal for Scotland. Here his great work consisted in the re-construction of the National Observatory at Blackford Hill, the full development of the capacity of which was denied him by reason of his failing health. But he still enjoyed opportunities for foreign travel. Norway, India, Spain, were all visited in turn for the observation of solar eclipses. His favourite instrument on these expeditions was a telescope of long focal length.

Dr. Copeland's acquaintance with astronomical literature was wide and intimate, and his collection of works having reference to some departments, such as cometary astronomy, was probably unique for its completeness. In cometary observation he was particularly interested, and it will be recalled that for many years he gave valuable assistance to observers of comets by calculating and circulating ephemerides which he printed at a small press of his own. For some time he gave further encouragement to the science by editing, in conjunction with Dr. Dreyer, the periodical *Copernicus*, devoted to the publication of high-class papers. In fact, Dr. Copeland's activities were by no means limited to what may be called his official duties. He had the gift to interest by his varied knowledge and experience, and used it liberally. He was held in estimation by a large circle of friends and pupils for the picturesqueness with which he imparted his information and his readiness to assist and encourage. The writer is among those who will gratefully acknowledge the charm of his manner and the kindnesses received at his hands.

W. E. P.

CAPTAIN F. W. HUTTON, F.R.S.

NATURAL science has sustained a heavy loss in the death of Captain F. W. Hutton, curator of the Canterbury Museum, president of the New Zealand Institute, and formerly professor of biology and geology in Canterbury College, University of New Zealand. The second son of the Rev. H. F. Hutton, Rector of Spridlington, in Lincolnshire, Frederick Wollaston Hutton was born at Gate Barton in that county on November 16, 1836. He was educated at the grammar school at Southwell, and afterwards at the Naval Academy at Gosport. After serving for three years in the India mercantile marine he entered the Army, becoming ensign in the 23rd Royal Welsh Fusiliers in 1855. He served in the Crimea (1855–6), and saw further active service during the Indian Mutiny, being present at the capture and relief of Lucknow. He was made lieutenant in 1857.

In 1860 he furthered his military studies at the Staff College at Sandhurst, passing the examinations in 1861. At this date geology was taught in the Royal Military College by Prof. T. Rupert Jones, and Hutton, who had taken up the subject with enthusiasm, contributed in 1862 to the *Journal of the Royal United Service Institution* (vol. vi.) an essay on "The Importance of a Knowledge of Geology to Military Men." The importance, strange to say, does not appear to be so fully recognised nowadays. Hutton became captain in 1862, and served for a time as Deputy-Assistant Quartermaster-General at Dublin; but in 1866, having retired from the Army, he emigrated to New Zealand, and devoted himself to the study of natural history, and especially to zoology and geology. In 1871 he was appointed assistant geologist on the Geological Survey of New Zealand, in 1873 provincial geologist of Otago and curator of the Otago Museum, and in 1877 professor of natural science in the Otago University. In 1880 he settled at Christchurch, having become professor of biology and geology in the University of New Zealand, a post which he held until 1893, when he became curator of the Canterbury Museum at Christchurch. He was elected a Fellow of the Royal Society in 1892.

One of his earliest geological papers, a sketch of the physical geology of Malta, was published in the *Geological Magazine* (1866). From this date his work related mainly to the country of his adoption. He prepared official reports on the Lower Waikato district and on the Thames gold-field in 1867, and a report on the geology and gold-fields of Otago (with G. H. F. Ulrich) in 1875. To the Geological Society of London he contributed in 1885 an excellent sketch of the geology of New Zealand, which gave a comprehensive summary of the knowledge attained at that time, and in 1887 he sent to the same society an account of a recent eruption of Mt. Tarawera in North Island. He contributed many other geological papers to the Geological Society and *Geological Magazine*. While distinguished as a geologist, the importance of his researches on zoology was early recognised, and he was elected a corresponding member of the Zoological Society in 1872.

He contributed articles on the fauna and flora of New Zealand, on the land mollusca, the fishes, and the birds, including the extinct moas. Some of these articles were printed in the *Transactions of the New Zealand Institute*, the *Proceedings of the Linnean Society of New South Wales*, in the *Proceedings of the Zoological Society*, in *Ibis*, and other journals.

He was an ardent student of evolution, and among other works issued in 1899 "Darwinism and Lamarckism, Old and New," and in 1902 "The Lesson of Evolution."

After an absence of nearly forty years he paid a visit to this country, and received a hearty welcome from his many scientific friends. He was returning to his home at Christchurch when the announcement of his death on October 27 was received by telegram from the Cape. We are indebted to an obituary in the *Times* for some of the above particulars.

H. B. W.

NOTES.

THE Royal Society has this year made the following awards of medals. The awards of the Royal medals have received the King's approval:—The Copley medal to Prof. D. I. Mendeléeff, of St. Petersburg, for his contributions to chemical and physical science; a Royal medal to Prof. J. H. Poynting, F.R.S., for his researches in physical science, especially in connection with the constant of gravitation and the theories of electrodynamics and radiation; a Royal medal to Prof. C. S. Sherrington, F.R.S., for his researches on the central nervous system, especially in relation to reflex action; the Davy medal to Prof. A. Ladenburg, of Breslau, for his researches in organic chemistry, especially in connection with the synthesis of natural alkaloids; the Hughes medal to Prof. A. Righi, of Bologna, on the ground of his experimental researches in electrical science.

THE following is a list of those who have been recommended by the president and council of the Royal Society for election into the council for the year 1906, at the anniversary meeting on November 30:—*President*, Lord Rayleigh, O.M.; *treasurer*, Mr. A. B. Kempe; *secretaries*, Prof. Joseph Larmor and Sir Archibald Geikie; *foreign secretary*, Mr. Francis Darwin; *other members of the council*, Dr. Shelford Bidwell, Sir T. Lauder Brunton, Prof. J. Norman Collie, Prof. W. R. Dunstan, Prof. J. B. Farmer, Prof. F. Gotch, Dr. S. F. Harmer, Sir William Huggins, K.C.B., O.M., Prof. E. Ray Lankester, Dr. J. E. Marr, Mr. G. B. Mathews, Mr. H. F. Newall, Sir W. D. Niven, K.C.B., Prof. John Perry, Prof. E. H. Starling, Prof. W. A. Tilden.

AT a meeting of the council of the British Association on November 3 it was decided that, in consequence of strong representations by the local committee, the meeting at York next year shall be opened on Wednesday, August 1, which is earlier than the usual date of the opening meeting.

THE council of the British Association has received a gift of 50*l.* from Mrs. John Hopkinson, to be devoted to some investigation which may be suggested at the next meeting by the committee of recommendations.

THE Paris Academy of Moral and Political Sciences has awarded a prize of the value of 600*l.* to Dr. Calmette, of Lille, in recognition of his work in bacteriology and preventive medicine.

WE regret to see the announcement of the death, at forty-five years of age, of Prof. Walter F. Wislicenus, professor of astronomy in the University of Strasburg and editor of the "Astronomischer Jahresbericht."

A CHRISTMAS course of lectures, adapted to a juvenile auditory, will be delivered at the Royal Institution by Prof. H. H. Turner, F.R.S., on astronomy, from December 28 of this year to January 9, 1906.

DR. MAURITS SNELLIN informs us that he has resigned the directorship of the section of terrestrial magnetism and seismology at the Koninklijk Nederlandsch Meteorologisch Instituut. Dr. Snellin's private address is now Apeldoorn, Holland, and any papers intended for him personally should be sent to this address.

AT the inaugural meeting of the eighty-seventh session of the Institution of Civil Engineers, held on Tuesday, November 7, Sir Guilford Molesworth, K.C.I.E., the retiring president, formally introduced to the members his successor in the chair, Sir Alexander Binnie, who delivered an address to the members, in which he traced the influence of scientific thought and investigation upon the development of engineering practice. The president subsequently presented the medals and premiums awarded by the council for papers dealt with at the institution in the course of the past session.

THE fifteenth International Congress of Americanists will be held at Quebec on September 10–15, 1906. Papers in each division of the congress will take precedence in the order of the receipt of abstracts. Copies of regulations referring to papers may be obtained from Prof. F. Boas, department of anthropology, Columbia University, New York. The names of intending members or associates should be sent to Dr. N. E. Dionne, Librarian to the Legislative Assembly, Quebec.

Science reports that the Alvarenga prize for 1905 has been awarded to Dr. Chalmers Watson, of Edinburgh, for his essay entitled "The Importance of Diet; an Experimental Study from a New Standpoint." This prize is given by the College of Physicians of Philadelphia, and consists, each year, of the income of the bequest of the late Señor Alvarenga, amounting to about 36*l*. The next award will be made July 14, 1906, provided that an essay deemed by the committee of award to be worthy of the prize shall have been offered. Essays intended for competition must be received by the secretary of the college on or before May 1, 1906.

WE regret to learn that Mr. William Henry Greenwood, the eminent metallurgist, died on October 31 at fifty-nine years of age. He was educated at the Royal School of Mines, and at various periods in his career he held important positions at the works of Sir J. Whitworth and Co., the St. Petersburg Ordnance Works, and the Birmingham Small Arms Works. From 1885 to 1889 he was professor of metallurgy at Sheffield. He was the author of a well known manual of metallurgy, of a treatise on steel and iron, and of a series of metallurgical lecture diagrams, and contributed various papers to the Institution of Civil Engineers, the Iron and Steel Institute, and other technical societies of which he was a member.

THE Society of Arts will commence its 152nd session on November 15 with an opening address from the chairman of its council, Sir Owen Roberts. Among the papers set down for the Wednesday evenings before Christmas is one on the commerce and industries of Japan, by Mr. W. F. Mitchell, at which the Japanese Minister will preside. Sir William Preece will give an account of the recent meeting of the British Association in South Africa, and Mr. F. Martin-Duncan will describe recent applications of the kinematograph for scientific purposes. A course of Cantor lectures by Prof. J. A. Fleming on electric waves will also be given before Christmas. Among the courses of lectures announced for the meetings after Christmas is one under the Cantor trust on modern warships, by Sir William E. White, and one under the Howard trust, by Prof. Silvanus P. Thompson, on high-speed electric generators. The usual course of juvenile lectures will be given this year by Prof. Herbert Jackson, the subject being flame and combustion.

BARON ERLAND NORDENSKJÖLD has published through Reuter's Agency some details of his eighteen months' expedition to the Andes, which was undertaken for the purpose of penetrating the northern forests of Bolivia and studying the Indian tribes along the various tributaries of the Amazon in practically unknown districts. Baron Nordenskjöld left England in January, 1904, his intention being to travel *viâ* the Peruvian port of Mollendo to Puno on Lake Titicaca, at an altitude of 12,000 feet, and thence to La Paz, the Bolivian capital. He visited in all three tribes, the Yamiacas, Guarayos, and Atsapuacas, who, until a couple of years ago, lived like people of the Stone Age. The two last mentioned, in the main, still retained their original customs. No white man had ever previously visited the Atsapuacas, but yet they were in possession of tools, which they had obtained through other tribes. The expedition was unable to get into contact with a fourth tribe. The explorers marched through their territory and were constantly watched by the people, who, while abstaining from molesting the strangers, would not have any dealings with them. Baron Nordenskjöld states that the Quichuas and Aymaras, living round Lake Titicaca and in the fells of the Andes, are an interesting study for the ethnologist, as they have retained many customs unaltered, or but slightly modified, since the time of the Incas.

FROM a report in the *Times* we learn that the old students of the Royal School of Mines resident in South Africa held their annual dinner at the Rand Club, Johannesburg, on October 7. Mr. J. Harry Johns presided, supported by Mr. A. R. Sawyer and Mr. H. H. Webb. In proposing the toast of "The Royal School of Mines," the chairman emphasised the importance of teaching students to put scientific knowledge to practical use. He laid stress upon the importance of training in mechanical engineering and electricity, and congratulated the Government upon choosing a thoroughly practical engineer to fill the chair of mining at the Royal School of Mines. Mr. Brodigan, in replying, endorsed the general opinion that, considering the national importance of the mining industry to Great Britain, the Government should endow more liberally the leading mining school of the world. A letter was read from the Commissioner of Mines (Mr. H. Weldon), in which he offered a scholarship of 32*l*. to be competed for by the mining students of the Transvaal Technical Institute. Mr. Webb proposed that a register should be kept of all old School of Mines students residing in the country, and stated that the Consolidated Gold Fields of South Africa would always be ready to provide work for a certain number of students who had finished the graduation course at the Royal School of Mines. The students would earn enough at such work to maintain them while they were gaining practical experience. In connection therewith, those who have studied at the Royal School of Mines are requested, should they come to South Africa, to send their names and qualifications to Mr. C. B. Horwood, Rand Club, Johannesburg.

