THURSDAY, OCTOBER 10, 1901.

RATIONAL GEOMETRY.

Plane and Solid Geometry. By Arthur Schultze, Ph.D., and F. L. Sevenoak, A.M., M.D. Pp. ix+370. (New York: The Macmillan Company, 1901. London: Macmillan and Co., Ltd.) Price 6*s*.

THIS is an excellent work for all young students who wish to begin the study of geometry. In its order of treatment it completely ignores Euclid, and thus saves the young pupil from a long and wearisome waste of time, giving him clearly and rapidly a knowledge of the subject and an insight into its nature and purpose. We wish that the English schoolboy could congratulate himself on its appearance; but this is forbidden by our conservatism and the attachment of our public and preparatory schools to mediævalism. When an Educational Reformation takes place in England—and there are signs of its advent—such a work will be welcomed by all of us who are interested in the scientific education of the people.

The book is divided into two parts—Plane Geometry and Solid Geometry. The first part is divided into five books (225 pages), and the second into three (93 pages). The type is excellent, and the figures (especially those in the second part) beautiful.

To enter now into a few matters of detail, we would suggest to the authors that they should not have followed the English plan of beginning with a catalogue of fifty definitions before the pupil reaches the real work of the subject: this makes for tediousness. The term *straight angle* (adopted, apparently, from the A.I.G.T.) is, we think, very objectionable, because the notion of straightness should be kept quite distinct from that of an angle. The first proposition in the book, "vertical angles are equal," is Euclid's 15th; prop. 2 is Euclid's 26th; prop. 3 is Euclid's 4th; prop. 4 is Euclid's 16th. Thus a common-sense order of treatment is freely adopted. Then comes the treatment of parallel lines in which all of Euclid's results are given. The definitions of degrees, minutes, and seconds are given in the preliminary definitions (p. 5), but the protractor is not mentioned, so that the actual way of reading the value of a given angle is not exhibited. This omission of the protractor seems to us to be a mistake. Some propositions are merely enunciated, and, instead of a formal proof, a "hint" to the pupil in a few words is given. This is good, because it exercises, without severity, the power of the young thinker. The famous Asses' Bridge is given as prop. 14, with the mere hint that it would be obvious if the bisector of the angle at the vertex were drawn—as, of course, it would be. Herein observe the contrast to Euclid, who would not allow us to use this bisector unless he had previously shown how to construct it—a perfectly useless restriction which runs through the whole of Euclid. Of course it is subsequently shown (p. 35) how to bisect an angle and a line. The authors are generally precise in their use of language, without adopting the grotesque show of accuracy in our school Euclids. Nevertheless, they occasionally make an absurd use of the word *respectively*, which is so prominent in these works. Thus (p. 30), "two triangles are equal if the three sides of the one are respectively equal to the three sides of the other"; clearly no *order* of equality is necessary. See also end of p. 74.

In p. 33 and elsewhere the authors boldly define a circle as an area, and distinguish it from its bounding curve, which they call "a circumference." If we punch a wad out of a sheet of cardboard, which area has the right to be called the circle—the wad or the whole of the outside area of the sheet?

In this respect, however, the authors are consistent, while Euclid is not. Euclid's formal definition makes the circle an area, while in his Book III. he says that two circles cannot have more than two points in common.

The English barbarism involved in the proposition "if two sides of a triangle are equal, the opposite angles shall be equal," is consistently avoided, the simple word "is" or "are" being always used instead of the compulsory and ridiculous "shall be" of our school Euclids.

The second book of Part i. treats of the circle, and travels over the ground of Euclid's III. and a little more, arithmetical examples being occasionally given—a great desideratum in our English system. Here measurement and ratio are introduced, as well as the notion of limits—a great improvement. Euclid's first book problem, "to construct a triangle when its three sides are given," appears here as prop. 19—a postponement of more than doubtful value.

The third book is on proportion and similar polygons, and the propositions are illustrated and explained by simple algebra and arithmetic; thus the beginner can learn the essence of the subject in a few minutes without wasting a lifetime on Euclid's Book V. In this book the authors give the propositions relating to the equality of areas, of triangles, and parallelograms, while the proposition of Pythagoras now appears for the first time (p. 147), founded on the similarity of the two triangles into which a "right triangle" is divided by the perpendicular from the vertex on the hypothenuse; the old proof and time-honoured figure are, however, given in the next book (p. 178). Near the end of the third book we have Euclid's well-known proposition whose trigonometrical form is $c^2 = a^2 + b^2 - 2ab \cos C$, the proof being, of course, geometrical, but presented in algebraic form.

The fourth book treats of the areas of polygons, and the proofs are presented in algebraic form. The exercises all through are numerous and very appropriately placed.

In the part dealing with solid geometry and the fundamental properties of spherical triangles, the figures are, as we have said, exceedingly good and realistic.

In p. 264 we have the proposition "the sum of any two face angles of a triedral angle is greater than the third face angle"; but the proof will have to be slightly modified, as, in its present form, it is confusing for the beginner. Thus, to the words "in the face AVC draw VD equal to VB, making $\angle DVA = \angle BVA$," it may fairly be objected that this is impossible if the points A and C are already given. The line VD should first be drawn, and then the lines ADC and BC. Again, in

p. 205, the proposition "the circumference of a circle is less than the perimeter of any enveloping line" has no special reference to a circle—it is true of any oval figure whatever, and no special property of the circle is employed in the proof. We think that it should be struck out as misleading. Finally, we must point out that the Socratic method of teaching the pupil by a system of questioning—the most efficient of all teaching methods—is adopted throughout the book. The limited space at our disposal has not by any means allowed of such an exhaustive exhibition of its merits as this work deserves. GEORGE M. MINCHIN.

NATIVE LIFE IN SOUTHERN INDIA.

Occasional Essays on Native South Indian Life. By Stanley P. Rice, Indian Civil Service. Pp. vi + 223. (London: Longmans, Green and Co., 1901.) Price 10*s.* 6*d.* net.

THESE sketches of south Indian life are concerned, not with any of the districts, like Madura or Tanjore, in the extreme south of the peninsula, but with Ganjam, which while politically connected with the Madras Presidency, is by the race, language, and customs of its people more closely linked with the Bengal Province of Orissa. This political separation from his northern kinsfolk has worked evil to the Uriya of Ganjam. The ordinary Madrasi looks on him as an inferior creature, "not merely low in the rank of civilisation, but incapable of better things"; and he is carefully excluded from the official employment which is monopolised by his Telegu neighbours in the south. Hence, as might have been expected, he has no ambition to develop his own language or literature, and he remains a boor, slovenly in his mode of life, and with little love for the foreign native officials who manage his affairs. But he is not quite destitute of good qualities. He is a hard-working farmer; he is not given to drink, like the Telegu; and Mr. Rice vouches for the fact that, when addressed in his own tongue by one who understands and appreciates him, he is courteous and hospitable. But still there is a vein of savagery beneath his boorish exterior, as is shown by the graphic account given by Mr. Rice of the so-called Rebellion of Parlakimedi, which plunged the land in ruin and anarchy during the early years of last century. As usual in such cases, it arose from the apathy and ignorance of the early officials; and it was not till many years had passed in maladministration that a strong man was found at last in Mr. George Russell, one of those little-known heroes of our Indian services, who gave the land peace which has never since been disturbed.

Mr. Rice, though a careful and sympathetic observer of native life, seems to have little knowledge of Indian anthropology and folklore. This is perhaps not an unmixed disadvantage. He does not come, like some of our Indian officials, ready to apply book learning to the study of savage life; nor is he primed with that modicum of acquaintance with comparative anthropology which leads him to see a totem in every bush, or a tree-god in all rural ceremonies. But had he possessed a wider acquaintance with some of the problems which anthropology attempts to solve, his studies could have hardly failed to gain in precision and interest.

We have in Ganjam an excellent example of three overlapping races. The Uriya of the plain country is a Dravidian with a certain amount of Aryan intermixture. His language is not "a blend of Sanskrit and Hindustani," but a form of Bengali affected by the Telegu or other South Indian tongues. A wider study of linguistics would make it clear to Mr. Rice that the word Ponda for a priest, which puzzles him, is merely the Sanskrit *panda*, "a learned man."

Next on the lower hills come the Khonds or Khânds, who seem here to have preserved no tradition of the Meriya sacrifice through which they are best known to ethnologists. They are a race of half savages already half ruined by the trickery of the Uriya Shylock, and deprived of their old mode of livelihood in the jungles by the repressive rules of the Forest Department.

Still further back in the more remote hills are the Savaras or Sauras, who enjoy a free savage life, periodically burning down the jungle to sow their scanty crops, but living mainly on the fruits and roots which the forest supplies. But they possess some traditions of a more settled life, because it is their law that the dead man must be cremated with the wood of the mango, and this must be done "in the portion of ground—one cannot call it a field—which he last occupied." Of course this may be a sign of Hindu influence, but Mr. Rice does not say so, and Mr. Risley's account of the race in Bengal does not support the suggestion.

Of the marriage rites of these jungle people Mr. Rice gives some interesting details, but he misses the point of some of their practices because he has not grasped the fact that they indicate a reaction against the early custom of "Beena" marriage, in which the bridegroom is adopted into the clan of his wife. This still prevails among the Savaras, where if the bride's father agrees to the alliance, "he and the bridegroom elect to go into partnership and cultivate for two or three years."

The religion of these races is, as usual, of the animistic type, but it has been largely influenced by the Orissa cult of Jaggannâth. Witchcraft, of course, and the custom of rendering the witch harmless by knocking out the teeth, prevail widely. Special respect, which may be totemistic, but is more probably the survival of some animal cult, is paid to the bear, "as they have a curious fancy that the souls of their ancestors inhabit the bodies of bears after leaving their human prison." Mr. Rice has never been able to discover why, when building a house, they plough up the site and sow some grain after consulting a priest or seer. This is a common form of mimetic magic, performed with a view to ensure the prosperity of the household.

We trust that if Mr. Rice has the good fortune to be again posted to such an interesting district as Ganjam he will continue his studies among those wild races about whom he displays such a sympathetic interest. But he would come better prepared for such inquiries if he mastered Mr. Risley's account of the tribes of Bengal and other equally accessible works on Indian ethnology and folklore.

THEORETICAL EXPLANATIONS OF GEOLOGICAL FACTS.

Essai d'une Explication par les Causes actuelles de la Partie théorique de la Géologie. Par H. Hermite. Pp. 115. (Neuchâtel: Attinger, 1901.)

M. HERMITE believes that the facts of geology admit of much simpler theoretical explanations than they have hitherto received. Whether his substitutes will be generally adopted is, we think, open to question; but as it would be a lengthy business to criticise them in detail we must restrict ourselves to a brief outline of their leading features. Mountain-making is not, as is generally thought, the result of a cooling of the liquid earth's interior, for that is not in accord with the theory of heat. It is caused thus:—The crust is very flexible. Materials deposited upon it produce a downward movement in that part with a corresponding upward one in another, so the ocean basins are constantly sinking and the continents rising. This upward movement is concentrated on the periphery of the basins, where the strata are bent, strained, and finally fractured. Motion is converted into heat and the temperature of this zone is elevated. It then communicates heat to the adjacent ocean, and thus increases evaporation. That results in a heavier rainfall. The precipitated water works down into the rising land, thus cooling it, and producing of course the greatest effect nearest to the surface. So the rise of temperature observed in sinking wells, &c., is due to a local cooling rather than to the cause usually assigned. That the consequence of mountain-making is abundant rain is proved by the prevalence of sandy deposits in the earliest geological ages. Another consequence is that periods of extensive and rapid deposit of detritus are succeeded by others of slow and regular sedimentation. M. Hermite passes on to explain the occurrence of the warm era with which the earth's history began, and the glacial epoch of its later days. Crust cohesion, he says, was great in early times, so more material was needed to make it sink; and thus the rise of temperature of the basins was greater. Evaporation was thereby increased and the whole surface covered with a veil of mist, resulting in a mild, uniform climate. But the heavy rains penetrating into the crust ultimately chilled it, and the streams which they produced cooled the ocean, till things returned to their former condition. As the cohesion afterwards became gradually less, this universal, warm, damp atmosphere did not recur, and the loss of heat by radiation gave rise to the seasons. But earth movements were augmented about the time of the passage of the Tertiary into the Quaternary, and led to precipitation which supplied the snow for the great glaciers. Thus this epoch was brought to an end rather by the diminished warmth of the ocean waters than by a rise of the general air temperature. At the present day the great glaciers of the Polar regions are largely fed by the water emitted from volcanoes. The Carboniferous period seems to have been a turning point in the history of the globe; for the crust up to that time was less fissured, and so was not chilled by the penetrating water; hence the high temperature of the seas kept the carbonic acid in the atmosphere. But after that became fixed in the form of coal the present conditions became possible. M. Hermite, we think, is not likely to get his theory adopted by geologists until he shows in more detail that it will harmonise with the facts; for he usually contents himself with vague statements, which read like his impressions of books. Also, when he plays havoc with the names of fossils (*e.g.*, *Rhinocéros*, *Thycorinus*, for *R. Tichorhinus*), and attributes the cirques and gorges of mountain regions, with the cañons of more level districts, to the action of subterranean water, we feel that he is making a possible exception a general rule, and we cannot help doubting whether he has any practical knowledge of the science. In fact, much of his geology seems on a par with his statement (p. 29) that the volume of a series of spherical shells increases as the cube of their radii.

OUR BOOK SHELF.

La Géologie. Par H. Guède. (Bibliothèque des Sciences Contemporaines.) Pp. 724. 151 figures intercalées dans le texte. (Paris: Schleicher Frères, 1901.)

IN his very modest preface, the author of this volume disclaims any idea of adding to the accumulated mass of geological facts or of advancing new theories to account for them. His object is to present, in a lucid manner, a summary of acknowledged facts and generally received theories, following the encyclopædic treatise of M. de Lapparent, and to do so in such a way as to make the subject of interest to the general reader, while avoiding the claptrap style of certain so-called popular works.

In a task of this kind there is not much opportunity for originality of treatment, and the author wisely follows the general plan of geological treatises in discussing first the causes at present in operation in the earth's crust, secondly the changes in the earth's surface features, thirdly the internal forces at work within the earth's crust, and fourthly the evolution of the earth. In his classification of the geological periods, the author follows most French writers in treating the Quaternary era as the equivalent of the Tertiary, Secondary and Primary eras, a plan which is not without inconvenience to the student. The illustrations of the book appear to be all original, and are of a very simple character—indeed, nothing more than transcripts of such rough sketches as a teacher would draw upon the blackboard. While this plan has the advantage of enabling the teacher to emphasise the *essential* features in the sections and fossils he refers to—and these are often missed in more elaborate picture-illustrations—it is in some cases manifestly inadequate for teaching purposes. Thus the reader of this work would have no idea of the characters of the rocks described when seen in thin sections under the microscope. On the whole, however, the author may be congratulated on having produced, within a very moderate compass, a clear and exact exposition of geological science.

Farm Poultry. By G. C. Watson. Pp. x + 341. Illustrated. (New York: The Macmillan Company, 1901; London: Macmillan and Co., Ltd.) Price 5*s.* net.

THIS popular sketch of poultry farming is a very useful addition to the Rural Science Series. Mr. Watson has written for practical men, and gives working details on every part of his subject, but he has at the same time written in a really scientific spirit. Scientific terms are, indeed, entirely avoided; the language is clear and simple; but the principles which underlie good practice are in every case brought to the front, so that a rational

acquaintance with the subject is ensured. There is, perhaps, no department of farming which suffers so much from mismanagement as the poultry yard, yet the industry is of national importance. Mr. Watson reminds his readers that the annual value of farm poultry and eggs produced in the United States, according to the census returns of 1890, exceeded the annual value of the coal, iron, and mineral oil produced during the same period. In England we have no such statistics, but the Trade and Navigation Returns show that the imports of poultry and eggs to this country amounted last year to the value of 6,416,468*l*. The book has numerous illustrations.

R. W.

The Collected Scientific Papers of John Couch Adams. Vol. ii. Pp. xxxii+646. (Cambridge University Press, 1900.)

THE astronomical papers in this volume have been ably edited by Prof. Sampson. The first eighteen papers form a connected series on the lunar theory, and are substantially the lectures on that subject which Adams used to deliver at Cambridge. As an aid to the student they probably surpass any text-book that has been written on the subject. It has been said that the difficulties of the lunar theory begin where the text-books usually leave off, but Adams introduces the reader to many of the practical difficulties of the numerical work, such as the slow convergence and small denominators.

The other astronomical papers are miscellaneous in character and must have taxed the editor to the utmost, for, to quote the preface, "the papers . . . were almost devoid of arrangement. . . . It would have been a hopeless task . . . had not almost every page been dated. This permitted reference to a diary. . . ." Among the most interesting papers are those on Jupiter's satellites, a subject which Prof. Sampson has made his own, a paper on an infinite determinant in the motion of the moon's node which shows that Adams came nearer than anyone else to anticipating Hill in his treatment of the lunar theory, and some papers on the moon's secular acceleration.

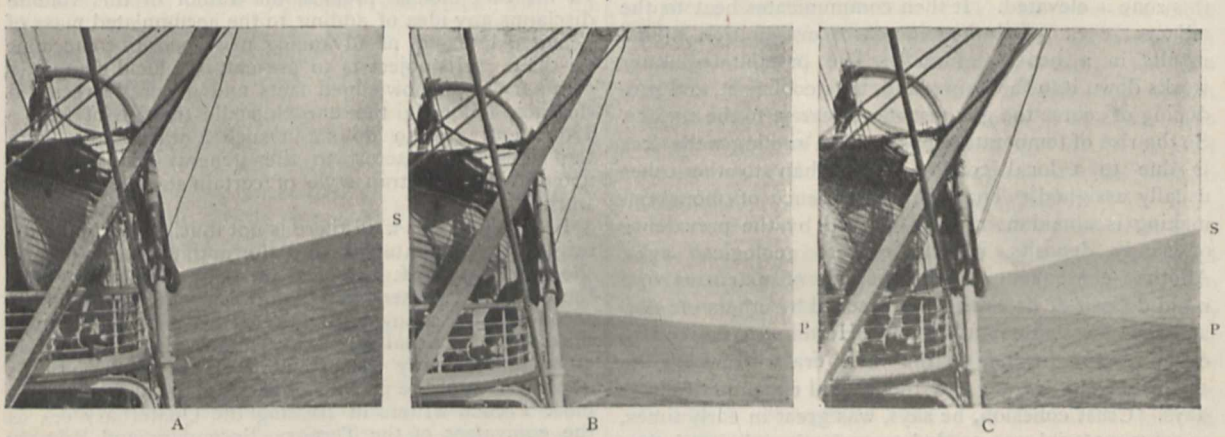
The second and larger half of the volume is devoted to Adams' papers on terrestrial magnetism edited by his brother, Prof. W. C. Adams. These consist chiefly in a determination of the Gaussian magnetic constants, a problem for which the material is even now scanty, owing to the fact that such magnetic observatories as there are, are for the most part closely grouped together in one portion of the earth's surface.

LETTERS TO THE EDITOR.

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

The Rolling Angle of a Ship found by Photography.

WHILE crossing the Pacific Ocean between Auckland, N.Z., and Sydney, N.S.W., in the Union s.s. *Mokoia*, I wished to determine, if possible, the rolling angle of the ship by some means, other than that of the inclinometer, which the captain allowed me to inspect from time to time. As the period of rolling was long, it seemed quite possible that an ordinary kodak camera might be manipulated and a fresh film introduced, between the end of the roll to port and then to starboard. This turned out to be the case; the results are shown in the pictures A and B, which indicate the inclination of the ship to the horizon, to starboard and to port, respectively. The films when developed and finished were superposed, so that the pictures of the ship in each photograph coincided. The print made from this combination of the pictures B and A gives the composite picture C, in which the horizon in picture A is separated from that in picture B by the angle shown, which when measured with a circular protractor was found to be 19° 6′. After a few trials, no difficulty was experienced in making the exposure at the right time, viz., at the ends of a roll. Better results might have been obtained on dry plates, as films do not stand high temperatures well. The film B is very slightly distorted. The angle may also be found by means of a single picture; in this case a small stop should be used, and the exposure made for a longer period than that of one roll; the angle then appears as a rather faint fan, but the definition at the ends of the roll is not so well defined as when two pictures are made and then superposed.



Union Steamship Co.'s *Mokoia*. Rolling angle found by photography. A is a picture taken at the instant of the end of rolling to the right, S: B is a picture taken at the instant of the end of rolling to the left, P; C is a composite picture made by superposing the two films, A and B. The pictures of the ship are made to coincide, thus the angle between the two horizons in A and B is found. Lat. 34° 27′ S. Long. 157° 43′ E. To Sydney 325 miles.

Since my return to England, I find that M. Huet, of the French Navy, used a photographic method for indicating the rolling angle. But as his work on the subject is only in the hands of the French Naval Department, it cannot be consulted. His method is referred to in Sir W. White's "Manual of Naval Architecture." After obtaining the results shown in picture C, I devised an apparatus whereby the inclinometer angle may be simultaneously compared with that found by the photographic method. By this means, the positions of the inclinometer are also recorded on the films on which the horizon appears, so that the angle shown by the inclinometer may be at once compared with the angle found by the photographic method, which is entirely free from the errors inherent in pendulum inclinometers.

F. J. JERVIS-SMITH.

British Instruments at the Paris Exhibition.

IN connection with the English exhibits at the Paris Exhibition last year, it may be worth while to quote the concluding paragraph of this part of the impartial and very carefully con-

sidered report of Prof. Dufour, of Lausanne, the Swiss member of the jury.

"L'Angleterre vit, dans le domaine des instruments scientifiques, dans un isolement assez grand par rapport aux autres pays. Elle a ses habitudes et ses traditions, des instruments bien faits, mais ces constructeurs, ne paraissant guère se soucier de ce qui se fait hors de chez eux, ont peu d'influence sur l'étranger."

C. V. BOYS.

Notes on Minerals from the Lengenbach Binnenthal.

IN a recent visit to Binn I obtained some interesting minerals —viz (1) a new mineral (2) Dufrenoysite, (3) Hyalophane.

(1) A new member of the sulpharsenites of lead, crystallising in the oblique system

$$\beta = 82°42\tfrac{1}{2}'. \quad a:b:c = 1{\cdot}36817 : 1 : {\cdot}947163.$$

Very similar to dufrenoysite in appearance, but distinguished by the rounding of the dome and pyramid planes and well-marked oblique symmetry.

I found an imperfect crystal three years ago, but it was not till last August that I obtained sufficient material to fully determine this new mineral.

(2) I also found some very finely developed crystals of dufrenoysite having fifteen new faces, also a twinned crystal, twin plane (0.1.14), thus resembling rathite, whose twin plane is (0.15.1).

(3) Hyalophane, the baryta felspar which is isomorphous with orthoclase, is now shown by some of my specimens to twin according to the Baveno and Manebach laws of twinning in orthoclase.

A full account of the above will appear in the next number of the *Mineralogical Journal*. R. H. SOLLY.

Cambridge.

Gog and Magog.

YOUR interesting paragraph in NATURE of September 26 on the local Flemish giants carried annually in procession omitted the parallel most suggestive to English readers: Gog and Magog, cousins German of Gayant and Phinar, used also to figure annually in the Lord Mayor's Show, as is noted in Chambers's Encyclopædia. According to tradition "the Guildhall giants are images of the last two survivors of a race of giants who inhabited Albion, descendants of wicked demons and the thirty-three infamous daughters of the Emperor Diocletian, who, after murdering all their husbands, sailed to Albion. These giants Brute and his Trojans finally overcame, leading the last two survivors prisoners to London, where they were kept as porters at the palace-gate. This is Caxton's account; another represents one of the giants as Gogmagog, and the other as a British giant who killed him, named Corineus. These giants have stood in London since the days of Henry V., and have witnessed all its history since. The old giants were burned in the great fire, and the new ones, which are 14 feet high, were constructed in 1708. The ancient effigies, which were made of wicker-work and pasteboard, were carried through the streets in the Lord Mayor's Shows, and copies of the present giants were in the show of 1837. Formerly other towns in England and abroad had their giants, as the Antigonus of Antwerp, 40 feet in height, and Gayant, the giant of Douay, 22 feet in height." D.P.

Edinburgh, October 3.

Fireball of September 14.

A VERY memorable meteor fell into the Atlantic on September 14, 1492, and is recorded in the diary of Columbus. It would be interesting to know whether his notes are sufficiently precise to enable one to say whether the radiant of that meteor is the same as that of more recent ones. C. E. STROMEYER.

Lancefield, West Didsbury.

A New Name for an Ungulate.

IN a paper published in the *Geological Magazine* for September 1901 I described a large ungulate from the Eocene of the Fayûm, Egypt, under the name *Bradytherium grave*. I now find that the name *Bradytherium* had been employed a few months previously by G. Grandidier for a large extinct edentate from Madagascar (*Bull. Mus. d'Hist. Nat.*, Paris, 1901, p. 54), and I therefore wish to propose the name *Barytherium* for my genus. CHAS. W. ANDREWS.

British Museum (Natural History), October 7.

ON THE MAGNETIC ROTATION OF LIGHT AND THE SECOND LAW OF THERMODYNAMICS.

IN a paper published sixteen years ago I drew attention to a peculiarity of the magnetic rotation of the plane of polarisation arising from the circumstance that the rotation is in the same absolute direction whichever way the light may be travelling. "A consequence remarkable from the theoretical point of view is the possibility of an arrangement by which the otherwise general optical law of reciprocity shall be violated. Consider, for example, a column of diamagnetic medium exposed to such a force that the rotation is 45°, and situated between two Nicols whose principal planes are inclined to one another at 45°. Under these circumstances light passing one way is completely stopped by the second Nicol, but light passing the other way is completely transmitted. A source of light at one point A would thus be visible at a second point B, when a source at B would be invisible at A; a state of things *at first sight*[1] inconsistent with the second law of thermodynamics." (*Phil. Trans.* 176, p. 343, 1885; *Scientific Papers*, vol. ii. p. 360). It is here implied that the inconsistency is apparent only, but I did not discuss it further.

In his excellent report ("Les Lois théoriques du Rayonnement, Rapports présentés au Congrès International de Physique," Paris, 1900, vol. ii. p. 29), W. Wien, considering the same experimental combination of Nicols and magnetised dielectric, arrives at a contrary conclusion. It may be well to quote his statement of the case. "La rotation magnétique du plan de polarisation constitue un cas exceptionnel digne de remarque, et l'on pourrait ici imaginer un dispositif qui mettrait en échec principe de Carnot s'il n'existait pas une compensation inconnue.

"Faisons, en effet, les suppositions suivantes; Deux corps de température égale sont entourés d'une enveloppe adiabatique. Les rayons qu'ils s'envoient réciproquement traversent deux prismes de nicol. Entre ces prismes se trouve une substance non absorbante sur laquelle agissent des forces magnétiques qui font tourner le plan de polarisation d'un angle déterminé. La radiation émanant du corps 1 pénètre dans le nicol 1. Nous supposerons que le rayon subissant la réflexion totale n'est pas absorbé, mais renvoyé dans sa propre direction par des miroirs convenablement disposés. Admettons que le plan de polarisation soit tourné de 45° par les forces magnétiques. La section principale du deuxième nicol étant orientée dans la direction parallèle au plan de polarisation du rayon émergent, toute la lumière transmise par la substance absorbante (*sic.*) traversera le nicol. Par consequent, la moitié des rayons émis par le corps 1 frappera le corps 2.