THE tercentenary of the birthday of Sir Thomas Browne, author of the "Religio Medici," "Urn Burial," &c., physician and philosopher, who was born in Norwich on October 19, 1605, was celebrated in Norwich on October 19 with a remarkable display of enthusiasm and interest. A statue by Mr. Henry Pegram, A.R.A., has been placed in the Haymarket at Norwich, close to the site of Sir Thomas Browne's house, and was unveiled by Lord Avebury in the presence of a distinguished company, including representatives of the Royal Colleges of Physicians and Surgeons, London, and of several of the universities and learned societies, who were afterwards entertained at luncheon by the members of the memorial executive committee.

IN the *University Review* for October (ii., No. 6) Viscount Mountmorres writes on the development of the tropics. The article is an indictment of our colonial policy on the west coast of Africa, and the energy of other nations in developing their possessions in this region is contrasted with the lethargy exhibited in our treatment of our own colonies. This applies not only in commerce but in scientific investigations, and, save for several excellent

experimental botanical gardens, there is a whole class of important questions dealing with the mineral, vegetable, and animal products of the country which is practically left to private individuals for solution.

SIR FREDERICK TREVES gave the opening address of the winter series of the Edinburgh Philosophical Institution on October 31, Lord Rosebery presiding. Sir Frederick's subject was "disease"; he said that the common conception of disease is that it is a calamity, and its end destruction, whereas disease is one of the good gifts, for its motive is always benevolent and protective. He demonstrated his proposition by a number of instances, showing that the phenomena of disease always tend to recovery and repair, though he acknowledged that in the case of malignant disease the assertion could be made that there was nothing good in it, to which no answer could at present be given.

MR. L. W. LAMBE, of the Geological Survey of Canada, has favoured us with a copy of a paper, from the *Transactions of the Royal Society of Canada*, on species of Hyracodon and the ancestral horse-like genus Mesohippus from the Oligocene of the Cypress Hills, Assiniboia.

No. 3 of the Brooklyn, N.Y., *Museum News* records improvements and additions to the central and children's museums in that city. A special feature is the collection of insects in the children's museum, this group being regarded as a peculiarly suitable one for infantile study owing to the number of its representatives and their adaptations to different modes of life.

PART V. of the first volume of the *Records of the Albany Museum* contains papers on Hymenoptera by Messrs. Cameron and O'Neil, and two on fossil reptiles and fishes by Dr. R. Broom. Several new generic types of fossil reptiles are described, but their affinities are for the most part doubtful; the one fossil fish recorded is referred to the European ganoid genus Cœlacanthus.

AN elaborate account of the alimentary tract of the mosquito is contributed by Mr. M. T. Thompson to the *Proceedings of the Boston (U.S.A.) Society of Natural History*, vol. xxxii., No. 6. The ordinary gnat (*Culex pipiens*) and two other species of the same genus afforded material for the investigation, Anopheles not being sufficiently abundant.

THE contents of *Biologisches Centralblatt* of October 15 include an article by Mr. H. Kranichfeld on the probability of the preservation and continuity of favourable variations in animals, with arithmetical calculations; a second (to be continued), by Mr. K. C. Schneider, on the elements of comparative animal physiology; and a third (likewise not completed) on "neurons," or nerve-fibrillæ, by Dr. Max Wolff, of Jena.

IN the October issue of the *American Naturalist* Prof. B. M. Davis continues his detailed account of the structure of the vegetable cell, while Prof. T. D. A. Cockerell furnishes a diagnosis of the bees of the genus Diadasia, and Dr. H. W. Shimer describes a variety of the brachiopod *Terebratalia transversa* from Alaska, remarkable for the extreme thickness and rugosity of the shell, its abraded umbo, and the presence of a small perforation on each side of the aperture for the pedicel.

THE latest issues of the *Proceedings of the U.S. Nat. Museum* include a list of American cochlidian moths, with descriptions of new genera and species, by Mr. H. G. Dyar; and descriptions of new South American moths, by Mr. W. Schaus, of Twickenham. The latter comprises no less than 479 species regarded as new, many of them indicating previously unknown generic types, one of the latter being designated Rothschildia, in honour of the owner of the Tring Museum.

THE October issue of the *Zoologist* contains a summary of the results of last season's sealing in Newfoundland waters by Mr. T. Southwell, of Norwich. It is very interesting to note that, owing to a postponement of the date for taking the young, the product of a given number of seals has exceeded that yielded by the same number last year by no less than 770 tons. That seals are still abundant is evident from the statement that one of the vessels came upon a "patch" of some 600,000, of which only a few could be killed. These northern harp-seals are stated to differ from those killed further south.

TO vol. xxvi., No. 3, of *Notes from the Leyden Museum* Dr. Jentink contributes an important and well illustrated paper on the wild swine of the Malay Archipelago. In the author's opinion all these pigs are indigenous, and each island form represents a distinct species, the long-snouted *Sus oi* of Sumatra thus being distinct from the Bornean *Sus barbatus*. Dr. Jentink appears to be unaware that Mr. Lydekker, on the evidence of photographs sent by Dr. H. N. Ridley, recorded in the *Field* for last year the existence of a representative of this long-snouted group in the Malay Peninsula.

MR. J. WIMMER, of Vienna, has sent us a copy of a "booklet" of sixty-four pages by himself entitled "Mechanik der Entwicklung der tierrischen Lebewesen," published at Leipzig by Mr. J. A. Barth. In this work the author discusses, with the aid of diagrams and mathematical formulas, the mechanical adaptations of animals of all classes to the conditions of their existence, and in relation to their modes of progression. One chapter is devoted, for instance, to the mechanics of the external form of the body, a second to those of its internal structure, and a third to those of the movements of the limbs. The work appears to be a concise summary of all the essential facts connected with the subject.

NATURE-STUDY on the part of children formed an essential feature in a paper on local museums (and the discussion which followed) read at the Worcester conference of the Museums Association, as reported in the October issue of the *Museums Journal*. While it was generally agreed that the proper function of local museums is to exhibit local faunas, floras, and antiquities, some difference of opinion was expressed as to whether it is desirable to enlist the services of children in making such collections, one speaker strongly disapproving of any encouragement being given to children to collect. The discussion also took into consideration the question as to whether museum curators should be called upon to assist in teaching, but the general opinion was that if any such instruction was demanded from them it should be confined to educating the teachers.

IN part xii. of the report of the Danish Biological Station to the Board of Agriculture, Dr. C. G. J. Petersen discusses the question whether plaice undergo their whole development, from egg to adult, in the open parts of the Baltic Sea. It is well known that the pelagic eggs of the plaice are shed between November and April (most of them in the depth of the winter), and also that the fry are pelagic until such time as they become unsymmetrical, when they seek the warm shallow water of flat sunny shores, this taking place in that part of the Baltic known as the Skaw during May and June. It has been found,

however, that the number of fry which visit the shores bears no proportion to the vast quantities of spawn that are shed; and it is concluded that this loss is accounted for by the fact that the whole development can only take place in cases where the young fish, when they cease to be pelagic, are in such localities that they can be carried by the current to the warm shallow water of the shores, such fry as sink in the cold depths of the Baltic itself inevitably perishing.

In the report on the botanic station, Grenada, it is mentioned that Mr. R. D. Anstead has been appointed agricultural superintendent, and Mr. G. F. Branch agricultural inspector.

New species of flowering plants recorded by Mr. J. N. Rose in vol. xxix. of the *Proceedings of the United States National Museum* include *Dahlia Chisholmi, Parnassia mexicana*—the first species of the genus from Mexico—a Henchera and Polianthus, all from Mexico, and an umbellifer, from the coast of Georgia, with fruits like a Carum and leaves modified into hollow-jointed phyllodes, which is made the type of a new genus, Harperia.

A comprehensive account of the distribution and ecology of the flora of west Prussia, by Mr. J. B. Scholz, appears in vol. xi., part iii., of the *Schriften der naturforschender Gesellschaft* in Danzig. The original flora is described as Baltic, and this has been enriched by the invasion of a south-east European or pontic element, consisting of plants requiring warmth and dryness, that have advanced from the steppe regions. Characteristic pontic species are *Artemisia scoparia* and *Scutellaria hastifolia* in the river valleys, and in the region of the Vistula are found *Stipa pennata, Stipa capillata, Adonis vernalis, Campanula sibirica,* and others. The writer has paid special attention to the plant associations of the moors, heaths, and forests, as they help to elucidate former migrations of plants.

The analysis of the species of Hevea is complicated partly owing to the close relationship existing between them and partly on account of the difficulty of obtaining flowers and fruit. Dr. J. Huber, of the museum at Pará, who has made a study of Brazilian rubber plants, has published a synopsis in vol. iv. of the *Boletim do Museu Goeldi,* Pará. The section Euhevea has not been augmented, but in the section Bisiphonia the variety *cuneata* has been raised to specific rank, and two new species have been formulated. Of the twenty-one species enumerated, none seems likely to rival the well known *Hevea brasiliensis*; *Hevea Benthamiana* and *Hevea discolor* are considered to be the best rubber-bearing trees growing on the Rio Negro.

The *Century Magazine* for November contains an account of the very important Egyptian finds of Mr. Theodore M. Davis, of Newport, early in the current year. Among the tombs of the kings at Thebes were found those of Ioua and Tioua, father and mother of Queen Tii, wife of Amenhotep III. and mother of the heretic King Akhenaten. In addition to the ordinary appurtenances of tombs, such as vases, the find includes stools, chairs, beds, and other furniture magnificently overlaid with gold. One of the objects found was a chariot, the pole of which was broken, as were many other things; Maspero explains this as a method of killing the object and making it available for the use of the dead, and his view would hardly be questioned by anthropologists, or, we may suppose, by Egyptologists. The writer of the article, however, Mr. Greene, appears to doubt this explanation, holding that the custom may have been practised in Peru, but that the Egyptians were on too high a level of culture for it to be thinkable that such savage ideas survived among them. This view will hardly commend itself to experts; in fact, savage survivals are conspicuous in Egypt. The article is excellently illustrated with one plate in colours and many photographs, both of the tomb and the objects found there, and of the difficult task of conveying them to a place of safety in Cairo through a land in which honesty is not one of the prevailing features.

Mr. A. A. Read gives in *Engineering* the results of a comparison of the principal methods for the determination of manganese in iron and steel. The volumetric results are slightly lower than those obtained by the gravimetric method, but they agree sufficiently closely for practical purposes. With ferromanganese the bismuthate method gives rather too low a result as compared with the ammonium acetate method, probably owing to a small quantity of the permanganate having been decomposed and filtered off with the excess of the sodium bismuthate.

The Home Office has just published the annual return of the quantity and value of various minerals raised in the United Kingdom in 1904. The total value of the mineral output was 97,477,639*l.* as compared with 101,808,404*l.* in 1903. The decrease is due to a fall in the average price of coal. The production of coal, 232,428,272 tons, was the highest hitherto recorded. The output of gold from Merionethshire rose from 5495 ounces in 1903 to 19,655 ounces in 1904, the value of the gold being 73,925*l.*

We have received from the author, Dr. H. Potonié, professor at the Berlin School of Mines, a copy of the third edition of his interesting work on the origin of coal (Berlin: Borntraeger Brothers, 1905, price 4*s.*). It is an admirably illustrated pamphlet of 53 pages prepared to elucidate the diorama of a Coal-measure landscape exhibited by the Erkelenz Boring Company at the Liége International Exhibition. It is written in French and German in parallel columns, the French translation having been made by Prof. Gaspar Schmitz, of Louvain. Prof. Potonié's views as to the origin of coal are well known from his previous publications. He now brings forward further evidence to show that, just as at the present time the deposits of humus were almost exclusively formed *in situ,* in previous geological times it was also the rule that such beds were formed at the place where the plants grew from which they were derived.

Dr. van Rijckevorsel has sent us a copy of an elaborate and valuable discussion entitled "Constantly Occurring Secondary Maxima and Minima in the Yearly Range of Meteorological Phenomena." Dr. van Rijckevorsel, who is an honorary assistant attached to the Meteorological Institute of the Netherlands, and has for many years been known as a conscientious and painstaking investigator in the domain of meteorology and terrestrial magnetism, has divided the present work into two parts. The first portion exhibits ordinary mean daily values and smoothed means for many stations, mostly in the northern hemisphere, for a large number of years, and for various elements, with curves of the normal annual range of temperature. The principal results of the investigation show (1) that the resultant curve of daily normal temperature in the northern hemisphere is a continuous zigzag of maxima and minima; the rise from the winter minimum to the summer maximum is not uniform, but occurs in

spells or periods which at times are so strongly pronounced that the mean temperature falls, instead of rising, for several days together, and these irregularities, generally speaking, occur everywhere at the same time. (2) That this phenomenon is apparently similarly exhibited over the whole globe. (3) That probably other elements than temperature, even those not generally reckoned as meteorological, exhibit the same peculiarity. (4) That it is not improbable that these occurrences are connected with the sun's activity. In the second portion of the work the author endeavours to show that there is great probability that the same phenomenon really occurs in the southern hemisphere, but the data available do not at present allow of positive conclusions. The magnitude of the work undertaken may be gauged from the fact that the observations of some 3636 years have been discussed. In this portion of the discussion Dr. van Rijckevorsel has departed from the usual method of treating the means of observations from any particular locality as a separate unit, but has thrown all the observations for any year together, irrespective of place or date, as he considers that this method gives better data for the object in view.