"Les rayons émis par le corps 2 se divisent en deux parties égales, dans le nicol 2. Une moitié est, comme précédemment, renvoyée par réflexion. L'autre moitié, après que son plan de polarisation a subi une rotation de 45° dans le même sens que le rayons émis par le corps 1, vient frapper le premier nicol. La section principale de ce nicol étant perpendiculaire au plan de polarisation, aucune radiation ne le traverse, et nous pouvons renvoyer toute la lumière au corps 2.

"Le corps 2 recoit ainsi trois fois plus d'énergie que le corps 1. [That is, 2 receives the whole of its own radiation and the half of that of 1, while 1 receives only the half of its own radiation.] L'un de ces corps s'échauffera par conséquent de plus en plus aux dépens de l'autre."

Wien then suggests certain ways of escape from this conclusion, but it appears to me that the difficulty itself depends upon an oversight. It is *not* possible to send back to 2 the whole of its radiation in the manner

[1] The italics are in the original. That magnetic rotation may interfere with the law of reciprocity had already been suggested by Helmholtz.

proposed. The second half, which after passage of Nicol 2 is totally reflected at Nicol 1 and then returned upon its course, on its arrival at Nicol 2 is not transmitted (as Wien seems to suppose) but is totally reflected. When again returned upon its course by a perpendicular reflector, and again rotated through 45° by the magnetised medium, it is in a condition to be completely transmitted by Nicol 1, and thus finds its way to body 1, and not to body 2 as the argument requires. The two bodies receive altogether the *same* amount of radiation, and there is therefore no tendency to a change of temperature.

Although I have not been able to find any note of it, I feel assured that the above reasoning was present to my mind when I wrote the passage already cited.

RAYLEIGH.

MARTIN F. WOODWARD.

IN Martin Fountain Woodward, whose untimely death by drowning we recorded in our issue of September 26, science has lost an untiring devotee, zoology a brilliant student and investigator, a teacher whose personal influence and example will live in the memory of those to whom he so willingly imparted knowledge.

M. F. Woodward, younger son of Dr. H. Woodward, F.R.S., keeper of the geological department of the British Museum of Natural History, was born in London on November 5, 1865, and educated at Kensington Grammar School. In 1883 he entered the Royal School of Mines and Normal School of Science as an associate student, qualifying in 1885 with distinction, as the recipient of the Murchison medal and prize of books, for excellence in geology. In zoology he attended the last session's work conducted by the late Prof. Huxley. In both elementary and advanced examinations he headed the pass-list, and showed his power by an achievement in the practical work which so far excelled all precedent that for years his dissection was at Huxley's request kept for use, as an ideal to which the ordinary student might aspire. In this and his class-work combined, Woodward evinced such special aptitude for biological study that Huxley at once appointed him an assistant. In the following year he was made demonstrator of zoology, and in that capacity he continued to labour zealously and with great ability for the remaining seventeen years of his life, inspiring affection and respect in all with whom he came in contact.

With advancing years, Woodward developed a special aptitude for microchemical work and marine investigation. His fame as a preparateur brought to him numerous friends and coworkers anxious to benefit by his assistance and advice, who are to-day unanimous in their admiration of his manipulative skill and mental attainments. His mind was ever clear, his judgment sound, and by his energetic enthusiasm and foresight he was at times directly influential in uprooting error and misinterpretation in their work, thereby earning their lasting gratitude. His leaning towards marine zoology received a welcome impetus in an opportunity afforded him in the summer of 1887, by Mr. W. H. Hudleston, F.R.S., of conducting a dredging trip in the English Channel, at the conclusion of which his efforts elicited the high encomium of his friend. He later spent his summer vacations in marine research, exploring the fauna of the Channel Islands, working at the Plymouth Marine Station, till finally, through the instrumentality of Mr. E. W. L. Holt, whose friendship he made while he was a student in our College, he was enabled to spend his last three vacations at the Marine Biological Laboratory of the Irish Fishery Board, first at Inishbofin and then at Moyard, where he met his death. Published reports bear testimony to the success of his achievements, and in a recent letter the Vice-President of the "Department of Agriculture and Technical Instruction for Ireland," under which the later work was done, has highly eulogised his labours, character, and attainments. Only a few days before his death, Woodward, in a letter to his friends, wrote with delight of a 380-fathoms haul, which had yielded a *Haloporphyrus*, a large *Pomatomus*, and about 20 Asthenosomas, rare captures for the British Seas. In describing this catch he presented a word-picture worthy his high artistic ability, which, while testifying to his own great enthusiasm, appealed strongly to that of the zoologists to whom it was communicated.

Woodward from time to time published papers on subjects of special study, the outcome of work done in the scanty leisure his official duties allowed. Among the earlier of these is a valuable paper in the Proc. Zool. Soc. for 1892 on the dentition of Hyrax, Huxleyean in its methods and based on the specimens briefly recorded by Huxley in 1863. In this memoir much that was hitherto confusing in the dentition both of *Hyrax* and other placentalia was rendered clear, and through it Woodward was led to an extended inquiry into the genesis and succession of the teeth in the marsupialia, with the result that his published memoirs placed him in the front rank of comparative odontologists. To have revolutionised our conceptions of the incisors of the Diprotodonts, to have shown that the single so-called successional cheek-tooth of the marsupialia is most probably a retarded pre-molar, and to have contributed to the unravelling of the intricacies of the tooth-complex of the Insectivora, is to have essayed a plucky task and to have earned the lasting gratitude of zoologists of all nationalities.

Woodward, true to his family traditions, cultivated a love of the Mollusca, and upon these animals he published a series of most valuable papers, terminating in a well-nigh exhaustive study of the famous *Pleurotomaria*, published in the *Qu. Jour. Microscp. Sci.* for 1891. His papers upon other molluscs were for the greater part contributed to the Proceedings of the Malacological Society, of which he was one of the original members and the secretary at the time of his death. To read these memoirs is to appreciate the fact that Woodward possessed a knowledge of molluscan morphology second to that of no living malacotomist, and his discussion of the affinities of the Monotocardia set forth in his last published paper may be recommended to those who would gauge his reasoning capacity. Upon the Mollusca he had long specialised, and his concluding act as a teacher was a course of lectures at the Royal College of Science which for depth and originality of treatment will be a lasting memorial to his powers to those who were so fortunate as to hear them. They embodied his preliminary notes and ideas for a book he had intended to write, and it is terrible to think that with his death this brilliant achievement has been cut short.

Ever alert for a new observation, Woodward, as opportunity occurred, made public his passing notes. As an example may be cited his intensely interesting discovery of an earthworm possessed of seven pairs of ovaries. He performed a notable task, involving the spare time of three of his best years, in editing the English edition of vols. ii., iii. and iv. of Korschelt and Heider's "Text-book of Embryology," the emendations, curtailments, and annotations which he effected materially increasing the value of the work.

Woodward was always ready to cooperate with friends and fellow workers in anything which would advance our knowledge of the phenomena of life. He leaves behind him a magnificent series of photomicrographs of the fertilisation process in *Ascaris megalocephala*, made from sections which he had prepared, and an extensive series of preparations, drawings, and notes, upon the spermatogenesis of the Mollusca, the rough arrangement of which constituted the closing act of his College life.

On August 2, Woodward, having just recovered from a surgical operation, journeyed to Moyard, in company with his friend Mr. W. Watson, F.R.S., assistant professor of physics in the Royal College of Science, who had before accompanied him on similar occasions. On Sunday, September 15, after spending the day with their friend Mr. Allies, resident land-owner of Inishbofin and other adjacent islands of the Galway seaboard, on the return journey and within sight of land their boat was capsized by a sudden squall. While Watson and the fisherman in charge managed with extreme difficulty to reach the shore, Woodward, though a good swimmer, sank and entirely disappeared, and although every effort was made to recover the body, it was not brought to the surface till September 27.

He was laid to rest on Sunday, September 29, in the peaceful little Protestant churchyard at Moyard, in the presence of his two sisters, Mr. Watson, Mr. Holt, of the Irish Fisheries Board, and a few of his devoted friends. One reflects with sorrow that circumstances should have combined to remove from the world of action before he was thirty-six a man so universally esteemed. We revere his memory as that of an earnest and original worker, loving and sympathetic, whose self-sacrificing nobility of character, critical capacity, and devotion to the cause of science will long be remembered by the many friends who mourn his loss. G. B. H.

NOTES.

THE Harveian Oration of the Royal College of Physicians will be delivered by Dr. Norman Moore on Friday, October 18.

WE regret to have to record the death, at the age of sixty-nine, of M. R. Koenig, of Paris, well-known for his researches in acoustics, light and heat.

THE *Journal of Botany* records the death, from cholera, in India, on September 14, of a promising young botanist, Mr. William West, at the age of twenty-six. Mr. West had passed a distinguished career at the Royal College of Science, where he obtained the Forbes medal for botany, and at Cambridge, though greatly marred by ill health. He had devoted himself chiefly to the study of freshwater algæ, and had gone to India as biologist to an Indigo Planters' Association.

THE ship *Discovery*, engaged on the British exploring expedition in the Antarctic regions, arrived at Cape Town on October 3. After coaling the *Discovery* will proceed to Simons Bay and thence direct to Lyttelton, not calling at Melbourne in order to save time.

SPEAKING at Upsala to the Swedish Geographical Society on Wednesday of last week, Prof. Nordenskjöld announced that the Swedish South Polar Expedition would be ready to start soon after the 8th inst. After reaching the Falkland Islands, where a depôt will be established, the expedition will continue its voyage southwards. After making their way as far south as possible, the explorers will look for a spot suitable for wintering in. The ship, with three geologists on board, will then return to the Falkland Islands, whence scientific excursions will be conducted throughout the winter. The expedition will probably return to Sweden at the beginning of 1903.

IT is announced in the German semi-official newspapers that the German Government has again placed at the disposal of the Chinese Government the astronomical instruments which were removed from Peking by the German contingent. The Chinese Government has replied that in view of the inconvenience and difficulties which would be involved in conveying the instruments back to China and placing them in their former position it declines the offer.

THE resignation of Dr. Purser, King's Professor of the Institutes of Medicine in the School of Physic, Trinity College, Dublin, is announced. In 1899, on the completion of the twenty-fifth year of his professorship, Dr. Purser's past pupils, in token of their appreciation of him and his services, founded the "John Mallet Purser Medal" for award yearly in the School of Physic to the candidate who obtains the highest marks in physiology and histology at the Half M.B. examination. Prof. Purser's decision has been arrived at, not on account of ill-health or failing energy, but, as the *British Medical Journal* understands, in order that with the increased laboratory accommodation which the Board of Trinity College has provided for the teaching of physiology and histology his successor may have the advantage of equipping the laboratory and organising the work on the more extended basis.

A REUTER telegram, dated October 7, gives further particulars as to the progress of the campaign in Freetown, Sierra Leone, of the Liverpool School of Tropical Medicine against mosquitoes. Up to September 17, 6500 houses had been cleared by Dr. Logan Taylor and his assistants of the receptacles in which the Culex mosquitoes breed, and draining operations against the Anopheles mosquitoes are being pushed forward as much as the rain will allow. In addition to fifty other men employed on the operations of the expedition, two men are specially employed to look constantly after the centre of the town, where the offices, warehouses, and European houses are. The Governor, Sir Charles King Harman, is giving every assistance. Dr. C. W. Daniels, medical superintendent of the London School of Tropical Medicine, who was attached to the expedition and has been studying Dr. Taylor's work at Freetown, has now returned to England. In a report of his observations, addressed to Major Ross, he says:—"In my opinion your efforts have already been crowned with a large degree of success, as there has been a noteworthy diminution in the number of the two first genera of mosquitoes, Anopheles and a kind of Culex, found in the houses. The number o breeding ground has been enormously diminished."

AT the International Congress of Physiologists recently held at Turin a noteworthy tribute of esteem was paid to Sir Michael Foster on his resigning the presidency to his successor, Prof. Angelo Mosso. This consisted in the presentation of a plaque, of which we reproduce (from the *British Medical Journal*) the inscription, granting him the unique distinction of Honorary Perpetual President of the Congress. The wording on the plaque is as follows:—

CONVENTUS PHYSIOLOGORUM INTERNATIONALIS QUINTUS HOC DIE VIRUM ILLUSTRISSIMUM SENIOREM

MICHAELEM FOSTER

PRAESIDEM HONORARIUM PERPETUUM CONVENTUUM PHYSIOLOGICORUM INTERNATIONALIUM CREAVIT

CONVENTUS NOSTRI GRAVISSIMI VIRI DOCTI AUCTORITATE EIUSDEMQUE STUDIO STRENUO INTEGRE FLORENT FOSTERO CATALOGUM SCIENTIARUM NATURALIUM QUO NEMO IAM NATURAE INDAGATOR CARERE POTEST DEBEMUS GRATIA SIT HONOSQUE PROPUGNATORI NOSTRO! NOMINE CONVENTUUM PHYSIOLOGICORUM INTERNATIONALIUM CONVENTUS QUINTI PRAESES

ANGELUS MOSSO.

AUGUSTAE TAURINORUM AD XV KAL. OCT. A. MCMI.

THE Hanbury gold medal for 1901 was presented on the 1st inst. to Dr. George Watt by the president of the Pharmaceutical Society. This medal, which was established as a memorial to Daniel Hanbury, is awarded biennially for high excellence in the prosecution or promotion of original research in the chemistry and natural history of drugs, and the council of the Pharmaceutical Society are the trustees of the memorial fund.