THE *Proceedings of the Mathematical Society of Edinburgh* for the session 1904–5 open with a systematic paper on the properties of the envelope of the Wallace or Simson line by M. Collignon, including not only geometrical, but also kinematical considerations. Dr. Mackay also publishes a bibliographical note intended to accompany Collignon's memoir. Mr. R. F. Muirhead gives new proofs of Newton's theorem on sums of powers of roots, and also of Waring's expression for the sum of the powers in terms of the coefficients. Mr. E. B. Ross contributes a neat discussion of the degree of contact between a curve and its envelope; and in a paper on polar loci Mr. D. G. Taylor, in order to get rid of the confusion due to multiple values of r for what seems to be graphically one value of θ, imagines an infinite number of parallel planes one above the other slit up from o to ∞ along the initial line and joined together so as to form a kind of helical surface. Dr. Muir communicates a note on the condensation of continuants, and Prof. Bromwich gives a useful method for distinguishing the ambiguous cases in the solution of spherical triangles.

IN the *Transactions of the Faraday Society* (vol. i., part iii.) Mr. Sherard Cowper-Coles gives an interesting account of the various processes which have been suggested for increasing the rate of deposition of electrolytic copper on a commercial scale. It is claimed that the centrifugal process is at least ten times as rapid as any other process. When the mandrel which constitutes the kathode is rotated with sufficient rapidity, smooth, thick deposits of copper in the form of tubes are obtained which show no trace of lamination. The paper is illustrated by numerous plates, in which the influence of the rate of rotation on the character of the electrolytic copper is clearly evident.

THE supposition that radium is a disintegration product of uranium has received considerable support from the investigations of Strutt, McCoy, and Boltwood. The question whether the production of radium from a pure uranium compound can be experimentally detected would, however, seem to be answered in the negative by recent experiments of Mr. Bertram B. Boltwood, published in the *American Journal of Science*, vol. xx., 1905. Observations on a solution containing 50 grams of uranium, which extended over a period of 390 days, indicate that the quantity of radium formed is less than $1{\cdot}7\times10^{-11}$ gram. This is less than one sixteen-hundredth of the quantity which would be expected from the disintegration theory, and the author concludes that one or more products of a slow rate of change intervene between uranium and radium.

THE *Revue générale des Sciences* for September 15 contains a reprint of a lecture which was delivered by Prof. P. A. Guye before the Chemical Society of Paris on new researches on the atomic weight of nitrogen. The author reviews the results already obtained, and concludes that sufficient differences exist to render fresh determinations necessary. The classic gravimetric methods are not considered sufficiently accurate, and a description is given of new methods of determining the atomic weight of the element based on the analysis of nitrous oxide. A spiral of iron wire is heated electrically in a known weight of the gas and the increase in weight found. In another series of experiments, an iron spiral is similarly heated in a known volume of nitrous oxide. The mean value assigned for the atomic weight is 14·009. An article is also contributed to the same number by MM. J. de Kowalski and J. Dalemont on the teaching of applied science at Fribourg University.

AN important paper by Mr. H. v. Steinwehr on the influence of the size of crystals of mercurous sulphate on its relations to electromotive force ("Vorlaüfige Mitteilung über den Einfluss der Korngrösse auf das electromotorische Verhalten des Merkurosulfats") has lately been published in the *Zeitschrift für Instrumentenkunde*, 1905, Heft. vii. The paper deals with a subject of great interest, and one which at the present time is occupying a great deal of attention in all countries in connection with the preparation of standard cells. The author experimented on samples of mercurous sulphate obtained from different makers, and found that they gave a difference of electromotive force equal to 5×10^{-4} volts; it was also found that they varied in solubility. On examining them under a microscope a difference in the size of crystals was observed, the smaller crystals having a higher solubility and higher E.M.F. The subject was pursued both in the direction of reducing the crystals by grinding and of increasing them by crystallisation, and the same result was obtained, viz. the larger the crystals the lower the solubility and the smaller the E.M.F. The author thinks it highly probable that the size of crystals is the chief, if not the only, cause of the differences observed in different samples of mercurous sulphate. He further criticises the conclusions of Hulett that it is the presence of basic salt that affects the result. In conclusion, he discusses the electrolytic method of preparation suggested by Hulett and Fr. A. Wolff and recommended by Carhart for standard cells, stating that it is bound to lead to the production of crystals of very varying size, and the device used by them of continuing the stirring after the circuit is broken cannot have the desired effect, as the crystallisation of mercurous sulphate is very slow. We await with interest the further communication by the author, and hope he will then have some suggestion as to an improved method of preparation.

WE have received part i. of a book on leather dressing, including dyeing, staining, and finishing, by Mr. M. C. Lamb, director of the leather dyeing department, Herold's Institute, Bermondsey. This portion, containing thirty pages, is the first of twelve monthly parts of which the book will consist; it deals with sorting, splitting and shaving, and is well printed and illustrated, the working parts of the machines described being explained by

diagrams. Until the book is completed it would be impossible to form an opinion of its value, but the first part promises well.

THE annual report of the board of regents of the Smithsonian Institution for the year ending June 30, 1904, has now been published. As usual, the general appendix to the report, which makes up about seven-eighths of the volume of 804 pages, will prove most interesting to British readers. This appendix contains more than fifty articles upon scientific subjects to which special attention was directed during the year with which the report deals. Five of the articles represent addresses at the congress of arts and sciences held at St. Louis during September, 1904. Among these may be noticed that of Prof. H. H. Turner, F.R.S., on some reflections suggested by the application of photography to astronomical research; Mr. C. T. R. Wilson, F.R.S., on condensation nuclei; and Sir William Ramsay, K.C.B., F.R.S., on the present problems of inorganic chemistry. Two addresses delivered at the Cambridge meeting of the British Association are also reprinted. A generous selection of articles from important American, French, German, and British scientific publications is included, and nearly every department of scientific knowledge is represented. There are several articles which appear to have been contributed specially to this report, and of these may be mentioned the essays of Dr. S. P. Langley on experiments with the Langley aërodrome (see p. 645), Dr. J. O. Skinner on the house sparrow, Dr. Theodore Gill on flying fish and their habits, Mr. Edgar L. Hewett on a general view of the archæology of the Pueblo region, Dr. Alés Hrdlička on the painting of human bones among the American aborigines, and Mr. W. C. Gorgas on the sanitation of the Isthmian Canal zone. The profusion and excellence of the plates and other illustrations again call for remark. Readers who are fortunate enough to have access to these yearly reports are provided with an excellent means of keeping abreast of current scientific studies.

OUR ASTRONOMICAL COLUMN.

ITALIAN OBSERVATIONS OF THE RECENT SOLAR ECLIPSE.—A series of valuable observations of the partial eclipse of the sun was made at Aosta (Italy) on August 30, and the results are given in No. 17 (1905) of the *Comptes rendus*.

The times of contacts, the meteorological changes, and the spectroscopic phenomena were observed in an atmosphere of exceptional purity, and, in connection with the last named, Dom Cl. Rozet describes what he believes to be a unique observation. At about 1h. 40m. (Paris M.T.) the cusp of the crescent sun (position angle about 90°) was projected on to the widened slit of the spectroscope, arranged perpendicular to the solar limb, and the lines C and D_3 were seen very bright and showing a hazy, cloud-like prominence.

The bright line in each case, however, was divided sharply into three parts. First, on the red side was a broad bright line with sharp edges, then came a narrow, well defined *dark* line, and finally, on the more refrangible edge, a bright line showing the form of the prominence was seen.

MARTIAN METEOROLOGY.—In No. 8, vol. liii., of the *Harvard College Observatory Annals*, Prof. W. H. Pickering discusses a number of photographs of Mars some of which were taken with the 13-inch Boyden telescope at Cambridge (Mass.) in 1888, and the others at Mt. Wilson, with the same instrument, in 1890. Although these photographs do not show the canals and lakes, they show sufficient variation, due to meteorological changes, for a discussion of Martian meteorology.

Prof. Pickering describes, in order, the appearance and disappearance of clouds, snow, &c., and deduces therefrom some valuable suggestions as to the seasonal changes which take place on or above the planet's surface, giving, in each case, the equivalent terrestrial date at which these changes occur. Nine reproductions from the original photographs, on a scale of 1 mm. = 200 km., accompany the paper, and show the clouds, &c., to which Prof. Pickering refers; the Sinus Sabæus and the Syrtis Major are also shown on some of them. On two occasions the height of the clouds above the Martian surface was measured, giving about 15 miles as the result, and Prof. Pickering suggests that the existence or non-existence of such clouds in the equatorial regions may account for the discrepancies noted between various estimations of the amount of the polar flattening.

In conclusion, Prof. Pickering points out that there is now direct evidence of an effective atmospheric circulation of moisture on Mars which would seem to account, adequately, for the observed transfer of precipitation, during the Martian year, alternately from pole to pole.

A 300-YEAR CYCLE IN SOLAR PHENOMENA.—From a lengthy discussion which appears in No. 1, vol. xxii., of the *Astrophysical Journal*, Mr. H. W. Clough, of the Washington Weather Bureau, arrives at the conclusion that a 300-year cycle exists in solar, and the allied terrestrial, phenomena. In the first place, Mr. Clough discusses the observations of numerous terrestrial phenomena which are supposed to be dependently associated with solar changes, and finds that a 36-year cycle is common to these and to solar variations. He then shows that the 36-year cycle varies in length during a cycle of 300 years, and supports this by reference to old observations of various terrestrial phenomena, *e.g.* auroræ, time of grape harvest, &c., extending back to the early centuries of the Christian era.

SOME SUGGESTIONS ON THE NEBULAR HYPOTHESIS.—In a paper communicated to the Royal Society of Edinburgh, and published in part vii., vol. xxv., of the *Proceedings* of the society, Dr. Halm makes some suggestions, concerning the probable genesis of the solar system, which may overcome some of the difficulties experienced in the acceptance of Laplace's theory. Whilst the Laplaceian hypothesis considers that the matter now forming the planets was thrown off by the original *rotating* nebulous mass, a consideration which is not consistent with the principle of the constancy of the rotary momentum in a system, Dr. Halm suggests that the conditions necessary for the formation of planets were not introduced until after the solar body had condensed from a *non*-rotating nebula into a spherical body having a diameter probably less than the distance of Mercury. This spherical body then encountered a swarm of meteorites, and finally a ring of these bodies, rotating with orbital velocities about the solar nucleus, was formed.

The planets were formed subsequently by the evacuation of the ring by the larger nuclei existing therein, their rotary motions being generated by the tangential impulses given to each nucleus by the smaller masses falling into it. Many subsidiary considerations are discussed in Dr. Halm's paper, but they are too lengthy to be given here.

SYSTEMATIC ERROR IN TRANSIT OBSERVATIONS OF JOVIAN SPOTS.—We recently referred in these columns (September 21) to a suggestion made by the Rev. T. E. R. Phillips to account for a systematic error in eye-estimates of the transits of Jupiter's spots, and, in the current number of the *Observatory*, Mr. Stanley Williams supplements Mr. Phillips's remarks with a brief discussion of his own results, in which a similar, but larger, systematic error seems to exist. Mr. Williams suggests that the phase-darkening of any long feature such as the red spot, or hollow, may introduce the error. For example, at the quadrature preceding opposition the planet's disc for some distance from the preceding limb is less bright than it is near to the following limb, but at the quadrature following opposition the reverse is the case. As the spot and the hollow are so long, the transit is observed, in practice, by comparing the relative spaces between their ends and the limb, and if the latter are unequally bright, irradiation may lead to such a systematic error as the one which appears in the results.

THE ORBIT OF σ CORONÆ BOREALIS.—As the orbits calculated from the observations of σ Coronæ Borealis show great divergence, ranging from 200 to 800 years, Prof. Doberck has investigated this subject, and now publishes the results in No. 4051 of the *Astronomische Nachrichten*. The set of elements which he gives depends upon Herschel's measures of the angle, and shows the period to be about 1679 years, and the motion to be direct.