THE sixtieth anniversary of the foundation of the Pharmaceutical Society has just been celebrated by the presentation of a badge of office to be worn by successive presidents of the Society. An illustration of the badge appears in the current issue of the *Pharmaceutical Journal*.

AN expedition is about to be despatched to Christmas Island, under the auspices of the London School of Tropical Medicine, for the purpose of investigating beri-beri. The leadership of the expedition has been accepted by Dr. H. E. Durham, who will join the s.s. *Islander* at Port Said on or about October 16. The inquiry will probably extend over a period of twelve months.

SIR FRANCIS LOVELL, Surgeon-General of Trinidad, will, according to the *Hospital*, leave England during the present month on a mission to tropical and other countries on behalf of the London School of Tropical Medicine. Lord Brassey will preside at a meeting at the Royal United Service Institution on October 16 to deliver an inaugural address on the opening of the third winter session of the school and to give a send-off to Sir F. Lovell.

THE return of Dr. H. F. Knowlton, of the U.S. Geological Survey, from a trip through the John Day Basin, Oregon, is noted in *Science*. The special object of the expedition was to secure collections of fossil plants, and of the vertebrate fauna of the neighbourhood, and much valuable material has, it is reported, been obtained.

MAGNETIC observatories are being established under the auspices of the U.S. Coast and Geodetic Survey at Sitka, Alaska and in Honolulu.

A COURSE of six popular science lectures for young people, entitled "Peeps into Nature's Secrets," will be delivered at the Kensington Town Hall on October 17, 24, 31, November 14, 28, and December 5. Particulars as to the subjects of the lectures and the names of the lecturers are to be found in our advertisement columns.

FREE popular science lectures will be delivered in the museum of the Whitechapel Free Library as follows:—November 12, at 8 p.m., "The Faroe Islands and Iceland," by Prof. C. Lloyd Morgan, and December 11, at the same hour, "The Instincts and Intelligence of Animals," by Lord Avebury. In connection with the course, Dr. T. K. Rose lectured on Tuesday last on "Alloys, and what we know about them."

THE *Athenaeum* states that the Berlin Königliche Akademie der Wissenschaften and the Danish Academy at Copenhagen have decided to prepare a collection of all the medical works of antiquity under the title of "Corpus Veterum Medicorum," and will cause a thorough examination to be made of all libraries, Oriental and European, which are likely to contain MSS. dealing with medical subjects.

A MEETING of the Royal Microscopical Society will be held on Wednesday, October 16. A paper on the fungi found on germinating farm seeds will be read by Miss A. Lorrain Smith; it will be preceded by an exhibition of mounted specimens of marine zoological objects by Mr. C. L. Curties.

A VERY successful meeting of the British Mycological Society was held at Exeter from September 23 to 28, when several scarce specimens of fungus were obtained. At the evening gatherings papers were read by the president (Prof. H. Marshall Ward), Miss A. Lorrain Smith, Dr. C. B. Plowright, and Mr. B. T. P. Barker.

THE Paris correspondent of the *Times* states that the French Post Office has decided to print upon letters the hours of collection numbered, as in Italian and other railway time-tables, from 1 to 24, or rather to 0, which will signify midnight.

ACCORDING to the *Lancet*, the New York City Board of Health has adopted resolutions to the effect that the officers of "public institutions, hospitals, homes, asylums, &c., be required to report all cases of malarial fever which come under their observation, giving the name, age, sex, occupation and present address of the patient," and "also information as to whether the attack is a primary infection or a relapse, and the address where the disease was probably contracted"; also "that all physicians in the city of New York be requested to furnish similar information in regard to patients suffering from malarial fever under their care."

DR. ADOLPH GEHRMANN, director of the Chicago City Laboratory, and Dr. W. A. Evans, of the Columbus Medical Laboratory, have devised a plan of investigation, the main feature of which is to make the experiment with lupus. They hold that just as satisfactory a test can be obtained by inoculating the skin of a human being with the bacillus from an animal as could be got from experiments with pulmonary tuberculosis, with the great advantage that there is no risk to life. Preparations are being made for the experiments, and two persons have already consented to be inoculated.

SCIENTIFIC visitors to Ceylon, and botanists generally, will be interested to know that a small residential laboratory has been opened at the Hakgala Botanic Gardens, near Nuwara Eliya, at an elevation of 5600 feet above sea-level. The laboratory is a branch of the Peradeniya institution, described in NATURE, November 9, 1899, and consists of a small building containing a working room 21 feet × 12½ feet, a living room, two bedrooms, kitchen, &c. The climate is temperate, fires being required in the evenings at least. The botanic garden itself is very beautiful, and occupies an unrivalled position for the study of equatorial hill vegetation, for on one side there are jungles stretching for 25 miles or more into the wet region of the hills, on the other grassy plateaux (patanas, *cf.* Pearson in *Journ.* Linn. Soc., 1899), reaching for an equal distance into the dry region, and extending from 3000 to 7000 feet above sea-level. The garden itself contains both jungle and patana reserves of several hundred acres.

THE *Daily News* of October 7 contains a long interview with Mr. Cheesewright on the scheme for constructing a high-speed electric railway between London and Brighton. The system proposed to be adopted is not described, but it is stated that the monorail, of which so much has been heard of late, is not to be used and that each car will carry its own motor. A speed of nearly 90 miles an hour is aimed at, so that the whole journey of 47 miles will only occupy 32 minutes. This high speed is to be made possible partly by having no intermediate stations, and partly by avoiding all curves and gradients by tunnelling wherever hills occur along the route. In addition to the benefit conferred by a half-hourly service of express trains, the public is to be attracted by the cheapness of the fares. The Bill will, without doubt, meet with seriou opposition in Parliament from the London, Brighton and South Coast Railway, but we wish the promoters of the scheme every success. We feel sure that the public have only to be taught, by a few striking examples, the immense improvements that electric traction can effect in railway travelling to insist upon its adoption in suitable cases by our existing steam railroads. It is only by healthy competition of the kind that such railways as this will introduce that it will ever be possible to eradicate

the often very primitive ideas of comfort and convenience that seem to be possessed by the great railway monopolists; and we hope, and believe, that it will be the function of electric traction to produce as great a change in the comfort of travelling in the present century as did steam railways in that which has just closed.

THE *Electrician* announces that the Hon. A. Lyttelton has been appointed by the Board of Trade as arbitrator to settle the dispute between the Metropolitan and District Railway Companies as to the electrical equipment of the Inner Circle. The disagreement has been long and bitter, and, as the *Electrician* points out, has not only unnecessarily delayed the improvement of the Inner Circle, but has also created an impression that electrical engineers are undecided upon the question of the most satisfactory system of electric traction. That this is true in its broadest sense is no doubt the case, but there are many thoroughly satisfactory systems from which to choose, and it is to be hoped therefore that it will not now be long before one is selected and the alteration of the Inner Circle begins in real earnest.

THE New York *Electrical World and Engineer* for September 28 contains a long article descriptive of the Cooper-Hewitt mercury vapour lamp. A brief description of this lamp was given in NATURE (May 9, p. 39) at the time it was first exhibited in America. The present article is founded on the contents of ten patents just issued to Mr. P. Cooper-Hewitt, and describes in considerable detail the construction and manufacture of the lamps. The chief difficulty met with is apparently in starting the lamp; it is found, however, that a small amount of sulphur introduced into the tube (as sulphide of mercury) makes it much easier to overcome the initial high resistance, but even with this addition a transformer or induction coil is still needed. Once lighted, the lamp is said to burn steadily on 100-volt or 200-volt circuits. The unpleasant colour of the light from mercury vapour can be cured, according to the inventor, by the use of nitrogen in the lamp, this adding the necessary red rays. When originally iutroduced, the consumption of energy was given as only half a watt per candle, a value which is astonishingly small. We await, therefore, with the greatest interest some account of the practical performance of the lamp; unfortunately, it is often a big wait from the patent to the commercial lamp, and it can only be hoped that in this case the time will not be over long.

THE general report on the operations of the Survey of India for the year 1899–1900 shows that the total area triangulated was 41,110 square miles, including 16,000 square miles triangulated in connection with reconnaissance surveys, and valuable scientific observations were effected in the determination of latitudes. The Government of India, in a resolution reviewing the report, notice with interest the large addition to the geographical knowledge of Yunnan and the north-eastern frontier, and acknowledgment is made of the efficient way in which the work of the department has been carried on.

SOME stir has been made in connection with "Kent coal" by the proving in another boring at Dover of certain coal-seams which in reality were discovered some twelve years ago. The original coal-boring was commenced as far back as 1886, and a depth of more than 2000 feet was ultimately reached. The fact that another boring in the immediate neighbourhood has been carried to a depth of 1194 feet is of no particular importance. What is required is that the shaft should be completed down to the workable coal, and the information with regard to this (given in the *Financial Times* of October 4) is that it is hoped to bring up coal "in about fifteen months' time." That the existence of the "coal-field" has been proved "beyond reasonable doubt" will not be questioned; the extent of it remains to be proved. There may be small isolated tracts of faulted Coal Measures, or a continuous field extending ten miles or more.

THE Geological Survey of Egypt has just published an account of Dakhla Oasis by Mr. Hugh J. L. Beadnell. This oasis lies to the south of that of Farafra, an account of which was previously published (NATURE, August 8). It is by far the most important of the four great oases of the Libyan Desert, on account of the number of its inhabitants, the extent of its cultivated lands and palm groves, and the copiousness of its water-supply. The water-supply is derived from an underground bed of sandstone, which is never visible. This is overlain by a bed of red clay and underlain by black clay. The water appears to flow to the surface entirely through artificial wells and bore-holes, ancient and modern. Many of these artesian wells were made during the Roman occupation of the country, some are still in thorough working order, and they are as deep as those bored recently, about 140 metres. The temperature of the waters varies from 78° to 102° F., the heat being due to the depth from which they arise and being modified by local conditions. The water-bearing strata belong to the Nubian Sandstone series (Senonian or Upper Cretaceous). They are overlain by a great thickness of soft Danian beds capped by hard white chalky (Danian) limestone. After the hard capping had been eroded further waste proceeded rapidly, and the formation of great depressions, without drainage outlets, has been due mainly to wind erosion.

THE eruptive rocks of the neighbourhood of Ménerville, Algeria, form the subject of an elaborate essay by MM. Louis Duparc and Francis Pearce, to which Dr. E. Ritter has contributed particulars of the geological structure of the country (*Mem. de la Soc. de Physique et d'Hist. Nat. du Genève*, xxxiii. part 2, 1901). Special attention is given to the liparites and dacites and to their relations with the granitoid rocks (tonalites and micro-tonalites). In the same volume, M. P. de Loriol describes some new echinoderms, including *Pygurus* from Cenomanian and *Echinolampas* from Oligocene strata, and a number of recent species of *Astropecten*, &c., from various parts of the world.

IN the *Proceedings* of the Royal Society of Victoria, vol. xiv. part 1 (August, 1901), geology dominates. Various trachytic rocks are described by Mr. J. Dennant, while the older Tertiary mollusca are in course of description by Mr. G. B. Pritchard, who contributes an account of the lamellibranchs (part 2). There is also a short article by Mr. T. S. Hall on the stages of growth in modern trigonias, which exhibit considerable variation both in the shape of their shells and in their ornament.

IN 1895, a gravitational survey of the kingdom of Württemberg was commenced, and ten stations for the purpose were selected in the first instance on the meridian of Tübingen. The first definite results were obtained in 1899. Dr. K. R. Koch now describes the results of redeterminations made by pendulum methods in 1900, and publishes an account of the methods adopted for eliminating errors of experiment and observation. With the exception of one station, the observations of 1899 and 1900 agree to within about two millionths of the observed values.

A DISTRICT which is free from malaria, in spite of the fact that species of *Anopheles* are abundant and all the conditions are favourable to the occurrence of this fever, forms the subject of a paper by Dr. Grassi in the *Atti dei Lincei*, x. 6. The district is that of Massarosa, about eight kilometres from Viareggio. This district is largely given over to rice cultivation, and, among other noteworthy points, Dr. Grassi finds (1) that malaria formerly existed in Massarosa, but has now practically

died out; (2) that its decrease has taken place concurrently with the extension of the rice plantations, notwithstanding that these form a breeding ground for the mosquitoes; (3) that the mosquitoes in question have not acquired any special immunity from malaria, seeing that they have been artificially infected by being allowed to bite a malarial patient; (4) that many of the inhabitants spend a portion of the year in infected districts where they frequently take the disease, showing that they likewise are not immune. The only conclusion which Dr. Grassi can draw is that malaria does not necessarily occur even in districts favourable to its propagation, and hence he thinks it probable that the disease may be easy to stamp out in infected districts, especially with the systematic use of wire mosquito nets. But there is quite a possibility that the district of Massarosa may be visited at some future time by a scourge of malaria.

A REPORT on the work done at the observatory of Catania in connection with the international photographic survey of the heavens is contributed by Prof. A. Riccò to the *Atti dei Lincei*, x. 5. Among the difficulties to be contended against in the work, that of developing the negatives in the hot climate of Catania may be noted. Since the beginning of 1897, the total number of celestial photographs taken was 430, including 250 for the catalogue, 78 of the zone traversed by the planet Eros, 6 of the new star in Perseus, 3 of the occultation of Saturn, and 6 of lunar eclipses. In addition, the writer and Prof. Tacchini took 66 photographs on the occasion of the eclipse of May 20, 1900, in Algiers. A number of measurements, embracing 22,435 stars, have been made on the plates by Signori L. Franco and M. Massa, and reduced by Signor Mazzarella. Among the calculations made by Prof. Boccardi, with the assistance of Signori Traversa and Taffara, we note the construction of tables for the differences of precession depending on the different constants of Struve and Newcomb, catalogues of 2200 stars taking account of proper motion and of the constants of Newcomb, and the reduction to the equinox of 1900 of 8000 stars of the zone studied at Catania. Prof. Riccò hopes shortly to commence the publication of the catalogue.

THE *Century Magazine* for October contains a short article on "How to cross the Atlantic in a Balloon," by Prof. Samuel A. King, with an introduction by Prof. Cleveland Abbe. Prof. King deprecates the attempts to solve a problem of this character by means of flying machines or mechanically propelled balloons, and thinks that the secret of success lies in mastering the problem of maintaining the ordinary spherical balloon at any required height by the aid of the drag rope or similar appliances. The author also points out the necessity of overcoming the propensity of the balloon to rise and fall with varying temperature, and suggests the use of a hood as a protection from solar radiation. With proper precautions, Prof. King considers a Transatlantic balloon voyage now quite within the range of feasibility.

WE have received a copy of the Results of the Magnetical and Meteorological Observations made at the Royal Alfred Observatory, Mauritius, in the year 1899. Some of these results were alluded to in our notice of the Annual Report (NATURE, June 6, p. 135). Magnetic disturbances occurred on nineteen occasions. A list of them is given in an appendix; the principal were: January 28–29, February 12–13, May 3–5, and September 26–27. The mean declination in the year 1899 was 9° 32′·89 west. There were only four tropical cyclones in the South Indian Ocean during the year, viz., on January 1–8, March 3–8, November 30–December 3, and December 10–16. This cyclone passed over Mozambique on the 17th; the length of its path (more than 3000 miles) has seldom been exceeded in the Indian Ocean. The barometrical readings at the Observatory were appreciably affected at a distance of more than 800 miles. Twenty-seven seismic disturbances were recorded at the Observatory during 1899. The small number of recorded earthquakes at Mauritius as compared with other countries is noteworthy.

THE origin and birthplace of the Proboscidea have long been a puzzle to students of evolution and distribution, the mastodons suddenly making their appearance in the middle part of the Miocene, without our having hitherto had the slightest clue as to their connection with more generalised types. The puzzle has, in a great degree, been solved by Dr. C. W. Andrews, of the British Museum, who, during a recent visit to Egypt, was fortunate enough, while travelling in the Fayum district in company with Mr. H. J. L. Beadnell, to come across two Tertiary deposits which have yielded a previously unknown vertebrate fauna, a part of which is described by Mr. Andrews in the September issue of the *Geological Magazine*. From the upper beds, provisionally regarded as Lower Oligocene, were obtained remains of a small mastodon-like animal (Palæomastodon), differing from Mastodon by the simpler last molar and by having five pairs of cheek-teeth simultaneously in use. The other remains are from a lower horizon, perhaps Upper Eocene, but possibly rather older. Most remarkable is a primitive proboscidean (Mœritherium), with a nearly full series of front and cheek-teeth, the latter being of a generalised Ungulate type. That this animal is an ancestor of the mastodons and elephants may be inferred from the enlargement of the second pair of incisors in both jaws and the small upper canines. All the six pairs of cheek-teeth were in use at the same time. More problematical are the affinities of a huge Ungulate described as Bradytherium. From the same beds Mr. Andrews obtained a Zeuglodon, previously described by Dames, and also a Sirenian, probably identical with Owen's Eotherium. A description of the reptiles is promised later. The importance of the discovery can scarcely be overestimated. It is noteworthy, in connection with a recent theory, that the fauna is situated in the Holarctic, and not in the Ethiopian, region.

IN their Report to the forthcoming anniversary meeting, the committee of the Natural History Society of Northumberland, Durham and Newcastle-upon-Tyne have to deplore the deaths of three prominent members, namely Lord Armstrong, Dr. Embleton and Mr. R. Howse, the last of whom served the Society so well for many years as curator of its valuable museum. We learn that Mr. E. L. Gill, who has been appointed to succeed Mr. Howse, speaks well of the general state of the collections. The finances of the Society, we are glad to hear, continue in a satisfactory condition.

THE *Bulletin* of the Agricultural College at Tokyo contains a capital investigation by Mr. U. Suzuki on the formation and distribution of theine in the tea plant. The seed contains no theine, but this alkaloid appears during germination even in the dark. The roots and stem contain a moderate amount of theine, the bark very little. It occurs in greater quantity in the dormant leaf-buds, and reaches its greatest development in the young leaves, in which 20 per cent. of the nitrogen is sometimes in this form. In old leaves the quantity is greatly diminished. The theine appears to be specially localised in the epidermis of the leaf. Mr. Suzuki has another paper in the same periodical, on the occurrence of organic iron compounds in plants. The seeds of *Polygonum tinctorium* and *Indigofera tinctoria* yield an ash containing 12 per cent. of ferric oxide. The whole of this iron exists in the seed in organic combination, apparently as a ferro-nuclein. The greater part of the iron in plants probably exists in a similar state of combination.

THE decorative symbolism of the Arapaho, a tribe of Plain Indians belonging to the Algonquin stock, is the subject of an

essay by Mr. A. L. Kroeber in the *American Anthropologist* (N.S., vol. iii. 1901, p. 308). In all the examples referred to by the author there is, as there is practically everywhere else, a well-developed symbolism and a conventional decoration, which exist not side by side but in each other. Most primitive decoration, no matter how geometric or simple, has significance, and thus is, visually or ideographically, realistic. This fusion of two differing tendencies (symbolism and decoration) is a rule practically without exceptions. It is universal, because it is necessary. At times, as in European civilisation, the two tendencies become more separated, but the more primitive a people is, the more intimately fused in its art will these two tendencies be. Other tendencies also are still combined with these two in a sufficiently early and rude condition of society. The symbolism of the Arapaho is as ideographic as it is realistic, and is as much a primitive method of writing as it is of artistic representation. The author argues that it is incorrect to assume that symbolism, or any other single motive, accounts for the origin of a design. Thus we come to the conclusion that all search for origins in anthropology can lead to nothing but wrong results. The tendencies referred to are at the root of all anthropological phenomena. Therefore it is these general tendencies, more properly than the supposed causes of detached phenomena, that should be the aim of investigation.

THE additions to the Zoological Society's Gardens during the past week include a Black Kite (*Milvus migrans*), European, presented by Mr. J. B. Thornhill; a Diana Monkey (*Cercopithecus diana*) from West Africa, a Yellowish Capuchin (*Cebus flavescens*) from South America, a Fournier's Capromys (*Capromys pilorides*) from Cuba, a Small-clawed Otter (*Lutra leptonyx*), two Bungoma River Turtle (*Emyda granosa*), a Ring-necked Parrakeet (*Palaeornis torquatus*) from India, a Vulpine Phalanger (*Trichosurus vulpecula*) from Australia, two Yellow-winged Parrakeets (*Brotogerys virescens*) from Brazil, a South Albemarle Tortoise (*Testudo vicina*) from the Galapagos Islands, eight Wrinkled Terrapins (*Chrysemys scripta rugosa*) from the West Indies, a Grey Monitor (*Varanus griseus*) from North Africa, a Razorbill (*Alca torda*), British, deposited; a Grey Squirrel (*Sciurus cinereus*) from North America, a Mouflon (*Ovis musimon*) from Sardinia, a Common Rhea (*Rhea americana*) from South America, purchased; eight Golden Orfe (*Leuciscus idus*) from European fresh waters, purchased.

OUR ASTRONOMICAL COLUMN.

EPHEMERIS OF ENCKE'S COMET (1901 *b*).—Herr Ch. Thonberg gives a further ephemeris for following this comet, in *Astronomische Nachrichten*, Bd. 156, No. 3740.

Ephemeris for 0*h. Berlin Mean Time.*

1901.	R.A.	Decl.
	h. m. s.	° ′
Oct. 10 ...	14 19 46 ...	−20 11·2
12 ...	32 42 ...	21 22·9
14 ...	45 20 ...	22 28·0
16 ...	14 57 42 ...	23 26·9
18 ...	15 9 46 ...	24 19·8
20 ...	21 32 ...	25 7·2
22 ...	33 0 ...	25 49·3
24 ...	44 10 ...	26 26·6
26 ...	15 55 2 ...	26 59·4
28 ...	16 5 35 ...	27 27·9
30 ...	16 15 50 ...	−27 52·5

NEW ALGOL-TYPE VARIABLE, 78 (1901), CYGNI.—Mr. A. Stanley Williams has detected variability in the star, whose approximate position is:—

R.A. = 20h. 18m. 4·0s.
Decl. = +42° 46′·4 } (1855).

The measures of brightness were made from photographs obtained with a 4·4-inch portrait lens. Normally the star is about 10th magnitude, falling almost to 12th magnitude at mininum. It appears about a magnitude below normal brightness on a photograph taken 1900 October 21, 13h. 0m. to 13h. 50m. G.M.T.; and minima have also been visually determined on the following dates:—

	h.	m.	
1901 Aug. 24 ...	14	27	G.M.T.
Sept. 7 ...	9	43	
,, 14 ...	7	29	

From these data the elements of the star's variation are:—

Minima = 1901 Sept. 7d. 9h. 43m. + 3d. 10h. 49m. E.

For about 3d. 2h. 19m. the star remains constant at 10·0 magnitude. It then diminishes in 3h. 30m. to 12 magnitude, at which it remains for 50m. Recovery to 10 magnitude occurs in 4h. 10m., the whole change occupying about 8h. 30m. (*Astronomische Nachrichten*, Bd. 156, No. 3740).

PHOTOGRAPH OF THE SPECTRUM OF LIGHTNING.—Prof. Pickering announces that a successful photograph of the spectrum of a lightning flash has been obtained recently at the Harvard College Observatory. The spectrum showed a complicated series of bright lines which have as yet not been individually recognised. No information is at present extant as to the instrument with which this interesting photograph has been taken, but it is to be hoped that the scale is sufficient to ensure accurate determinations of wave-length. For some years back attempts have been made at the Solar Physics Observatory at South Kensington to record the lightning spectrum, using both prisms and gratings in conjunction with short-focus cameras of varying size. Up to the present time, however, no success has been attained, and it is with the greatest interest that the publication of further details from Prof. Pickering will be awaited.

THE ROYAL COLLEGE OF SCIENCE AND THE UNIVERSITY OF LONDON.[1]

I AM sorry to have to sound at the outset a note of sadness. We little thought when the end of the session brought release for us all that before we could meet again death would intervene to prevent one of our number from joining his colleagues and friends at the reassembly. It may not be known to every one present that a deplorable accident has deprived the College of one of the most brilliant and popular of the junior members of the staff. Mr. Martin Woodward, demonstrator of zoology, was the younger son of Dr. Henry Woodward, the eminent keeper of the geological department of the British Museum, who is a personal friend of many of us and respected by everybody. United as father and son were, not only by ties of affection but by constant companionship in their scientific pursuits, we can only guess and I cannot express, the severity of the father's loss. All we can do on this sad occasion is to offer to the family of our departed friend our most heartfelt sympathy. Mr. Woodward entered the College as a student in 1882 and gained the Murchison prize and medal. He was appointed demonstrator by Prof. Huxley in 1885, and has since that time worked under the direction of Prof. Howes. Most of us deplore the loss of a genial, kindly and accomplished friend, but science too is the poorer by this unhappy event, for Woodward was well known as a zoologist, and his extensive knowledge, skill as a manipulator and scientific enthusiasm seemed to promise a high place for him among the biologists of his time.

The next announcement that I am permitted to make is of a more cheerful character. Dr. Stansfield, of the metallurgical division, has been appointed professor of metallurgy in the McGill University, Montreal. All students who have come under Dr. Stansfield's influence will, I believe, gladly unite with his colleagues in wishing him a long, happy and distinguished career in his new home across the sea.

By this time it is probably known to most of the students assembled here that the session now gone has seen the last of two of the most eminent members of the staff as professors in the College. In Sir Norman Lockyer we are losing an investigator of the first rank who may be said to have created a branch of science out of the results of his own researches. But apart from his labours in astronomical physics, I feel that the scientific part of the community owes much to Sir Norman Lockyer for the energy with which he has, on so many occasions, defended the cause of science. Whenever a question has arisen of public opinion or public policy involving the position of science, or of scientific men, he has always sounded the right note. You will, I am sure, join with us his colleagues on the council of the

[1] Address delivered at the opening of the Royal College of Science, October 3, by Prof. W. A. Tilden, F.R.S.

Royal College of Science in offering on this occasion of severing an official link an expression of our earnest wish that he may enjoy many years of health and undiminished strength to carry forward those researches which have made the name of Lockyer famous throughout the civilised world. Prof. Rücker has been called away to occupy the high position of principal of the reconstituted University of London, concerning which I shall say a few words presently. It is difficult to express the profound sense of loss with which I refer to the removal of Prof. Rücker. The members of the College have only the satisfaction of knowing that among their number was found the *only* man who seemed to possess the qualifications requisite for this difficult and arduous position. We also have reason to hope that the association of the College with the University will afford opportunities for the exercise of his friendly cooperation and advice whenever they are required in the work of the College which he has served so long and with so much advantage to all good students.

Days like this are milestones on the road of life for all of us—for you students marking very early stages of the journey—for some of us pretty far advanced toward the end. The metaphor suggests that those of us who have travelled in advance may have something useful to say to those who come after. But I am not going to offer much in the way of advice, because my experience tells me that it will be only very sparingly accepted. After all, the road which you have to follow is not the same, things are altered since *we* passed that way, times are changed, and even if it were not so the spirit of each succeeding generation appears to be unwilling to blend itself with the spirit of the past. The instinct of the young is always to try everything afresh and make up the sum of their own experience, and to regard with suspicion everything which the seniors have to say. But I do not seriously blame them. If it were not thus the world would soon be too wise for happiness, the sense of adventure would no longer brighten the springtime of life which "sicklied o'er with the pale cast of thought would lose the name of action."