Prof. Doberck states that the hypothetical parallax of this system is 0″·064, but the actual parallax is probably smaller, and that the mass of the system is probably greater than that of the sun.

RADIAL VELOCITIES OF CERTAIN VARIABLE STARS.—The results obtained by Prof. Frost from a series of spectrographic observations of certain variable stars (chiefly of the Algol type) are given in No. 3, vol. xxii., of the *Astrophysical Journal*.

R Canis Majoris, Z Herculis, and U Sagittæ are shown with certainty to be spectroscopic binaries, their determined velocities corresponding, in sense, to what would be expected from the phase in the light variation at the time of observation.

VARIABILITY OF THE ASTEROID (444) GYPTIS.—The variability of the apparent brightness of the minor planet (444) Gyptis is suggested by the results obtained from a series of observations made at Heidelberg and published by Dr. W. Valentiner in No. 4050 of the *Astronomische Nachrichten*.

In the same journal it is suggested, by Dr. Palisa, that the magnitude of minor planet 1905 RB is also variable.

CONFERENCE OF DELEGATES OF LOCAL SCIENTIFIC SOCIETIES.

AS it was not deemed expedient to call a meeting of the delegates of the corresponding societies of the British Association during the session in South Africa, it was arranged that a special conference should be convened subsequently in London. This meeting was held at the rooms of the Linnean Society on Monday and Tuesday (October 30 and 31), and was largely attended by representatives of various scientific societies in England, Scotland, and Ireland.

Dr. A. Smith Woodward, who presided at the conference, delivered an inaugural address rich in sympathy with the efforts of the provincial societies to further the progress of science, yet not without a word of gentle reproof to such societies as give undue prominence to the picnic element, which rather tends to the estrangement of the working naturalist. Probably the best work of the smaller societies was, in the chairman's opinion, that of instruction in the current progress of science. He suggested that it would be salutary to dwell on the unsolved problems of science, and pointed out the need of books which should treat of our ignorance rather than our knowledge, and so indicate the direction in which investigation is still urgently needed. Dr. Woodward condemned as extremely unfair the growing practice of certain societies to solicit men of scientific renown to deliver popular lectures without fee. Warm approval was expressed of the recent action of the British Association in seeking to extend its usefulness by including within its union the smaller non-publishing societies and field clubs, which will form henceforth a new class of *associated* societies distinct from the group of *affiliated* societies which publish original investigations in science.

Dr. W. Martin, of the Temple, introduced a discussion on the law of treasure trove, with the view of inducing the various local societies to assist in the preservation of antiquities found within their sphere of influence. While generally defending the law he advocated some revision, especially in the mode of its administration. He suggested that notices should be widely circulated, say at the post-offices throughout the country, explaining to the public that the finder of valuable relics would receive reasonable remuneration. In a similar way, relics like stone implements might be secured, where desirable, by the State.

Mr. Morris Colles, the director of the Authors' Syndicate, and Mr. Harold Hardy explained the present law of copyright as it affects the published proceedings of scientific societies. The general sentiment of the meeting seemed, however, to be in favour, not of hindering in any way the re-publication of papers, but rather of encouraging the dissemination of knowledge by favouring publication, naturally with due acknowledgment of the original source of information.

Prof. G. S. Boulger read an interesting paper on the preservation of our native plants, which led to a valuable discussion. There seems no doubt that some of the rarer indigenous plants are in serious danger of extermination, not wholly through thoughtlessness on the part of the public, but partly through the cupidity of botanists—an evil which has increased since the extension of nature-study. It was proposed that legislation should ultimately be sought for the protection of certain plants, but that meanwhile a circular should be issued bringing the subject before teachers, members of field clubs, and others interested in our flora and likely to assist in its conservation.

In addition to attending the two meetings, the delegates visited the Museum of the Royal College of Surgeons under Prof. Stewart, and, on the evening of October 30, dined at the Royal Societies Club, where they were received as guests.

ZOOLOGY AT THE BRITISH ASSOCIATION.

THE work of Section D was formally opened on Wednesday, August 16, with the president's address on "The Distribution of African Fresh-water Fishes," which has already been printed in NATURE (August 24, p. 413). This was followed by a paper by Mr. L. Doncaster entitled "Recent Work on Gametogenesis and its bearing on Theories of Heredity," which took the form of a *résumé* of the most important recent work on the relation between the phenomena of nuclear division and those of heredity. It was shown that whilst ample confirmation had been obtained of Weismann's hypothesis that the chromosomes are the bearers of inherited characters, yet the most recent work on the maturation of the germ cells had demonstrated the fact that they contained a mechanism which seemed precisely adapted to bring about that segregation of characters which forms the most fundamental part of the Mendelian theory; it was difficult, therefore, to believe that the two things were unconnected. The remainder of the paper was devoted to the consideration of certain obvious difficulties standing in the way of a complete correlation.

The programme for Thursday, August 17, was opened by Dr. J. D. F. Gilchrist with a paper on cases of extensive mortality among marine animals on the South African coast, with suggestions as to their cause or causes. After narrating specific cases of enormous quantities of fish either dead, or alive but "in a stiffened condition," being thrown up on various points of the coast, the author suggested that these occurrences might be due to a peculiar feature of the Cape seas, viz. the great difference in temperature, salinity, and contents of the warm Agulhas Stream of the Antarctic drift current, and expressed the hope that his notes might be of some use in directing attention to this problem and securing additional evidence in connection therewith. The paper was followed by a demonstration of the more interesting forms in a collection of deep-sea animals shown in the museum of the South African College, special attention being devoted to certain questions, such as methods of reproduction of deep-sea fish, the significance of luminous organs, and parasitism. A short paper by Mr. A. H. Evans on the ostrich and its allies was intended to be introductory to a contribution on ostrich-farming by the Hon. Arthur Douglass, one of the pioneers of the industry in the colony. In the latter paper the writer supplied a large amount of interesting information relating to the first commencement of ostrich farming in 1867 and its growth up to the present time, the best climatic and general conditions for the industry, the results of artificial hatching as used in the early days of the industry as compared with present methods of rearing the chicks, the principal diseases of the birds, the present different methods of farming them, the growth of the export of feathers and the range of values, the improvement of the breeds by selection to obtain better feathers,

the prospects of future development of the industry in South Africa, and of its being successfully developed in other countries. The reports of the committees on grants, which were also taken on this day, did not offer any special points of general interest.

The greater part of the sitting on August 18 was devoted to a paper on the origin of mammals, by Prof. Broom, in which the author had occasion to make extended reference to his work on the Triassic reptiles of South Africa in support of his views of a reptilian origin for the mammalian group. The author gave reasons for believing that in early Permian times a cotylosaurian reptile, owing to its frequenting marshy ground, took to walking with its body well supported off the ground. This habit gave rise to the forward direction of the ilium, and to the pubis and ischium being turned backwards, as also to the great development of the precoracoid. No member of this first stage in the mammalian line was at present known, but Pareiasaurus was apparently a considerably modified offshoot from it.

The next stage in the development arose by the marsh animals finding that the new modification of the limbs was specially suitable for progression on land. The new type of land animal was better equipped than the normal reptile, and took to predatory habits and became an active carnivorous animal. These early carnivorous types form the order of Therocephalians, of which about twenty genera are known. Between the Upper Permian and the Upper Triassic times the Therocephalians gave rise to the much improved Theriodonts or Cynodonts. These Theriodonts are almost mammals in every detail of structure, the only essential difference being that the lower jaw has still a small articular element, which hinges on a small quadrate bone. The change from the Theriodont to the mammal was probably brought about by a slight change of habit necessitating some antero-posterior movement of the jaw, the small quadrate bone becoming first a plate of bone and then a plate of cartilage—the inter-articular cartilage, the dentary taking the place of the articular. Neither the auditory ossicles nor the tympanic have ever had anything to do with the articulation. The mammalian malleus was held to be the reptilian extra-stapedial and the mammalian incus the supra-stapedial. The connection between Meckel's cartilage and the malleus, which is hyomandibular, was held to be similar to that between the extra-stapedial and the mandibular cartilage in the crocodile. The mammalian tympanic was considered to be the homologue of the distinct tympanic bone of Anomodonts and Theriodonts. The paper gave rise to considerable discussion, in which Prof. W. B. Scott of Princeton, the president, and others took part, and was followed by a communication from Dr. W. F. Purcell on some early stages in the development of Peripatus, in which the writer maintained that an examination of the segmentation stages of the ovum of *Peripatus balfouri* preserved in formalin shows that the endodermal cells are oval or spherical bodies with well defined convex or flattened contours, but without any anastomosing branches connecting the cells with one another or with the ectoderm. The embryo in the segmentation stages is therefore not a syncytium, as maintained by Mr. A. Sedgwick. The remainder of the session was devoted to an important paper on the habits and peculiarities of South African ticks, by Mr. C. P. Lounsbury, which the sectional committee resolved to print *in extenso* in the *Proceedings* of the association, whilst certain details in the structure of the buccal apparatus of a tick (*Haemaphysalis punctata*) were elucidated in a concluding joint paper by Drs. Nuttall, Smedley, and Cooper.

The first day of the proceedings at Johannesburg (Tuesday, August 29) was opened by Prof. Herdman, F.R.S., who gave an account, illustrated with lantern views, of his well known investigations on the pearl-oyster beds of Ceylon. This was followed by an interesting communication on Cephalodiscus by Dr. S. F. Harmer, F.R.S., in which the author gave a preliminary account of the new species discovered in African seas by Dr. Gilchrist. The session was concluded with a demonstration of ankylostoma preparations by Mr. A. E. Shipley, F.R.S.

The programme for Wednesday, August 30, was opened by Prof. E. B. Poulton, F.R.S., who gave a lecture, illustrated with lantern slides, on mimicry in South African insects. This was followed by a paper by Mr. W. L. Sclater, director of the South African Museum, on the migration of birds in the southern hemisphere. For the purposes of the paper the author took the list of birds contained in the recently published volumes of the "Fauna of South Africa," written by the late Dr. Stark and himself, together with those of the fourth volume, shortly to be issued. The number of species described in the four volumes was 814, which the author divided into five categories, as follows:—residents, 631; northern migrants, 76; African migrants, 21; partial migrants, 50; and island breeders, 36. Mr. Sclater stated that he considered it would be most unwise to evolve any theories on migration in South Africa at present, owing to the dearth of observations hitherto recorded. He was, however, in hopes of making some advance by the distribution of schedules among the lighthouse keepers along the coast, teachers in the schools all over the country, and any others who would undertake to make the observations, for the purpose of recording, day by day and month by month, the appearance of different species of birds.

Mr. C. B. Simpson, the Transvaal Government entomologist, then read a paper on locust destruction in the Transvaal during the season 1904–5, in the course of which the writer gave an outline of the history of the locust pest in other countries, and then proceeded to describe the locust invasions in South Africa, due to two species, *Acridium purpuriferum* (the purple locust) and *Pachytelus sulcicollis* (the brown locust). Although both species were shown to have many natural enemies, yet every natural method of decimation was found to be insufficient. Therefore, in order to save the farmers' crops, recourse had to be had to artificial means. Amongst the methods adopted were beating by hand, tramping with stock, crushing with rollers, burning grass, driving into trenches, the use of locust screens, and spraying. The screens were described in detail with the help of the lantern, the author stating that twenty miles of them were distributed throughout the Transvaal for the use of farmers. Spraying was, however, the most efficient means for the destruction of locusts. The spray used was arsenate of soda, and it was given to the farmers free, while the screens and spray-pumps were lent without charge. The results of the campaign in the previous year had been most gratifying. It was of course stated that the Transvaal, still less South Africa, could not expect to eradicate the pest completely on account of the vast area of unoccupied country; but the author's department did hope to place in the hands of the farmers a means whereby by combined action they could kill the insects and protect their crops. If they could do this they would consider that success had been achieved. With the purple locust the author believed they had proved that the farmers could do this, but with the brown locust they had not yet had sufficient experience to be able to tell whether they could prevent injury or not. The concluding paper of the session, by Dr. H. Lyster Jameson, was entitled "On Some South African Land Planarians," and dealt with certain points in their anatomy.

The concluding meeting of the section was held on Friday, September 1, on which day Prof. W. B. Scott, in an opening paper on convergent evolution as illustrated by the Litopterna, maintained that while convergent evolution was admitted by most naturalists to be a frequent and important phenomenon, there was a great difference of opinion as to how nearly identical the results of such a mode of development might be. So far as the Litopterna were concerned, there were striking resemblances to certain Perissodactyls in teeth, skull, and skeleton, but the differences were many and fundamental. It did not appear at all likely that so complex a structure as a mammalian skeleton was ever produced in identical terms by two independent series.

In the course of the succeeding paper, on a neuro-syncytial theory of development, Dr. W. H. Gaskell, F.R.S., referred to his theory of the origin of vertebrates, and pointed out that it was based upon the paramount importance of the central nervous system as the chief factor in the upward progress of the animal kingdom. Every line of investigation pointed to the conclusion that the

vertebrate arose from that group of invertebrates which possessed a central nervous system most nearly similar to that of a low vertebrate such as Ammocœtes, an invertebrate, therefore, belonging to the group of arthropods. This argument had been worked out by the author in a series of papers published in the *Journal of Anatomy and Physiology*, and receives especial support from the palæontological record. For the dominant race now, the biped mammal man, arose undoubtedly from the highest race evolved up to that time—the quadrupedal mammals; these in their turn originated from the dominant reptiles; these again from the amphibians, which were the most highly organised group of their day. The amphibians themselves came from the dominant race living in the sea at the time—the fishes; so, too, according to the author's theory, the fishes arose directly out of the race previously dominant, *i.e.* the arthropod group. This theory necessitates the formation of a new alimentary canal at the transition from the arthropod to the vertebrate—a requirement which is no more unlikely than the formation of a new respiratory apparatus at the transition of a fish into an amphibian. The reason why others have found this formation of a new alimentary canal so difficult of acceptance is because embryology—and embryology alone—in its recent teaching makes the alimentary canal, and not the central nervous system, the important organ around which the animal is built up. The author, basing himself especially on Braem's papers in the *Biologisches Centralblatt*, pointed out that in reality the germinal layer theory was a physiological and not a morphological conception, that the one criterion of hypoblast was not its mode of formation but its ultimate fate; whether or no, the definite alimentary canal was formed from it. Morphological laws of development must exist, but to quote Samassa, "one thing can be said with certainty at the present time, the germinal layer theory is not one of them." The author suggested a re-consideration of the whole matter, and, starting with the adult, pointed out that the tissues of the body fall naturally into two great groups, those which are connected with the central nervous system, the master tissues of the body, and those which live a free existence without any such connection. The body might be looked upon as composed of a neuro-epithelial syncytium, in the meshes of which free cells live.

Prof. Cleland, F.R.S., in conclusion, read a communication on the growing-point of the Vertebrata, in the course of which he pointed out that while the medullary folds appear in close connection with the blastopore, and the parts concerned with the cranium and its contents are the first to appear, both mesoblastic somites and spinal nerves appear in succession, each metamere behind that which is immediately proserial to it. It follows, therefore, that it is from the short space between the medullary folds and blastopore that new metameres of the neuromuscular system are formed, and there is no reason to doubt, the author held, that the visceral system is extended in the same manner. The nucleated corpuscles of this region furnished, therefore, in his opinion, the parents of the corpuscles of which the successive metameres of the trunk are composed, and they do so by giving off successive series of corpuscles which belong each to a particular metamere.

EDUCATIONAL SCIENCE AT THE BRITISH ASSOCIATION.

THE most noteworthy feature in the educational science section at the South African meeting of the British Association was the address of its president, Sir Richard Jebb, an address which was originally delivered at Cape Town, and repeated with a little variation at Johannesburg. The address, which was printed in full in NATURE of September 28 (p. 545), dealt with the idea of a university and the distinction which marks off the teaching of a university from that of a higher technical school or similar institution.

The subject of the address was the more apposite in that the most pressing educational question in South Africa at the present time is the creation of a teaching university. The present Cape University is an examining body only, and it has been suggested that the time has come for it to grow into a teaching university by the combination of the colleges at present preparing for its examinations, much as the University of London was so recently re-created. The difficulties, however, both of funds and of conflicting interests have not yet been overcome.

At Johannesburg, also, the successful start of the recently established technical institute has led to a plan for its growth into a university, with engineering, agriculture, law and education as its main faculties, and it seems not unlikely that liberal financial support would be forthcoming should it be decided on fuller consideration to adopt such a scheme.

At the sectional meetings a large proportion of the papers was contributed by teachers resident in South Africa, so that opportunities were afforded to the visitors of learning what were the more pressing educational problems, and to the local members of discussing these problems on a wider platform. At Cape Town the Rev. W. E. C. Clarke gave a general review of the development of education in the colony, laying particular stress on the perennial difficulty of providing any efficient scheme for the instruction of the widely scattered country population. Mr. Clarke's paper excited considerable interest, and led to renewed discussion, especially the latter portion, which dealt with the status of the teacher in Cape Colony. He spoke of the power of the Cape Teachers' Union, and deplored the tendency of their conferences to be rather exclusively occupied with questions of salary and allowances instead of leading public opinion on matters of educational policy.

Mr. W. W. Way, principal of the Graaf Reinet College, also contributed a brilliantly written and hard-hitting paper on the disabilities of the South African schoolboy. He pointed out how the semi-tropical climate, the wealth of sun and air, the freedom and isolation of the life of the South African boy, while they produce an alert and self-reliant race, do not work well in the interests of education. The youth are essentially undisciplined and unintellectual, while the early physical development brings its own dangers. Mr. Way touched upon the further difficulties, both as to mind and morals, which arise out of the proximity of the native, the co-existence of two languages, the inferior type of teacher that characterised the past, and the narrowing influence of many of the religious bodies in the country. Nothing but an ampler endowment and a general rise in the status of the teacher can induce in the future South African a proper respect for his intellectual development.

The general history and administration of education in the other colonies were thoroughly dealt with at the Johannesburg meeting in a series of papers contributed by Mr. Warre Cornish, Mr. Gunn, and Mr. Duthie. They all showed certain common problems—the scarcity of suitable teachers and the necessity of improving their status and training, the expense of providing adequate school buildings, and the difficulties induced by the isolation of the farms. This latter question of education upon the Veld was also dealt with in a breezy paper by Mr. J. H. Corbett, a vivid and sympathetic presentation of the case, in which the author evidently trusted more to the self-devotion of the individual teacher than to any possibilities of organisation.

The second meeting at Cape Town opened with a paper by Mr. W. M. Heller on the methods of teaching science, with an introduction by Prof. H. E. Armstrong. At its close Mr. Oscar Browning expressed his dissent from the current view of the "heuristic" method—as an instrument of education it was valueless, and all good teachers of history and literature had worked by this method long before Prof. Armstrong resuscitated its unhappy name. Mr. A. D. Hall claimed that the value of the "heuristic" method lay in the inspiring ideal it set up; unrealisable as it might be, the natural tendency of the teacher was to drift along the other easier way of giving instruction *ex cathedra* instead of by the path of discovery and experiment. Mr. G. Fletcher, however, rather hit off the feeling of the meeting when he suggested that a close time should be declared for discussions of the "heuristic" method, which had in past years occupied far too much of the

attention of the educational section. Mr. Fletcher's own paper, which followed, dealt with the development of technical education in a new country, and suggested that many of the methods which had been successful in Ireland in the way of creating public interest and of eliciting the cooperation of the locality might well be adopted in South Africa. Nor should the Administration be deterred from making a start with technical education at any centre by reports as to the apathy of the residents; Irish experience would seem to show that a supply of good instruction would always produce an increasing demand for it.

The very important question of agricultural education was treated at Johannesburg by Mr. F. B. Smith, the Director of Agriculture in the Transvaal, and by Mr. A. D. Hall at Cape Town. Mr. Smith showed how efficiently an intelligence department had already been organised in the matter of agriculture in the Transvaal, where the farmer had at his call a service for investigation and advice which could not be rivalled in any other British country. An enormous amount of work had now been done on such matters as the introduction of improved crops, the eradication of stock diseases, &c., and the Afrikander farmer was beginning to rely upon the help of the department. Mr. Smith further outlined the nature of the course it was proposed eventually to establish in the Transvaal in connection with the future university. Mr. Hall was disposed to think that questions of economy would necessitate the colonies concentrating their efforts chiefly upon their expert staff for investigation and work among the current generation of farmers, and that there was not the same call for another staff to give instruction in the higher branches of agricultural science. The type of instruction for which the most pressing demand existed was a practical training in more improved methods of farming, and this could well be developed in connection with the experimental farms that had already been instituted in various parts of the country. It seemed as yet hardly worth while to create an elaborate teaching institution to produce the small number of experts and Government officers whom the country would require yearly, since suitable men could be picked out during the earlier practical courses of instruction and sent home to complete their scientific training.

One question, which recurred constantly during the tour, both in section meetings and in conversation, was that of native education, a thorny subject interwoven with many prejudices, both racial and religious. The general feeling among colonials is almost wholly opposed to education of what may not unfairly be called the ordinary missionary type, which seeks to teach the native to read and write English. Many large employers of labour refuse to engage any native acquainted with English, and other experienced men declare that the only effect of such a bookish training as has been given in the past is to make the native parasitic, either upon the white community or his more primitive fellows. But education by means of handicrafts, and proceeding entirely in the natives' own language, meets with general approval, both as supplying a much desiderated discipline and making the native more efficient economically, and also as likely to prove a sound method of eventually leading the native on to a higher plane of civilisation. This is essentially a matter on which the visitor can only speak with diffidence; indeed, it is claimed that many of the difficulties have arisen from the ill-considered, though well meaning, action of people at home.

The papers of more general interest included a discourse by Dr. J. H. Murray on "the world of words," in which he discussed, with appropriate illustrations from the English language, the various types of words and the manner in which they originated. Dr. Brill, rector of the Grey College at Bloemfontein, again submitted a paper of great interest on the origin of the "Tael," the form of Dutch commonly spoken throughout South Africa. The Tael he holds to be a pure Dutch, "clipped," however, by the removal of practically all inflexions, genders, and irregular forms. What little foreign element exists in the language he attributes to early intercourse with the East, and regards it in the main as of Malayo-Portuguese origin. The members of the British Association who were interested in education had many opportunities of seeing the schools in the centres they visited, and also of intercourse with the teachers at work in them. The raw material with which the latter have to deal may not as yet have imbibed any great keenness for learning, but the general attitude of the citizens of the country towards education, as indicated, for example, in such matters as school buildings (often in the smaller towns of Cape Colony the most notable public building was the school), shows a life and determination which will not be long before bearing fruit.

THE SCOTTISH NATIONAL ANTARCTIC EXPEDITION.

A SUMMARY of some of the preliminary scientific results of the Scottish National Antarctic Expedition appeared in the August number of the *Scottish Geographical Magazine*, and this has now been issued in the form of a corrected reprint, from the office of the expedition in Edinburgh. The pamphlet contains an introduction by Mr. W. S. Bruce, the leader of the expedition, a paper on the bathymetrical survey of the South Atlantic Ocean and Weddell Sea, also by Mr. Bruce, and short papers on the deep-sea deposits, by Dr. Harvey Pirie, on the meteorology of the expedition, by Mr. Mossman, and on Diego Alvarez, or Gough Island, by Mr. Rudmose Brown. An account of part of the work of the expedition has already appeared in these columns (NATURE, March 2).

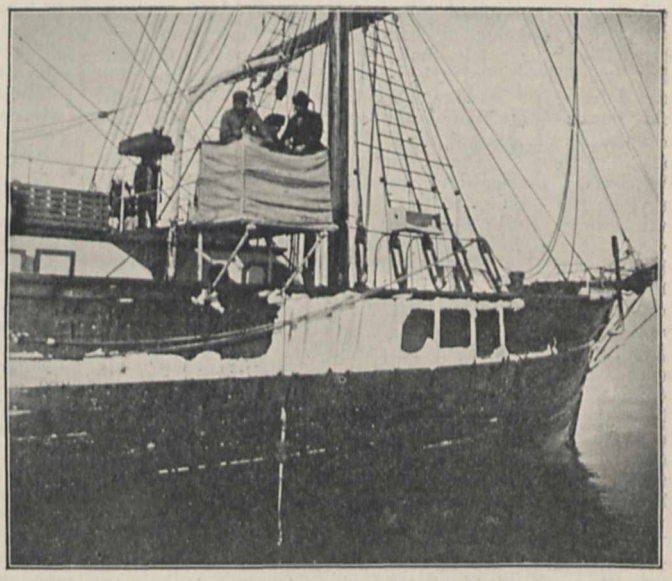

FIG. 1.—*Scotia* sounding in supposed Ross Deep 68° 32′ S., 12° 49′ W., on March 23, 1904.

The most important facts brought to light in the course of the sounding and exploring work are those connected with the discovery of Coats Land, and the final removal from the map of the "Ross deep," in which the *Erebus* and *Terror* reported 4000 fathoms no bottom. The supposed coast-line of the Antarctic continent south-east of the Weddell Sea has hitherto been placed in about 80° S. lat., probably because of the belief, to which certain temperature observations seemed to give support, that Ross's sounding was really correct. The *Scotia* discovered Coats Land in 72° 25′ S., 17° 27′ W., and skirted the coast for 150 miles. Within 2 miles of the assigned position of Ross's sounding (68° 32′ S., 12° 49′ W.) the *Scotia* touched bottom in 2660 fathoms, and the sounder brought up a large sample of blue mud. "Thus," as Mr.