Apart from the advice which it is my custom to address to my own class on the conduct of their studies, all I desire to say to the students here can be expressed in a few words. Do not suppose that we seniors are indifferent to your fortunes, to your struggles and successes or failures. On such a day as this we rejoice with those who have reason to rejoice—the winners of prizes and rewards. We would gladly be among you as equals or competitors; we think of our own time and the happiness of something attempted, something done. Go on and prosper. To the newcomers whom we welcome to-day, we wish a like success in the years which are to follow. But it must not be forgotten by them that this demands effort, strenuous and sustained effort. It will not be enough to enter the College every day at a few minutes after ten and leave it at a few minutes before four, and though I do not advise midnight oil, I do venture to say that the chief purpose of the Royal College of Science is not to provide a pleasant kind of club for a few privileged young persons at the expense of the Government or of their own parents and friends.

Aut disce aut discede ought to be written up here as it is in another place.

The third course hinted at on that celebrated notice board is not available here. So you must understand that there are but two alternatives recognised among us—either learn or leave the place.

Independently of the circumstances to which I have already referred as marking in a special way the opening of this present session, there is another subject which must before long assume a position of great importance to us. This College is a recognised school of the new University of London, the majority of the staff are recognised teachers, and those students who choose may become matriculated *internal* students of the University. We cannot yet see clearly to what extent this association will influence our work. We hope for the best; but I think we shall all be agreed that we shall not welcome any changes which will not enable us to live up to the splendid standard of the traditions of our College. Some modifications of detail are, no doubt, from time to time desirable, but we cannot have the standard of attainment and of original work lowered to suit the arrangements of some other institution, however influential.

As it is probable that many of you have not had occasion to consider the subject of the constitution and work of the University, I will venture to submit a few thoughts connected with the subject.

I wonder whether any of you have formed an idea of a university so as to be able to define it. Many people think a university is a place where you may get a degree; a few think it is a place for instruction of a professional or technical kind, still fewer think it is a place for research. An eminent member of the present Government made a speech only a few weeks ago in which at the outset he promised to define a university. In the end, however, he did not supply a definition, but he expressed, certainly very clearly, what in his opinion a university ought to do.

Mr. Chamberlain's view is that a university should do four things—it should teach, it should examine, it should add to knowledge by research, it should show the applications of knowledge. A pretty extensive programme surely!

Cardinal Newman's definition—"A place of *teaching* universal *knowledge*"—does not seem to imply so much, because he almost immediately adds that its object is, *inter alia*, the diffusion and extension of knowledge rather than the advancement. "If, he says, its object were scientific and philosophical discovery, I do not see why a university should have students." ("The Idea of a University," preface).

I will venture a new definition. I should say a university is a place of higher education for those who are qualified by nature to profit by it. And I say that deliberately, holding the opinion as I do that it is not advisable to give more than elementary education to everybody, nor to encourage young people indiscriminately to enter upon a university course. An enormous amount of educational power is now wasted in trying to give a training to intellectual faculties which do not exist, for Providence has not given brains equally to everyone, and many a boy and girl now forced by parents or circumstances to the study of books would be much happier and more useful members of the community if they were taught to lay bricks and to sew and cook and wash, and do these necessary things *well* which are now done badly. This, of course, is not the business of a university, but if the university can so arrange its tests, whether by examination, or in some other way yet to be devised, as to prevent any large number of weaklings from entering upon the university curriculum, it will be doing a kindness to the rejected and a service to the rest of the world.

The new University of London is to be a place of education, we are told, and no longer only a system for testing knowledge got anyhow and anywhere. Its business is to prepare its students for the world. I hold strongly to the view that the *primary* business of a university is not to provide technical instruction from the outset, but to provide those conditions which will help to convert *the boy* into *the man*, and so to prepare him by the cultivation of his faculties that he is then ready to receive instruction in any profession or pursuit which may be marked out for him by his own special gifts or opportunities. All your bachelors, whether in arts or sciences, should be merely well-educated young people with brains. If the programme at school and college has been properly laid out, they cannot have had time to have made much progress in technical work. This does not shut other doors into the professions. A man may become a doctor, a lawyer, an engineer or a chemist without going near the university, but the way through the university must, if things are properly ordered, be always the way chosen by the best students. What I fear is a continuance and increase of the confusion between the processes of education which properly belong to the university and the process of instruction in useful arts or applied science which belongs to the technical school, or, if you please, to the more advanced stages of the university curriculum. Some confusion is inevitable in consequence of the existence from early times in the history of universities of the faculties of theology, law and medicine which are necessarily connected with professions. But in a new university tradition should not be allowed too prominent a place.

In the faculties of engineering and commerce which are to be established it will be disastrous to the cause of higher education if technical practice is to be received as an equivalent for studies which contribute to culture, style and character.

I dissent altogether from the view which seems to be held by some people that the sooner a boy gets to things which will be connected with his future business the better. Doubtless circumstances compel the adoption of this course in some cases, but it is not one which ought to receive the sanction of the university.

The confusion of education with instruction, the mixing of

preparatory with professional studies, also leads to much waste of time. All preparatory studies ought to be over by the age of twenty-one, and in some cases even sooner. A young engineer ought not at that age to be learning the physics and chemistry and mechanics, the principles of which he certainly requires for use, but should be free to work at his engineering and what pertains directly to it.

We may hope that the university will provide such a liberal programme that there may be many avenues to the same degree suitable to the needs and circumstances of different classes of students. By this I mean that there should be a very free choice of languages and sciences; and I should exclude altogether from the early stages of a student's career commercial and technical subjects which, however practically important they may be, should only be taken up after the first degree, B.A. or B.Sc., has been reached, and the time for concentration has come.

As to the entrance or matriculation examination, much difference of opinion exists. But whether a classical language be insisted upon or not, and whether one or more modern languages be required, seem to me to be questions far inferior in importance to the requirement that every student admitted to the university should have been trained as far as he has gone in scientific method. This does not mean that he should be acquainted with any particular branch of science, but that by means of scientific study he should have been taught to use his eyes so as to see things clearly, and should have been made to understand the nature and the right use of evidence in coming to any conclusion. This cannot be done by literary study alone, and if not begun early in life will scarcely be accomplished later on.

An educated man must have not only thoughts, but language by which he may express his thoughts intelligibly and with such brevity or fulness as befits the occasion or the nature of the subject. He *must* speak and write his own language correctly. How much more should be required by the university I have no time to consider now, but I think no man of active mind will be content with translations of the literature or even of the scientific treatises of other countries.

The university is a place of education *primarily*, as I have said; but it should also be a place for research, and I will try to say why.

It is not, I think, the first business of a university to make new knowledge for the sake of the knowledge, but it is indispensable to all systems of advanced instruction that students should be associated with teachers who are daily engaged in the endeavour to penetrate by new ways into the regions which lie beyond the boundaries of existing knowledge. In no other way can the teaching of the university be preserved both fresh and free from error. Moreover, it is impossible to arrest the progress of discovery, which will go on elsewhere, however it may be ignored by the university, and how is it to keep abreast of the knowledge of the day except by taking part in the process of making it? Fortunately, the statutes framed by the commissioners distinctly include among the purposes of the University the promotion of research and the advancement of science and learning. This is a matter which cannot be passed by in silence, because it is one of those questions about which difference of opinion exists even within the senate of the University itself. This is shown by what occurred at the presentation for degrees last May. Lord Rosebery was present on the platform and everybody was very glad to see him, but there is great danger in yielding, as the Vice-Chancellor quite naturally did, to the temptation to invite a distinguished visitor to say a few words on the spur of the moment, unless you are quite certain beforehand as to what he will say. For on being asked to speak, Lord Rosebery expressed the opinion that the University should teach and should have nothing to do with research, which proved to my mind that he had never thought seriously about the question. Nevertheless, this remark was received with evident approval by a considerable part of the audience, and was of course reported fully in all the newspapers.

There are two influences exercised by newspapers which seem to me distinctly mischievous. The one is the diffusion of the idea that mere novelty is a virtue, that things of yesterday are more interesting and important than the things of any day before; and the other is that the utterances of a prominent public man, on any subject whatever, are better worth having than the opinion of the man who has given his whole life to it, and I venture to say that public men are not always cautious enough in what they say on subjects to which they have given no attention, considering the weight attached by the public to all their words.

But as to this question of research in all places of higher instruction, what *a priori* judgment can compare with experience already gained? I am not one of those who willingly refer to Germany, for I am weary of the exaggerated nonsense often talked about German competition and English incompetence. But it is easy to see that the universities of Germany have settled the question for us and all the rest of the world by simply acting on the advice and example of Liebig, to whose influence much of her present prosperity is due.

Newman, as already stated, did not think that scientific or philosophical discovery should be the business of a university, but there is a splendid passage in his famous book, "The Idea of a University," which, though he does not refer to research, I cannot refrain from tearing away from its context, because it supplies such a vivid picture of the benefits which attend the existence of such a university in which the art of research is cultivated. He says: "This I conceive to be the advantage of a seat of universal learning, considered as a place of education. An assemblage of learned men, zealous for their own sciences, and rivals of each other are brought, by familiar intercourse and for the sake of intellectual peace, to adjust together the claims and relations of their respective subjects of investigation. They learn to respect, to consult, to aid each other. Thus is created a pure and clear atmosphere of thought, which the student also breathes, though in his own case he only pursues a few sciences out of the multitude. He profits by an intellectual tradition which is independent of particular teachers, which guides him in his choice of subjects and duly interprets for him those which he chooses. He apprehends the great outlines of knowledge, the principles on which it rests, the scale of its parts, its lights and its shades, its great points and its little, as he otherwise cannot apprehend them. Hence it is that his education is called 'liberal.' A habit of mind is formed which lasts through life, of which the attributes are freedom, equitableness, calmness, moderation and wisdom; or what I have ventured to call a philosophical habit. This, then, I would assign as the special fruit of the education furnished at a university, as contrasted with other places of teaching or modes of teaching. This is the main purpose of a university in its treatment of its students."

This I also humbly believe to be the *primary* purpose of university education, and this kept steadily in view all other things, the making of good doctors, chemists, engineers and merchants will be added thereto. This it is which, I think, will also best satisfy the want so eloquently put forward by Lord Rosebery last November, when, speaking not on the spur of the moment, but deliberately in the character of Lord Rector of the ancient University of Glasgow, he declared that "the first need of our country is a want of men. We want men for all sorts of high positions. We want men who will go anywhere at a moment's notice and do anything." And Lord Rosebery rightly thinks that it is the business of universities to produce such men. Of course it will be asked what has all this to do with the Royal College of Science, which is essentially a technical school for the training of teachers and of mining engineers and metallurgists. The answer is that we have accepted provisionally a place in the new university, and so the future working of the university cannot fail to have a deep interest for us. The nature of the entrance examinations which hereafter we shall be obliged to impose, the extent to which our courses of instruction and our college examinations are to be recognised by the university, the position of our associates in the university, are questions which remain to be considered and settled. And, further, I may add that the character and organisation of the teaching side of the university are subjects which will hereafter seriously influence our feelings towards it and the extent to which we shall be inclined to cast in our lot permanently with the new institution. A great opportunity now opens for the establishment of a seat of learning in the richest and most populous city in the world, richest not only in material wealth, but richest in collections of all that is precious to literature, science and art, richest in magnificent traditions and in memorials of the past. The question is, Will the people of London rise to the level of the great occasion? It concerns them more nearly than anyone else. Is London to fall behind a dozen provincial towns which by the exertions or the munificence of their own citizens afford such splendid evidence of local patriotism? London is no longer one city, but has become lately

a number of adjacent towns. As they cannot well have separate universities, cannot the new municipalities unite in the same spirit which animates the citizens of Edinburgh and Glasgow, Manchester, Birmingham, Leeds and Liverpool, and help to make a real university common to them all?

I cannot hope to exercise much influence on the progress of events, but "out of the fulness of the heart the mouth speaketh," and I trust the views which I have expressed will not prove to be discordant with those of our late colleague, the distinguished Principal of the University, to whom we all look with hope and confidence for help in the solution of the multitudinous and tangled problems which the University of London still presents.

At the conclusion of his address Prof. Tilden distributed the prizes to the successful students.

MATHEMATICS AND PHYSICS AT THE BRITISH ASSOCIATION.

ALTHOUGH the number of members present at Glasgow was much smaller than was expected, the attendance at the meetings of Section A was well maintained. The papers presented to the Section were unusually numerous, and endeavours had to be made to restrict each speaker to the twenty minutes allowed by the rules of the Section. These endeavours were not always successful, and several papers which came late in the programme had to be given in too condensed a form to be properly appreciated. This was the case, unfortunately, with the "Note on the Theory of the Michelson-Morley Experiment," communicated by Principal Hicks. Prof. Morley, who was present, did not feel justified in discussing the question without having further details from Dr. Hicks. It is to be hoped that the debate which arose after the meeting of the Section was over, will lead to a repetition of these important experiments in the light of the new theory.

As in former years, the discussions which took place in the Section, either impromptu or by arrangement, formed some of the most interesting items of the proceedings. That on the magnetic effects of electrical convection was opened by Dr. Crémieu with a description of his experiments, all of which gave negative results. Dr. H. A. Wilson pointed out several causes which might possibly account for these results, but subsequent speakers expressed doubts as to them being adequate. On the whole, as Lord Kelvin said, we must wait for a repetition of the experiments under the simplest possible conditions before we accept as final a conclusion against which there is so much indirect evidence, and which, if accepted, would necessitate the entire reconstruction of electromagnetic theory.