Bruce puts it, "after more than sixty years of doubt, Ross Deep was removed from the map, and all the bathymetrical maps based upon this sounding were no longer of any practical use. It is interesting to contrast the methods of sounding employed on the two occasions by

FIG. 2.—*Scotia* beset in heavy ice in 74° 1′ S. off Coats Land. The shearlegs show the position of the baited trap in 161 fathoms.

comparing Mr. Bruce's photographs, which we reproduce, with the illustration given in Ross's book. Another discovery of great importance is that of a ridge showing a continuation of the "South Atlantic rise" a thousand

FIG. 3.—Meteorological Instruments at Scotia Bay.

miles further south than it was previously known to exist. There is thus a ridge "extending in a curve from Madagascar to Bouvet Island, and from Bouvet Island to the Sandwich Group, whence there is a forked connection through the South Orkneys to Graham's Land, and through South Georgia to the Falkland Islands and South American continent." . . . "Antarctica, South America, and Madagascar, become connected with one another in a most direct manner by this 'rise.'" Basing his arguments on these discoveries, Mr. Bruce strongly opposes Sir Clements Markham's theory, set forth in his recent address to the Royal Geographical Society, that the Antarctic area consists of two land masses of unequal size, Victoria Land and Edward VII. Land, separated by a great barrier of ice, and of two seas extending far to the south, the Ross Sea and the Weddell Sea.

The papers by Dr. Harvey Pirie and Mr. Mossman contain many points of great interest, although in the nature of things the material collected requires further elaboration, and comparison with that of the other expeditions, before its full value becomes apparent. Dr. Harvey Pirie's observations give much additional information bearing on the variations in the relative amounts of diatoms in the surface waters and in the deposits, and the remarkable differences in the meteorological values for 1903 and 1904 enable Mr. Mossman to draw many important conclusions as to the factors controlling the climate. Mr. Rudmose Brown gives an interesting account of an island which has, curiously enough, remained unexplored until now, although it lies almost on the track of sailing-ships outward bound *viâ* the Cape of Good Hope.

THE PERCY SLADEN EXPEDITION IN H.M.S. SEALARK.

I HAVE just received the accompanying communication from Mr. Stanley Gardiner, bringing the account of his expedition to September 12, the date of his letter. The letter is written from Coetivey. I may remind readers of NATURE that his former communications appeared in the issues of August 10 and October 5. A. SEDGWICK.

Zoological Laboratory, Cambridge, October 23.

Since my last letter Cooper and I have had a tour round the reefs of Mauritius, and have for the last three weeks been working between the latter island and the Seychelles Group. The Mauritius reefs vary from fringing to barrier, the best example of the latter being at Grand Port, where it is four miles from the land. It has there a few small islets of somewhat metamorphosed coral-rock, varying up to 40 feet high. At first it seemed as if they might have been formed by hurricanes and blown sand, but we discovered the same rock in the immediate vicinity overlying a basalt, 70 feet above the water. The present islets probably represent the remains of a considerable island, elevated for at least 100 feet, extending along that part of the barrier reef.

Leaving Mauritius on August 21, we had three days' dredging and sounding off its reefs. The contour is the same as that off atoll-reefs, a gradual slope to 40 fms. (fathoms), succeeded by a steep to 150 fms., then tailing off in five miles to 1000 fms. The bottom at 150 fms. was covered by heavy blocks of coral from the reef above. At 300 fms. we found shell and small pieces of coral, and further out a bottom of bare coral mud, sweepings from the reef and land.

Between Mauritius and Cargados there was a depth of 1962 fms., there being no marked connecting ridge, though the bottom tails off very gradually from each bank. At Cargados we remained for six days, examining the reefs and islets, and dredging. It is a crescentic-shaped surface reef, 31 miles long, on the south part of the Nazareth Bank, which is roughly 220 miles long by 60 broad, with an average depth of 33 fms. The land is of coral rock with no signs of elevation, and is a great breeding resort for tern. It is covered with guano, owing to which the land flora is very scanty, only 18 different plants being found. Naturally land animals were scarce, but 42 insects were secured, four-fifths from the guano.

Cooper for the most part took the dredgings, and he reported to me that he found near Cargados "a wonderfully constant depth of 30–35 fms. over the body of the bank, while towards its western edge there is a slight but uniform rise to 27 fms., thus suggesting an incipient atoll with its eastern side slightly tilted up above its western. Over the plateau, where 30 hauls were made in different directions, the bottom was either coral-rubble, white sand, shell-rubble, or weed. The three latter occurred only in the central parts of the bank, while the coral-rubble, though also found there, alone formed the raised edge of the western side, being mostly in the form of large lumps. From this rubble, which is of a bright red colour due to an encrusting nullipore, we obtained a rich variety of animal life, nearly all forms tinted with red. The absence of living corals from the rim as well as from the plateau in all depths over 20 fms. was a noticeable feature." About 25 different species of algæ (not lithophytes) were dredged, several from 40–50 fms. on the outer slope, though none have so far been secured from more than 60 fms.

In the channel midway between Nazareth and Saya de Malha banks we found a depth of 222 fms., the connection being a ridge rapidly tailing off on its western side to more than 800 fms. Saya de Malha itself really consists of three banks, a northern, a very large central, and a small south-eastern. The north bank we found to be separated by a channel of 636 fms. from the central, while the depth between the latter and the southern bank is only 130 fms. All are of more or less atoll form, but the south side of the central bank differs from all other parts of the same banks and from the Nazareth Bank in tailing off *very gradually* from 65 fms., the general depth in its centre, to 200 fms. The area in this part beyond 120 fms., which is to some degree protected from the prevailing south-east winds and currents, formed a rich collecting ground, the bottom being composed of a white rubble of bivalve and sea-urchin shells, evidently all swept off the shallower bottom above. From 80 to 100 fms., where it is more exposed, the bottom is hard, being swept bare by the currents, but still further north at 60 fms., where the eastern edge of the bank has only 10–20 fms. of water, is soft mud with casts of pelagic foraminifera. A considerable number of dredgings were taken at depths above 20 fms., and fair collections have been obtained. Only the regular deep-living corals were secured, but two hauls at 26 and 29 fms. gave between them more than 20 species of corals, typical of shallow reefs. To the north of the banks we dredged between 300 and 500 fms., the bottom being of the usual character at such depths off coral reefs, though with rather more rubble.

Leaving the Saya de Malha banks we ran a line of soundings to the shallow bank, which surrounds the Seychelles, the greatest depth found being 961 fms. Thus our soundings prove the existence of a crescentic-shaped ridge, 1100 miles long, with less than 1000 fms. of water, arising on either side from a general depth of 2200 fms.

Now we are at Coetivy, the most southerly island of the Seychelles Group. It is an atoll bank with a large island to the east, where we shall camp for ten days, while the ship goes to the Seychelles for coal. On her return we propose to examine the line connecting the Seychelles to Madagascar.

J. STANLEY GARDINER.

September 12.

SOME CHARACTERISTICS OF AMERICAN UNIVERSITIES.[1]

THE total amount of private benefactions to university education in the States during the last thirty years reaches the amazing figure of forty millions sterling; and this is quite apart from the large annual appropriations made by the Federal Government and by the State Governments for technical colleges and State universities. The total amount contributed by private benefactions in the same period in these islands was about five millions.

The number of professors, lecturers, and other teachers in the American universities and institutions of university standing is very little short of the total number of university students in the British Isles; the figures are respectively 17,000 and 20,500.

A large and increasing number of the greatest industrial and commercial firms in America restrict their highest posts to college graduates. In Montreal two great railway companies—the Canadian Pacific and the Grand Trunk—have just clubbed together to establish and endow in McGill University a department of railway engineering for training the first-rate staff of officials, which they feel to be indispensable to the rapid extension of their lines in the great north-western territories now awaiting development. Of our own industrial leaders, it would be safe to say that at least nine out of ten would regard a college training as an absolute disqualification.

The vigour of the professional schools is to be explained by two features which differentiate them from our own:—(1) The presence of a culture element; (2) the close and almost organic connection between academic and industrial life.

(1) Where a professional or higher technical school is established in England, the tendency is to make it purely technical, to banish all literary studies, and confine the student's attention strictly to scientific study directly bearing on his future profession. In America a broader view is taken.

The great Morrell Act for agricultural and mechanical colleges was thus expounded by its author:—"These colleges were not established for the sole purpose of teaching agriculture. It was never intended to force the boys of farmers going into these institutions so to study, that they should all come out farmers, but to give them an opportunity to do so if they saw fit. Secondly it was a *liberal education* that was proposed. Classical studies were not to be excluded, and must therefore be included."

But further, the technical course itself in the great majority of cases includes a culture element, supplied not by Latin and Greek, but by French or German, history, civics, and economics. The Massachusetts Institute of Technology in Boston, the greatest school of the kind on the Continent, the Pratt Institute (Brooklyn), the Armour Institute (Chicago), all make literary studies of this kind an indispensable part of the curriculum for their diplomas. The same is true of the great Guelph College of Agriculture in Ontario: French, German, and English literature have to be studied before the student can graduate as B.S.A. of the University of Toronto; and the reason was well put by the principal:—"It is not sufficient that our graduates should know their professional work, they must have some knowledge of their fellow-men and power of holding their own and of presenting their subject to the educated public, which a purely technical training cannot give." These are the words of a remarkable man who found Guelph in 1884 on the verge of extinction, and in twenty years has raised it to a position of almost undisputed primacy among the agricultural colleges of the continent, and transformed thereby the agricultural industry of central Canada.

(2) Both professors and students are in the closest touch with the industry which the school is intended to feed. The former are not merely permitted, but encouraged to take private outside work. The latter are required to spend some part at least of their vacations in working in mines, engineering works, on farms, &c., as the case may be, and their reports on the work thus done contribute

[1] Abridged from an address delivered before the Guild of Graduates of the University of Wales at Aberystwyth, by Principal H. R. Reichel.

to form the professors' estimate of their fitness for the degree.

The universal length of the undergraduate course is four years, not three as with us; and I am bound to say the lengthened period seems to me to have a decided advantage in avoiding hurry and encouraging maturity of growth. For several years the doubt has been growing in my mind whether our qualifying period of three years can be regarded as satisfactory. We owe it, no doubt, to the habit of mind inherited from the old London University of regarding ability to pass a written examination as the true test of training. From this incubus the American university is almost wholly free. A student gets his degree for the regular work he does throughout his university course, and though there is a test at the end, that test hardly ever takes the form of a cumulative examination in all he has been studying for two or three years; often it is a thesis. The effect of this on the course of study is very marked.

Post-graduate study is of comparatively recent growth in the States, and largely the outcome of the foundation and development of the Johns Hopkins University.

Like the Owens College in Manchester, Johns Hopkins owes its origin to the philanthropy of a wealthy merchant of Welsh descent. Its peculiar character, however, is due to the academic prescience and statesmanship of its first president. He saw that there were plenty of universities and colleges of the ordinary undergraduate type, and that what the country really needed was a university for "graduate study," which at that time could only be secured by going to Germany.

The method of teaching is based on that of the German seminar, of which it has adopted the name, but it provides for more constant and systematic intercourse between professor and student. While the German seminar meets weekly, the American meets every day, and the student receives far more individual attention. The course again is more exacting, the minimum length being three years, and the average four and a half, starting, be it remembered, from the completion of the B.A. degree. The aim is to train in methods of original investigation—in short, as it was well put to me by one of the professors, "to transfer to literary studies the methods of higher work in science." The work is based on the preparation of the student's dissertation for the doctorate. At every stage, first in outline and subsequently in complete form, the dissertation is discussed section by section, chapter by chapter. Each department of study has its own seminar room furnished with a departmental reference library. The arrangement is not that of the lecture theatre, which implies an orator and an audience, but rather that of the committee room with a chairman and a ring of debaters. The class, which would never exceed from twelve to fifteen, sits at an oblong table, the professor, so to speak, occupying the chair of the meeting at one end. Round the walls at their backs are the shelves containing books of reference, often running to several thousand volumes, and these, it should be noted, are quite independent of the central university library.