A paper by Dr. Guillaume introduced a discussion on the proposed new unit of pressure, the megadyne per square centimetre, which was received with favour by the Section. It is very nearly the pressure exerted by a column of mercury 75 cms. long, at 0° C., at sea level in latitude 45°, and differs therefore little from the atmospheric unit at present used. Dr. Guillaume does not propose to interfere with the thermometric scale, and it seemed to be the opinion of the Section that when any change in the scale is made it should be "rationalised," and for convenience have a degree more nearly equal in length to a Fahrenheit than to a Centigrade degree. The discussion opened by Dr. Glazebrook was to have been on glass used for all scientific purposes, but on account of the small time at his disposal he had to restrict his remarks to optical glass, and gave an account of the advances made by Abbé and Schott in the construction of glass having the optical properties necessary for producing achromatic objectives. During the discussion it was pointed out by Mr. Hinks that the durability of some of the new glasses left something to be desired, one of the lenses in use at Cambridge having become partially covered by a fungus the removal of which would necessitate the taking apart of the objective.

Several of the reports of committees contained matter of special interest. That of the Electrical Standards Committee included the results obtained by Mr. S. Skinner on the slight difference of the amounts of silver deposited by the same current from solutions of silver nitrate in water and in pyridine. The Seismological Committee finds that the wind accounts for certain frequent small movements of the seismograph trace whose source had hitherto escaped detection. The report of the Committee on Underground Temperature contained tables of observations of temperature made in Michigan and in Silesia, down to depths of about 2000 metres. It seems, however, of little value to publish such tables without information as to the nature of the strata met with at different depths. The report of the Committee on the Determination of Magnetic Force on board Ship consisted of Captain Creak's description of the modified dip circle he has devised for carrying out the determination by Lloyds' method. The tests of the instruments having proved them satisfactory, two have been sent out in the *Discovery*, and one in the German ship *Gauss*, for use in the Antarctic.

Of the ordinary communications, that by Lord Kelvin on the absolute amount of gravitational matter in any large volume of interstellar space probably attracted the largest audience. Lord Kelvin gave a *résumé* of the arguments he brought forward in the *Philosophical Magazine* for August, to show that if 25 million years ago 1000 million masses equal to that of our sun had been distributed through a sphere of radius 3×10^{16} kilometres they would have now acquired velocities about equal to those known to be possessed by the stars visible to us. It seems, therefore, probable that the total amount of gravitation matter of our universe does not differ greatly from that of 1000 million suns. The same line of argument may be carried out for the mass distributed as atoms initially throughout space, and we then have the nebular hypothesis reduced to atomic dynamics.

Prof. Gray gave an account of the work he is doing in conjunction with his pupils on the viscosities of liquids and solids and the effect on them of changes of temperature, magnetisation, &c. Some of the most interesting of the results obtained were communicated to the Royal Society in June, and the experiments seem likely to have an important bearing on molecular theory. Dr. J. T. Bottomley's paper on radiation of heat and light from a heated solid was taken at the end of a sitting and received scant attention considering the importance of the subject. Dr. Bottomley finds by measuring the power absorbed by electrically heated polished or blackened platinum wire and strips placed in vacuo, that at the same temperature the blackened radiates four or five times as much energy as the polished surface, and that when the luminous appearance of the two is the same their temperature is practically the same. Prof. Morley and Mr. Brush have been determining the influence of water vapour on the energy lost by a heated body placed in an enclosure containing air, hydrogen or water vapour. At low pressures water vapour transmits heat more rapidly than air, but not so rapidly as hydrogen. In this connection Prof. Morley has devised a new pressure gauge capable of measuring pressures down to about a ten-thousandth of a millimetre of mercury. It consists of a U-tube containing mercury, on one of the free surfaces of which the pressure to be measured acts. The depression produced is measured by the amount of tilt of the tube necessary to bring the two mercury surfaces back into contact with two platinum points in the tube. A complete account of the arrangement is to appear shortly in the *American Journal of Science*.

Prof. Callendar communicated the results of applying a small correction hitherto thought negligible to the values of the specific heat of water between 0° and 100° C., determined from the observations of Dr. Barnes with Callendar's apparatus. The high degree of accuracy which Mr. E. H. Griffiths has attained in measuring temperature by the platinum thermometer has enabled him to determine the depression of the freezing points of extremely dilute solutions, and as a result he can now state that the depression produced by dissolving one gram-molecule of potassium chloride in a thousand grams of water is, to about one part in two thousand, double that produced by the solution of one gram-molecule of sugar.

Mr. B. Hopkinson brought forward a new argument for the existence of an ether. Although at certain times the two stars of a spectroscopic binary are moving in opposite directions at right angles to the line of sight with great velocities, the doubling to be expected, if aberration is due to relative motion of source and receiver, has never been observed. Aberration must then be due to the motion of the receiver with respect to something not matter, and be unaffected by relative motion of this something and the source. This "something" is the ether. Dr. Johnstone Stoney was unable to attend the meeting,

and his paper on the possibility of obtaining interference between light from different sources had to be taken as read. Dr. Stoney believes he has obtained undoubted experimental proof of the possibility, but the matter must be held over till his proof can be considered and discussed.

Prof. Schuster gave an account of his experiments on the passage of electricity through mercury vapour. They seem to indicate that pure mercury vapour is a non-conductor.

Prof. Minchin described the latest form of his photo-electric cell, which consists of two selenium coated aluminium wires dipping into certain solutions, and produces a measurable E.M.F. when one wire is exposed to the light of a star. An arrangement so sensitive should have a great future before it.

In the meteorological department of the Section, papers by Messrs. W. N. Shaw and R. W. Cohen, on the effects of sea temperature and wind direction on the seasonal variation of air temperature in these islands, were read. The presence of the sea delays each seasonal change of temperature, and the authors are investigating the effect of the direction and temperature of the prevailing winds on the air temperature at the four principal stations of the Meteorological Office. Mr. F. N. Denison has found that the depression of the earth's crust due to an area of high barometric pressure can be detected by a seismograph at great distances from the centre of the depression, the instrument being tilted towards the area of high and from that of low pressure. The approach of a barometric depression is therefore indicated by the seismograph long before the barometer shows any sign of it.

In the mathematical department, Prof. Mittag-Leffler communicated a paper on a criterion for recognising the irregular points of analytic functions, an important extension of the theory of convergent series of powers to convergent series of functions. Mr. R. W. H. T. Hudson extended the idea of Newton's diagrams to the theory of differential equations. Prof. G. H. Darwin communicated a paper on Poincaré's pear-shaped figure of equilibrium of a rotating liquid, and Col. Cunningham announced the discovery of certain high primes, mainly by the use of the numbers called by Euler "idoneal." Several new theorems dealing with idoneal numbers were announced by Col. Cunningham and the Rev. J. Cullen. Further papers dealt with modified proofs of propositions already known.

In the astronomical department, Prof. Turner in his opening address called attention to the need of cooperation in astronomical work, cooperation which should not sink the individuality of the observer, or substitute routine for an alert spirit of inquiry and investigation. Prof. G. Forbes brought forward several facts which seemed to support his contention that there is a planet beyond Neptune with a mass about equal to that of Jupiter. Father Cortie announced that he had found the faculæ on the sun's surface followed the same law of rotation as the spots, and Mr. Hinks showed that the objections which had been raised to the determinations of the solar parallax from photographs of Eros, on the ground that it was a moving object, were unfounded. At the close of the sitting, Prof. Turner announced that Prof. Pickering had succeeded in taking a photograph of the spectrum of a lightning flash, and that important information would be forthcoming when the photograph had been measured. C. H. LEES.

ZOOLOGY AT THE BRITISH ASSOCIATION.

THURSDAY, September 12.—The president's address was taken later than usual in order to afford opportunity of attending some other sectional address. In the afternoon the reports of committees and a few papers were taken, as follows:—

(1) Dr. Hepburn and Dr. D. Waterston gave a paper on the pelvic cavity of the porpoise as a guide to the determination of the sacral region in Cetacea. The chevron bones distinguish the caudal vertebræ in cetaceans, but there is no easy method of distinguishing sacral from lumbar vertebræ. The authors find a true pelvic cavity in the porpoise which corresponds to five pre-caudal vertebræ, and they suggest that these five vertebræ are to be regarded as sacral in Cetacea. They find considerable variation in the position of this sacral region in the different Cetacea, which they consider to be due to differences in the numbers of dorsal and lumbar vertebræ present.

(2) Prof. R. J. Anderson, on the relationships of the premaxilla in the bears. The premaxilla differs in the level and breadth of its articulation with the frontal, just as the nasals reach higher up and further back in some bears than in others. Genera allied to the bears approach them in regard to the relation of the premaxilla to the frontal, so do *some* of the Canidæ, but to a less degree, whilst other forms of the latter family have a wide interval between the premaxillæ and frontals. It is not difficult to account for the enlarged premaxillæ of elephants, whales and rodents, or for the short stout forms in Suidæ, &c.; but the seals, while in some respects resembling the arctoids, differ much in their premaxillæ. The isolated centres met with in some animals in the frontal region (*e.g.*, *Gorilla*, *Ursus*, *Labistus*) are wormian. The separate bone found in connection with the ventral part of the premaxilla in monotremes is not found in other mammals.

(3) Reports of Committees:—"On bird migration in Great Britain and Ireland."—The committee expresses its most grateful admiration of Mr. Eagle Clarke's invaluable services. Mr. Eagle Clarke supplies detailed statements on the migrations of the skylark and of the swallow, those of the former being of an extremely complicated nature.

"Index Animalium."—During the last year the period 1758–1800 has been dealt with. Arrangements had been made with the Cambridge University Press to begin the work of printing this first part of the Index in May, 1901. The indexing of 1801–1900 now continues. The whole of the work, as usual, has been done by Mr. C. Davies Sherborn.

Zoology of the Sandwich Islands.—This eleventh report states that Mr. R. C. L. Perkins has been working during the last year almost solely on the island of Oahu. The present position of the work is discussed.

Coral Reefs of the Indian Regions.—Mr. J. Stanley Gardiner has sorted out the marine collections from the Maldive and Laccadive archipelagoes into groups for the specialists, and some of these groups have already been worked up. The collections seem very complete, and the committee asks for assistance in publishing.

Table at the Naples Zoological Station.—In addition to the usual statistical information the committee give reports from Dr. Reginald Buller on the fertilisation process in Echinoidea, and from Dr. Hamlyn-Harris on the statocysts of Cephalopoda.

Table at the Plymouth Marine Laboratory.—The occupation of the table during the year is reported on.

Natural History and Ethnography of the Malay Peninsula.—Mr. W. W. Skeat gives an account (to Sections D, H and K) of the Cambridge Exploring Expedition. An extensive collection of vertebrates was made, and the first two species of *Peripatus* found in the Malay peninsula were discovered. These latter have recently been described by Mr. R. Evans.

Plankton Investigation.—Mr. Garstang reports upon his periodic work in the English Channel.

On September 13 the following papers were taken:—

(1) Mr. J. Stanley Gardiner, on the coral islands of the Maldives.—The Maldive group to the south-west of Ceylon is made up of a large series of comparatively shallow banks, separated from one another by channels of about 170 fathoms in depth. They extend north and south as a chain, double in the centre, for 550 miles. All are covered with coral reefs, arising to the surface. Some banks have on their circumferences the single ring-shaped reefs of perfect atolls, while others are studded with numbers of small isolated reefs, many of which are of circular form with shallow lagoons (atollons). The two classes of bank merge into one another, and the changes, going on at the present day, are such that the atolls may be supposed to have arisen by the fusion of the smaller reefs. All land in the group owes its origin directly or indirectly to elevation, and in most atolls is very markedly washing away. Everything points to a state of rest at the present day. The atoll reefs are perfecting themselves on all sides, and passages are closing up. The reefs, however, are not broadening, but to a certain point narrow as they become more perfect. The central basins of atollons are everywhere coming into free communication with the lagoons of the atolls. There is no trace of the filling in of the latter; indeed, such evidence as was found pointed, on the contrary, to their further widening and deepening and to the gradual destruction of the shoals and lands within the encircling reefs. The Maldive group marks the existence of an ancient land-area, but the changes going on are not consistent with the view that the reefs were formed on the subsidence of the land. The various reefs appear rather to have grown up separately on slight elevations of a common plateau at a depth of 150 fathoms,

while the plateau itself seems to have been formed by the washing away of the original land by wave and current actions.

(2) Mr. E. J. Bles, on a method for recording local faunas. Mr. Bles urges the use of uniform slips as in a library card catalogue, each slip to contain name of species, locality, date of capture, &c. The advantages of cooperation should be combined with this coordination of the recorders.

(3) Prof. J. Arthur Thomson's germinal selection in relation to inheritance was an attempt to test the utility of Weismann's subtle theory as a provisional interpretation of some of the important facts of inheritance. After inserting "a struggle of gametes and potential gametes" between the "histonal" or intra-organismal selection of Roux and the "germinal selection" of Weismann, he sought to extend Weismann's conception, pointing out that within the germ there might be three forms of struggle: (*a*) between determinants of the same character; (*b*) between determinants of quite different kinds; and (*c*) between the determinants and their somatic or more external environment. But the bulk of the paper was devoted to testing the theory as a unifying interpretation of otherwise unrelated facts of inheritance.

(4) Prof. Thomson also gave some notes on the behaviour of young gulls artificially and naturally hatched. After describing the actions of the young *Larus ridibundus* in the first three days after hatching, he noted that the young birds never ate deleterious or useless substances; that it took them a relatively long time to learn to recognise water in a shallow dish, though they drank with avidity when plunged into water or when they got their bills wet by pecking at their feet or at particles while standing in the water; that swimming and preening movements were seen in great perfection as early as the third day; and that the "kin-instinct" seemed very strong.