This seminar study was at first the sole, and is still the main, work of the university, and that which has made the name of Johns Hopkins famous throughout the civilised world. An age more given to omens might have seen in the remarkable fact that in the gigantic conflagration which recently swept away the centre of the city of Baltimore, the university was the only public institution the buildings of which escaped scot free, a tribute of the powers of nature to the unique position it holds in American academical life. Its influence on higher study through the whole North American continent has been rapid and profound. It is not merely that a large number of distinguished specialists has been produced whose labours have raised the level of American learning; post-graduate study has become the ambition of the American university, and more and more is being accepted as that which differentiates it from the mere college. There are few universities now which have not their seminar rooms and departmental libraries, though it must be admitted that in many cases these are at present only utilised for undergraduate study of the third and fourth years. But the growth in post-graduate work since Johns Hopkins was founded has been fairly staggering. In 1871 there were only 198 post-graduate students in the States; twenty-five years later the number had risen to 4919, or very nearly one quarter of the total number of university students of all classes in the British Isles.

The great bulk of those who win the Johns Hopkins doctorate naturally become university professors and lecturers. At the same time there is a rapidly increasing demand for them from the high schools, which are all organised on the basis of specialist teaching in each department. The evidence, both at the schools and the universities, supports the view that the Ph.D. candidate for a school post would have the advantage over a B.A. who had also been through a course of training in teaching, and would command a higher salary, and that this tendency is on the increase. It is felt that the man whose knowledge is deepest is likely to make the best teacher, and that lack of pedagogic skill at the start will be made up for in the long run by greater inspiration.

The system of our own older universities—at least of Oxford—is, it must be confessed, less favourable to post-graduate work. The explanation is to be found largely in the difference of the undergraduate course. The American university has no "honours" schools for the initial degree in which the energies of the best men are devoted rather to amassing the results of other people's investigations over an immense area than to cultivating the power of acquiring knowledge by their own. One of my fellow commissioners, who had examined at Cambridge in the law tripos, and bears a name of European reputation, told me he was often perfectly "horrified" by the amount the young men knew; such a mass of knowledge must have a most deadening effect on intellectual vigour. Thus, while the actual attainment at the initial degree is by no means so high as at Oxford and Cambridge, at all events for the best students, there is a far truer conception of learning, and an enormously larger proportion of men go on to higher work and research. In my visits to the universities the question was repeatedly asked of me, "What kind of men should we select for the Rhodes scholarships?" My answer has always been, "By all means, send us graduates. Undergraduates will do Oxford little good, and may get out of touch with American life; graduates will gain a wider experience without being de-americanised. Nothing, at the same time, would do so much for the revival of higher study at Oxford as a steady supply of picked graduates of an inquiring type." "But does Oxford want graduates?" has been the usual reply. "The experience of many men we know who have been there is that it is practically impossible to get assistance for post-graduate work; after a short trial they have generally gone on to Germany." The justice of the criticism it is difficult to question. Though the University of Oxford has created special post-graduate degrees in order to attract graduates of other universities for advanced study or research, the Oxford college with its pot-hunting instincts stands in the way. It makes, or thinks it makes, its name by the number of first classes won by its undergraduates, and will, therefore, give no encouragement to the higher learning which our Philistine upper class neither understand nor care for. I have known a case where the whole tutorial influence of a college was used to prevent one of its scholars competing for a university prize essay involving original research. It was not denied that the work might be intellectually better for him, but then it might endanger his "first." The scholar, I am glad to say, had the strength of mind to take his own line, and gained the prize.

Let me conclude with a word about the ideals of the students and their attachment to their old college or university. I have said that the course is never less than four years; when I add that there are hardly any scholarships and that a large proportion of the students are distinctly poor, you will doubtless ask how they manage to do it? This brings me at once to what I unhesitatingly affirm to be the most admirable feature of life on the other side of the Atlantic, whether in the States or in Canada, viz. the entire absence of the feeling that honest work of any kind can be derogatory to an educated man. The American and Canadian student whose friends

cannot afford to keep him at college pays his way either by working during the long vacation in all sorts of manual employment or by rendering what we should regard as menial services to his fellow-students during term time, much like the old "servitors" at Oxford and Cambridge. Nor does this create any social barrier. At one university visited by some of my Mosely colleagues they were waited upon during the college dinner by some very intelligent looking young fellows, and found on inquiry that these were students. Somewhat surprised at this, one of the party asked if this would not tell against them socially. "Not in the least," was the answer. "That man over there is president of one of the chief debating societies; that other is one of our best athletes and much looked up to." It is the same in the women's colleges. At Vassar one girl keeps a bicycle cleaning shop; they act as room-tidiers, clean shoes, &c. In Canada I was informed that at Queen's University, Kingston, no less than 70 per cent. of the men students earn their fees and maintenance for the coming session by working through the summer on farms, on the railway, in mines, river steamboats, &c. The fact is, the Transatlantic youth is rather proud of being able to earn his own living; it makes him feel himself more of a man, and it is not at all uncommon for the son of rich parents to take work in this way for the sense of independence it brings. It is a fine spirit, and makes one blush when one thinks how very different a reception such conduct would probably meet with over here.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The committee for the supervision of instruction in geography has appointed Dr. A. J. Herbertson, director of the school of geography, for the remainder of the term of five years for which the grants to the school of geography have been voted. A syllabus of the examination for the diploma in this subject has been issued, which includes regional geography, climatology and oceanography, geomorphology, historical geography, and surveying.

The delegates of the common university fund have elected Mr. G. W. Smith, New College, to the biological scholarship at Naples for the year 1905–6.

Mr. M. H. Godby has been elected to a Dixon research scholarship in chemistry at Christ Church.

CAMBRIDGE.—An interesting insight into the way the university is governed is given by the following figures. A careful analysis of the poll-book of the recent vote on "compulsory" Greek gives the following results:—(1) Of the residents, 288 voted in favour of the recommendation that Greek should no longer be compulsory in the previous examination; 240 voted against the recommendation—majority of residents in favour of the recommendation, 48. (2) Of the total number of members of the senate who voted, residents and non-residents included, 1591 were laymen, 1021 were clergymen. Of the laymen, 923 voted in favour of the recommendation; 668 voted against it—majority of laymen in favour of the recommendation, 255. Of the clergymen, 132 voted in favour of the recommendation; 889 voted against it—majority of clergymen against the recommendation, 757.

The report on the proposed diploma of forestry was discussed on Thursday, November 2. Among the speakers were the professor of geology, the professor of botany, the secretary of the financial board, and the master of Gonville and Caius College. The proposal was warmly welcomed.

The State medicine syndicate reports that last year seventy-one candidates presented themselves for the diploma in public health, and that twenty-four candidates entered for the diploma in tropical medicine and hygiene, sixteen of whom were successful.

The following have been nominated examiners for the natural science tripos in 1906:—in physics, Mr. R. T. Glazebrook and Mr. C. T. R. Wilson; in chemistry, Mr. H. O. Jones, and Mr. H. B. Baker, Oxford; in mineralogy, Prof. Lewis, and Mr. H. L. Bowman, Oxford; in geology, Mr. P. Lake and Dr. F. A. Bather; in botany, Mr. A. C. Seward, and Mr. A. G. Tansley, of University College, London; in zoology, Mr. A. Sedgwick, and Prof. MacBride, of Montreal; in physiology, Mr. W. M. Fletcher, and Prof. T. G. Brodie, of the Brown Institute; in human anatomy, Dr. Barclay Smith, and Dr. A. Robinson, of Birmingham University.

The Vice-Chancellor announces that Sir Archibald Geikie will, on behalf of the board of geographical studies, deliver a public lecture in the Sedgwick Museum on November 21, at 5 p.m., on "The Evolution of a Landscape." On the evening of the same day, and at the same place, Dr. C. Hose, of Sarawak, will lecture on Borneo.

The next combined examination for sixty-two entrance scholarships and various exhibitions at Pembroke, Gonville and Caius, King's, Jesus, Christ's, St. John's, and Emmanuel colleges will be held on Tuesday, December 5, and following days, commencing at 9 a.m. on December 5. Mathematics, classics, and natural sciences will be the subjects of examination at all the above-mentioned colleges. Scholarships and exhibitions will also be offered for history, for modern languages, and for Hebrew at some of the colleges. A candidate for a scholarship or exhibition at any of the seven colleges must not be more than nineteen years of age on October 1, 1905. Forms of application for admission to the examination at the respective colleges may be obtained as follows:—Pembroke College, Mr. W. S. Hadley; Gonville and Caius College, the Master; King's College, Mr. W. H. Macaulay; Jesus College, Mr. A. Gray; Christ's College, Rev. J. W. Cartmell; St. John's College, Dr. Donald MacAlister, Dr. J. R. Tanner, Mr. E. E. Sikes; Emmanuel College, the Master; from any of whom further information respecting the scholarships and other matters connected with the several colleges may be obtained. The forms of application must be sent in on or before Tuesday, November 28.

MR. F. S. PINKERTON has been appointed professor of applied mathematics at the University College of South Wales, Cardiff.

BY the will of Mr. J. E. Williams, of Chester, who died on July 15, a legacy of 10,000*l.* is bequeathed to the University of Wales, the income to be used in founding new scholarships and prizes in his name, to be held upon certain terms and conditions. In the event of the University of Wales not accepting the legacy within six months, the same is to be paid to the trustees of the University College of North Wales at Bangor upon the same conditions. He also bequeathed 10,000*l.* to the University College of North Wales at Bangor upon the same conditions, and 2000*l.* for the building fund of this college.

AT the last meeting of the council of the University of Birmingham, the Vice-Chancellor (Alderman C. G. Beale) in the chair, the Chancellor (Mr. Chamberlain) announced that a friend of the university, who desired to remain anonymous, had promised a donation of 50,000*l.*, the amount to be applied towards the completion of the new buildings at Bournbrook. The council desired the Chancellor to convey its best thanks to the generous donor for his munificent gift. This is the fourth amount of 50,000*l.* already contributed to the university endowment fund, the other sums having been received from Mr. Andrew Carnegie, Sir James Timmins Chance, and an anonymous donor. The total fund is about 450,000*l.*, to which must be added annual contributions from the City Council (6000*l.* per annum), and 500*l.* each from the county councils of Staffordshire and Worcestershire. The council has already approved of expenditure upon the site and buildings amounting to about 280,000*l.*, in addition to upwards of 80,000*l.* on equipment. It is hoped that a formal opening of the new buildings may be possible in about eighteen months' time.

THE Board of Education has issued the following list of candidates successful in this year's competition for the Whitworth scholarships and exhibitions:—(1) *Scholarships*, 125*l.* a year each (tenable for three years): H. Topham, Grantham; C. W. Price, Devonport; W. F. Paffett, Portsmouth; R. W. Bailey, Goodmayes (Essex). (2) *Exhibitions*, 50*l.* (tenable for one year): W. White, Southsea;

A. E. Humber, Portsmouth; G. Lees, Southsea; A. Ward, London; A. W. Sawyer, London; C. E. G. House, Chatham; H. Schofield, Halifax; J. M. Robertson, Pembroke Dock; W. E. G. Sillick, Devonport; J. A. Cormack, Glasgow; F. Clements, Chesterfield; B. J. Cole, Devonport; P. W. M. Sparey, London; S. Lees, Manchester; B. H. Penn, Bedford; W. H. Stock, Swindon; W. R. Sinclair, Newcastle-on-Tyne; M. Bell, Bensham, Gateshead; T. H. Essery, Devonport; S. H. Warren, Devonport; A. R. Valon, London; G. R. Wilkinson, Oldham; A. D. Johnston, jun., South Shields; W. C. A. Bowles, London; A. L. Bird, Cambridge; T. N. Adlam, Trowbridge; J. Bedford, Chingford; P. P. Smart, Wolverton; C. L. Gransden, Chatham; W. F. Brown, Birkenhead.

THE following list of successful candidates in this year's competition among science students for Royal exhibitions, national scholarships and free studentships has been issued by the Board of Education:—*Royal exhibitions:* Arthur B. Middleton, Bradford, Manchester; William White, Southsea; Alfred E. Humber, Portsmouth; George Lees, Southsea; Frederick E. Pollard, Eastwood, Notts; James L. Kent, Portsmouth; Frank Fielden, Halifax. *National Scholarships for Mechanics (Group A):* Arthur T. Wall, Plymouth; Arthur Cannon, Plymouth; William E. Dommett, Southsea; Herbert J. London, London; Charles E. G. House, Chatham; William E. G. Sillick, Devonport. *Free Studentships for Mechanics (Group A):* Charles L. Gransden, Chatham; Harford G. Stephens, Leicester. *National Scholarships for Physics (Group B):* John M. Strang, Glasgow; Frederick Reid, Glasgow; John W. Waters, Chatham; Dudley Orson-Wood, Chiswick; George F. Hemens, London; William F. Higgins, London; Walter C. M. Pettingill, Leeds. *Free Studentships for Physics (Group B):* Frederick J. Harlow, Whitstable; Edward F. Pattenden, Whitstable. *National Scholarships for Chemistry (Group C):* Harry F. V. Little, London; Tom Thornley, Blackburn; Samuel Lamb, Bradley, Bilston; Alan C. Webber, Brighton; John H. Jennings, Plymouth; Robert O'F. Oakley, London. *Free Studentships for Chemistry (Group C):* Archibald Wise, Plymouth; Charles S. Garland, London. *National Scholarships for Geology (Group E):* John W. Maxfield, Burnley; Ernest Proctor, Burnley; James Mitchell, Burnley.

THE annual general meeting of the Association of Teachers in Technical Institutes was held at the Birkbeck College, London, on November 4. The association, which was founded a year ago, already has a membership of 300 exclusive of the Association of Teachers of Domestic Sciences, which is affiliated with it. Mr. W. J. Lineham, the president, was in the chair, and moved the adoption of the report of the council, which was subsequently agreed to. The council recommends in the report that meetings of teachers in provincial technical institutes be called to lay the claims of the association before them directly. A resolution was passed instructing the council to call meetings of the teachers in provincial technical institutes and to consider the following matters with full powers to act therein:—(*a*) The formation of local or provincial branches of the association; (*b*) joint action or federation with the West Riding Association of Teachers of Science, Art, and Technology, the Federation of London Teachers, and other bodies of teachers. One of the most important matters discussed during the year has been the registration of teachers. A scheme has been drawn up by the council, and a circular has been issued to members pointing out its importance upon the future *status* and professional position of teachers in technical institutes. A scheme for registration has already been formulated by the teachers of domestic science. The council recommends that steps be taken at an early date, by deputation or otherwise, to urge upon public examining authorities the importance of securing closer connection between the examiner and the teacher. Various amendments to the constitution and rules were decided upon, and the title of the association was changed to that of "The National Association of Teachers in Technical Institutes," and it was resolved that its officers be a president, two vice-presidents, an hon. secretary, and an hon. treasurer. Mr. Lineham was elected president for the ensuing year.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, October 27.—Prof. J. H. Poynting, F.R.S., president, in the chair.—The theory of phasemeters: Dr. W. E. **Sumpner.** The author shows in the paper that the theory of the instruments is the same whether they contain iron or not, and however the coils may be arranged; that they can be calibrated by direct-current methods, although for use on alternating-current circuits; and that a new type of instrument, containing iron, conforms to the theory given. The main results of the investigation are:—(1) Phasemeters for multi-phase circuits are all equally accurate on balanced loads provided they have been correctly calibrated and possess no faults due to purely mechanical causes. Their accuracy is not affected by variations in wave-form or in current-frequency. (2) Phasemeters can be simply and accurately calibrated for balanced loads by means of a direct-current method of test. (3) The error of phasemeters on unbalanced circuits is generally serious for loads which are badly out of balance. The error, like that of a wattmeter, increases rapidly as the power-factor of the load diminishes. It can only be reduced at the expense of complication in the instrument, by increasing the number of coils used in the fixed and moving systems, and by arranging the coils and magnetic circuits to be symmetrical in regard to one another.—Apparatus designed for measuring the coronal radiation during an eclipse: Prof. H. L. **Callendar.** A preliminary test of the apparatus with the thermopile directly exposed to radiation of known intensity showed a deflection of nearly 25 cm. for one-thousandth of a calorie per sq. cm. per min., so that radiation one-millionth of full sunshine could be detected with certainty without using a mirror. When placed in the focus of the telescope used, radiation one thousand times smaller than this could be observed, so that even if the intrinsic heat-radiating power of the corona were only one ten-millionth of the solar surface it could still be measured to within 1 per cent. The essential point in the observations was to eliminate the variable effects of atmospheric radiation, for which a differential method of observation with the two halves of the pile was particularly suitable. In taking observations on the corona, the motion of the moon during totality was made use of to define the exact area of the corona corresponding to the differential reading. At the commencement of totality, the thermopile being centred on the sun, the inner corona on the eastern limb would be fully exposed, while on the western it would be partly covered by the moon. At the end of totality the reverse would be the case. The difference of the readings would correspond to the radiation of the strip of the inner corona uncovered by the motion of the moon between the two readings. The area of the strip of corona considered could be accurately determined from the times at which the readings were taken.

PARIS.

Academy of Sciences, October 30.—M. Troost in the chair.—Two hæmatozoa of the partridge and turkey: A. **Laveran** and M. **Lucet.** The first of these was the cause of the death of 97 out of 100 Hungarian partridges imported into France. Its appearance and mode of division corresponded with *Haemamoeba relicta*, a parasite which has been known to be responsible for epidemics in many birds, but not hitherto of the partridge. The other parasite, found to be the cause of perityphlo-hepatitis in the domestic turkey, appears to belong to a new species, and is named *Haemamoeba Smithi*.—A criterion for the application of the Gompertz-Makeham mortality law: Charles **Goldziher.** The application of this law depends absolutely on the regularity of the original series, but, so far, an exact criterion for the exactitude of the limits between which this application is possible has been wanting. This is worked out in the present paper.—On the composition of the hydrochloroferric colloid with respect to the amount of hydrochloric acid present in the suspending liquid: G. **Malfitano.** By increasing the concentration of the medium in hydrochloric acid, the colloid tends to approximate to the composition $H(Fe_2O_6H_6)Cl$.—Observations relating to some india-rubber plants: A. **Chevalier.** Whatever may be the family to which a caoutchouc belongs, its richness

in india-rubber is an individual peculiarity. The yield may be very different in two individuals of the same age and of the same size, living side by side, and having the latex extracted at the same time.—The influence of different kinds of light radiations on the migration of the albumenoids in the wheat grain: J. **Dumont.** It was found that the radiations which have the greatest effect on the migration of the albumenoids in the wheat grain are precisely those which act the least on the chlorophyll function.—On the mechanical work furnished by windmills: M. **Ringelmann.** The windmill studied was of the type used in agriculture for raising water. Automatic records were made of the velocity of the wind, the number of turns of the vane, and of the water lifted. A table of results for different velocities of the wind is given, and from this the work obtainable from a windmill can be calculated.—The accessory glands to the silk-producing apparatus of the larvæ of *Io Irene*: L. **Bordas.** The liquid or slightly viscous substance secreted by the accessory glands serves to agglutinate or unite the two silk threads. It is possible, also, that it exerts a chemical action on the threads, causing them to harden rapidly.—On the existence of strata containing Clymenia in the central plateau, Morvan: Albert **Michel-Lévy.**—On the dissymmetry of the loss of electricity in mountainous countries: the comparative *rôles* of height and relief: MM. Bernard **Brunhes** and Albert **Baldit.** At the summit of a mountain the rate of loss of volts is greater for negative than for positive electricity. These results serve to show why several authors have been led to think that passing from the plain to a mountain leads to a great exaggeration of the loss of negative electricity.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 9.

MATHEMATICAL SOCIETY, at 5.30.—Annual General Meeting.—The Continuum and the Second Number-class: G. H. Hardy.—On the Arithmetical Nature of the Coefficients in a Group of Linear Substitutions of Finite Order (second paper): Prof. W. Burnside.—On the Asymptotic Value of a Type of Finite Series: J. W. Nicholson.—On an Extension of Dirichlet's Integral: Prof. T. J. I'A. Bromwich.—(1) On Improper Multiple Integrals; (2) On the Arithmetic Continuum: Dr. E. W. Hobson.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Inaugural Address: John Gavey, C.B.

FRIDAY, NOVEMBER 10.

ROYAL ASTRONOMICAL SOCIETY, at 5.—(1) Observations of the Satellite of Neptune from Photographs taken between Nov. 11, 1904, and April 15, 1905; (2) Micrometric Measures of Double Stars made with the 28-inch Refractor in the Year 1904: Royal Observatory, Greenwich: Communicated by the Astronomer-Royal.—(1) On the Secular Acceleration of the Earth's Orbital Motion: (2) On the Ptolemaic Eclipses of the Moon recorded in the Almagest: P. H. Cowell.—Observations of Phenomena of Jupiter's Satellites made at Windsor, New South Wales, in the Years 1900 and 1902: John Tebbutt.—On the Corrections to Hansen's "Tables de la Lune," as deduced by Mr. Cowell: E. Nevill.

PHYSICAL SOCIETY, at 8.—The Question of Temperature and Efficiency of Thermal Radiation: J. Swinburne.—Note on Constant-Deviation Prisms: T. H. Blakesley.

MALACOLOGICAL SOCIETY, at 8.—(1) Descriptions of New Species of Drymæus, Amphicyclotus, and Neocyclotus from Central and South America; (2) Description of a New Species of Achatina from Mashonaland: S. I. Da Costa.—On a Collection of Land and Freshwater Shells from Sumatra with Descriptions of New Species, part i.: Rev. R. Ashington Bullen. On a New Species of Oliva: F. G. Bridgman.—On the Anatomy of *Ensis macha* and *Solen fonesii* and *S. viridis*: H. H. Bloomer.

TUESDAY, NOVEMBER 14.

INSTITUTION OF CIVIL ENGINEERS, at 8.—On Waterways in Great Britain: J. A. Saner.

ZOOLOGICAL SOCIETY, at 8.30.—On the Papillary Ridges in Mammals, chiefly Primates: Dr. Walter Kidd.—On a Collection of Mammals brought home by the Tibet Frontier Commission: J. Lewis Bonhote.—Note on the Geographical Distribution of the Okapi: Dr. Einar Lönnberg.—Notes on Goral found in Burma: Major George H. Evans.—The Mammals of Crete: Dorothea M. A. Bate.

MINERALOGICAL SOCIETY, at 8.—The Determination of the Angle between the Optic Axes of a Crystal in Parallel Polarised Light: Dr. J. W. Evans.—(1) On a Tabular Crystal of White Diopside; (2) On a Carlsbad-twin of Albite: Prof. W. J. Lewis.—Note on the Crystallisation of Drops, especially of Potash-Alum: J. Chevalier.—Note on the Formation of Gypsum Crystals in a Disused Well at Chemical Works: C. J. Woodward.—(1) Ilmenite from the Kollergraben, Binnenthal; (2) On a New Red Cubic Mineral; (3) On Seligmannite, Marrite, and Lengenbachite from the Lengenbach Quarry; (4) On Anhydrite and other Minerals found in the White Dolomite of the Simplon Tunnel: R. H. Solly.

WEDNESDAY, NOVEMBER 15.

SOCIETY OF ARTS, at 8.—Opening Address of the Chairman of the Council, Sir Owen Roberts.

ENTOMOLOGICAL SOCIETY, at 8.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—The Rainstorm of August 24-26, 1905, in Co. Dublin and Co. Wicklow: Sir J. W. Moore.—The Aquameter: Dr. W. B. Newton.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Exhibition of Microscope Slides of Tsetse-Fly Dissections, Trypanosomes, etc.

THURSDAY, NOVEMBER 16.

ROYAL SOCIETY, at 4.30.—The Physical and Chemical Properties of Iron Carbonyl: Sir James Dewar, F.R.S., and H. O. Jones.—The Transit of Ions in the Electric Arc: A. A. Campbell Swinton.—First Photographs of the Canals of Mars: Prof. Percival Lowell.—On the Laws of Radiation: J. H. Jeans.—The Pressure of Explosions. Experiments on Solid and Gaseous Explosives: J. E. Petavel.—On Newton's Rings formed by Metallic Reflection: Prof. R. C. Maclaurin.—The Accurate Measurement of Ionic Velocities: Dr. R. B. Denison and Dr. B. D. Steele.

CHEMICAL SOCIETY, at 8.30.—Silicon Researches, Part ix., Bromination of Silicophenyl Imide and Amide, and Formation of a Compound including (SiN): J. E. Reynolds.—Condensation of Ketones with Mercury Cyanide: J. E. Marsh and R. de J. F. Struthers.—Application of the Microscopic Method of Molecular Weight Determination to High Boiling Solvents: G. Barger and A. J. Ewins.—Green Compounds of Cobalt produced by Oxidising Agents: R. G. Durrant.—Synthesis of Tertiary Menthol and of Inactive Menthene: W. H. Perkin, Jun.—Optically Active Reduced Naphthoic Acids, Part i., Dextro-Δ(2 or 3)-dihydro-1-naphthoic Acid: R. H. Pickard and A. Neville.

LINNEAN SOCIETY, at 8.—Contributions to the Embryology of the Amentiferæ: Dr. Margaret Benson, Elizabeth Sanday and Emily Berridge.—On the Ears of certain Sharks: Prof. Chas. Stewart, F.R.S.

FRIDAY, NOVEMBER 17.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—The Seventh Report of the Alloys Research Committee; On the Properties of a Series of Iron Nickel-Manganese-Carbon Alloys: Dr. H. C. H. Carpenter, R. A. Hadfield, and P. Longmuir.

CONTENTS.