In the afternoon there were two papers by Mr. W. S. Bruce, on the fishes of the Coats' Arctic Expedition and preliminary notice of the fauna of Franz Josef Land, a paper by Dr. T. H. Bryce on heterotypical division in the maturation of the sexual cells, and a demonstration by Prof. Marcus Hartog and Mr. Nevil Maskelyne on the mechanism of the frog's tongue, showing the method of protrusion by means of a model.

On Saturday, September 14, the Section did not meet, but a number of the biologists took part in a very pleasant and successful expedition in connection with the Millport Marine Station. The party, on board the steamer *Ivanhoe*, accompanied the steam-yacht *Mermaid*, belonging to the station, on a dredging and trawling excursion round the shores of Cumbræ. In the afternoon the party landed and inspected the Marine Station, including aquaria, laboratory and the "Robertson" Museum. Copies of a special handbook issued by the Marine Biological Association of the West of Scotland, and compiled by the hon. sec., Mr. J. A. Todd, were supplied to the visitors. This gives an interesting account of the history of the Marine Station, and of the successive benefactions—Sir John Murray's "Ark," the "David Robertson" Museum, the present building, due largely to the liberality of Dr. Thomas Reid, the steam-yacht *Mermaid*, and other gifts from an anonymous donor—crowned, we believe, by an additional 3500*l.* given since this excursion to provide an extension of the building.

On September 16 the following papers were laid before the Section:—(1) Mr. J. J. Lister, on dimorphism in Foraminifera, with lantern illustrations. This subject was exemplified by the life-history of *Polystomella crispa*, in which two forms occur, the microspheric and the megalospheric, differing from one another in the size of the central chambers, the character of the nuclei and in relative frequency. The transition from the microspheric to the megalospheric form was traced by a series of photographs of an individual of the microspheric form, the protoplasm of which emerged from the shell and broke up into a brood of megalospheric young. These having reached maturity give rise in turn to actively motile zoospores. It was shown that the facts of the life-history are inconsistent with the view that the two forms represent the two sexes, but confirm that which regards them as alternating or recurring forms in a cycle of generations. While the megalospheric form arises asexually, there are considerable grounds for supposing that the microspheric form is produced by the conjugation of zoospores.

(2) Dr. J. Y. Simpson, on the relation of binary fission and conjugation to variation. The species specially examined were *Paramecium caudatum* and *Stylonichia pustulata*, and examination was restricted to (*a*) general outline, (*b*) total length, (*c*) extreme width, (*d*) distance between contractile vacuoles, (*e*) length of middle caudal bristle. In all five points variation was found. This was illustrated by microphotography. The author contends that there is variation in binary fission, and that the process is not merely one of duplication.

(3) Mr. W. E. Hoyle, on a new form of luminous organ, intrapallial, in Cephalopoda.

(4) Mr. R. Shelford, on the habits and life-histories of some Sarawak insects, illustrated by the lantern.

(5) Prof. J. C. Ewart gave a lantern demonstration on zebras and zebra hybrids. This was illustrated by an exhibition of three of the actual hybrids in the medical quadrangle (see description below).

(6) Dr. J. F. Gemmill, on a large nematode parasitic in the sea-urchin. This worm, which the author proposes to call *Echinonema grayi*, occurs in the perivisceral cavity, and seems to have escaped notice except for a brief mention by A. E. Shipley in 1900. The females are 60 to 150 cms. in length, and the males only 5 to 10 cms. An account of the anatomy was given.

(7) Mr. F. H. Marshall gave exhibitions of abnormal specimens of *Nephrops*, and of microscopic preparations of mammalian hairs.

Some of the members of the Section took part on the Monday forenoon in a conference between Sections C, D and E on the subject of limnology, with special relation to the scientific study of the lakes of the British Islands. It was announced that Sir John Murray and Mr. Lawrence Pullar had undertaken to defray the expenses of a survey to be undertaken by three scientific men during five years, and the conference discussed the best methods of carrying out the proposed scheme from the points of view of the different sciences involved.

On September 17, four papers were taken in the morning:—

(1) Mr. C. Forster Cooper, on the fauna of an atoll, with lantern illustrations.

(2) Mr. L. A. Borradaile, on the land crustaceans of a coral island. The author pointed out the importance of land crustaceans in the economy of tropical nature in general, and of a coral island in particular. He then enumerated the species he had observed in the island of Minikoi in the Indian Ocean with an account of their appearance and habits. Special emphasis was laid on the interesting land hermit-crabs of the genus *Coenobita*.

(3) Mr. J. S. Budgett, on the youngest known larva of *Polypterus*, with lantern illustrations. From his observations on the structure of the pectoral fin, the primordial cranium and the visceral arches of this larva, obtained in the Gambia in 1900, the author believed that the Crossopterygii showed affinities with the Selachii, but that the structure and development of the urino-genital organs, though in both probably of a very primitive nature, disclosed teleostean affinities, while the structure of the osseous skeleton has in many points been shown to resemble that of the Stegocephali and Amphibians. He therefore concluded that the Crossopterygii were a central group retaining relations with most of the great groups of Ichthyopsida, but not being actually ancestral to any one of them.

(4) Mr. J. Graham Kerr, on the origin of the vertebrate limbs. The author gave a short account of his hypothesis of the homodynamy of the vertebrate paired limbs with the true external gills. After pointing out the absence of solid foundation in fact for the two most widely accepted hypotheses of the origin of the paired fins, and having criticised these two views generally, he accentuated the probability that the two main types of limb, Ichthyopterygium (including Archipterygium) and Cheiropterygium, were derived independently from a simple styliform projection of the body (Stylopterygium), which was used, not for swimming, but for clambering about a solid substratum. This, from the evidence of Braus and others, was probably somewhere about the hind end of the branchial region. Now were there any projections from the body in this region from which the motor stylopterygium could have become evolved? Mr. Kerr pointed out that in the true external gills there existed a series of organs, projecting in various groups of lower vertebrates from the visceral arches (I.–VI. inclusive). These organs were potentially motor organs, as was shown by their powerful muscular apparatus and by the active flicking movements which they could perform; they were also potentially supporting structures, as was shown by the so-called "balancers," in which form the mandibular pair persisted in many Urodeles. He held that by far the simplest view of the origin of the paired limbs was that

they had developed out of a couple of the more posterior pairs of external gills, the girdles to which they were attached representing the skeleton of the corresponding branchial arches.

Mr. Kerr in the course of his paper controverted the view that the external gills were secondarily developed adaptive structures in the groups in which they occur; he also dealt with the difficulty that most true external gills contain no cartilaginous axis, pointing to the barbels of *Xenopus* with their cartilaginous axis, and to the rod of cartilage found by Budgett projecting into the base of the external gill of the hyoid arch of the young crossopterygian.

Tuesday afternoon's meeting of the Section opened with a lantern lecture by Major R. Ross on the story of malaria. He dealt in detail with the history of the various stages in the discovery and establishment of the mosquito theory, from the first fact, the discovery of the malarial pigment in 1849, to Manson's crucial experiment in 1900. He then passed to the prevention of malaria and other mosquito-borne diseases, and gave an account of the experiments now in progress in Sierra Leone and Lagos.

The session ended with three exhibitions—Dr. Francisco P. Moreno showing photographs of fossils in the La Plata Museum, Prof. Gilson a new sounding and ground-collecting apparatus, and Dr. J. Rankin a new orientating apparatus for the Cambridge microtome.

During the last few days of the meeting three of the zebra hybrids bred by Prof. Ewart were on view in the quadrangle (medical) adjoining the sectional meeting room. These hybrids were: (1) "Remus," the largest of the three, was born May, 1897, dam a 14-hands bay half-bred Irish pony. The mane of "Remus" was all but removed last April. (2) "Sir John," the small stout one, was born June, 1899. His dam is a yellow and white Iceland pony. "Sir John" probably reproduces fairly accurately the coloration of the primeval common ancestor of the horses and zebras. (3) "Birgus," the slender hybrid, was foaled May, 1900. His dam is a chestnut 14-hands polo pony. In 1898 this polo pony had twin hybrids, one of which goes extremely well and quietly in harness.

It is impossible to conclude even a brief account of the zoology of the meeting without at least a passing reference to the excellent volume on the natural history of Glasgow and the west of Scotland issued under the title "Fauna, Flora and Geology of the Clyde Area" as one of the three handbooks prepared by the local committee. A large number of specialists have collaborated in the production of the lists and articles, the result being a work of great completeness and of more than local interest, and of permanent value.

GEOGRAPHY AT THE BRITISH ASSOCIATION.

THE work of Section E at the meeting at Glasgow maintained the feature which has been noticeable for the last two or three years; the number of "popular" papers was comparatively small, while papers presenting the results of detailed research, or laying down foundations of future work, formed a distinct majority. Although the change has led to a marked diminution in the average numbers attending the meetings of the Section, it must be regarded as satisfactory, inasmuch as it indicates an increase in the annual output of scientific work by geographers in this country, and the fact is all the more gratifying in view of the difficulties in the way of geographical research, to which Dr. Mill drew attention in his presidential address. Dr. Mill laid his finger upon the true reason why "the few attempts which have been made in this country to promote the study of geography or to diminish the discouragements to geographical research have had but slight success" when he pointed out that "amongst the not inconsiderable number of teachers of geography in the universities and colleges of Great Britain there is not one man who receives a salary on which he can live in decent comfort so as to devote all his time, or a substantial part of it, to geographical research; and the same is true of every official of all the geographical societies." Until there are properly equipped centres offering adequate opportunities for research as well as teaching, we cannot expect students of geography to receive the intellectual stimulus which research alone can give, nor can we develop a system of geographical teaching suited to our special educational needs and methods, and capable of satisfactory extension to our schools.

Following the delivery of the president's address on Thursday morning, Mr. E. G. Ravenstein read a paper on Martin Behaim. Martin Behaim fills a place of some prominence in the history of geography on three grounds: firstly, the historian João de Barros, writing in 1539, states that he was a pupil of Regiomontanus, and was appointed a member of a committee which devised a method of "navigating by the sun"; secondly, Behaim claims to have commanded a vessel in Cão's second expedition; and thirdly, during a visit to Nürnberg in 1490–93, he superintended the manufacture of a terrestrial globe, which survives to this day. Mr. Ravenstein seriously doubts the first claim, rejects the second, and fully admits the third.

The tenth and final report of the Committee on the climate of Tropical Africa was also presented. In this report, drawn up by Mr. Ravenstein, abstracts of the meteorological observations received during the year are published, and a review is given of the work of the Committee since its first appointment in 1891. In completing its labours, the Committee recommends that where local provision is not made for the publication of observations, the registers should be forwarded in future (through the Foreign or Colonial Office) to the Meteorological Council or to the secretary of the Royal Meteorological Society. Copies of the "Hints to Observers," published by the Committee, may be obtained from the secretary of the Royal Meteorological Society.

Dr. A. J. Herbertson read a paper on the morphological divisions of Europe, in which he pointed out the inadequacy of the ordinary physical map for many of the purposes of the geographer. The paper was illustrated by a new "morphological" map of Europe, based primarily on the work of Suess, in which Europe was divided into physical regions, taking into account, not merely configuration, but composition and structure, and by a few well-chosen examples, such as the comparative structure of the south-east of England, the Seine basin, and the German Jura, Dr. Herbertson showed the undoubted value of maps of this type for purposes of both research and teaching.

The first paper in the afternoon was one by Mr. G. G. Chisholm, on geographical conditions affecting British trade. After illustrating his contention that geographical conditions, although often disregarded, were really important factors to be taken into account, by pointing out that Glasgow remained unimportant, both commercially and industrially, until the development of Transatlantic trade, Mr. Chisholm discussed the effects which improvements in means of communication, electric transmission of power, and other modern developments, are likely to produce in the trade of Great Britain as compared with that of other countries.

Prof. Alleyne Ireland read a paper on the influence of geographical environment on political evolution, in which he discussed the possibilities of native government within the tropics, concluding that while the natives of the tropics are not deficient in intellectual power, their "climatic discipline" renders them unfitted to play the part of legislators or responsible administrators, or to maintain a government sufficiently stable to admit of proper commercial development.

The Rev. Thomas Lewis gave an account of journeys in Portuguese Congo, in the course of which he has collected much valuable topographical information.

Friday morning was devoted to the geography of Scotland, and the proceedings afforded gratifying evidence that in spite of difficulties Scottish geographers are prosecuting research along various lines with vigour and success.

The first paper was one by Prof. G. F. Scott Elliot, on the effects of vegetation in the Valley and Plain of the Clyde. The general characters of the Clyde Valley in seven separate divisions were described—the sub-alpine, heather and peat, sheep pasture and arable districts; the Falls of Clyde canyon, the valley below the falls, and the flat and alluvial plains—and the successive stages in the formation of the valley slope were traced in a number of instances. It was shown that a perfect series of transitions can be found from the vertical scaur cut by the river to the continuous steep slope characteristic of the neighbourhood, and that the formation of the slope, in its various stages, was controlled by the vegetation.

Miss Marion Newbigin gave an account of a scheme which has been undertaken by the Scottish Natural History Society at the suggestion of Sir John Murray. It is proposed, firstly, to arrange, in a readily available form, references to papers already

published on the natural history of the Forth Valley, including its botany, zoology and geology; and, secondly, the Society proposes to utilise its various sections and the labours of its individual members in the acquisition of a mass of detail in regard to the existing organic conditions in the valley of the Forth.

Prof. W. G. Smith described the methods and objects of the botanical survey of Scotland inaugurated by his brother, the late Mr. Robert Smith. The difficulties of grouping the flora comprehensively into "plant associations" having been got over, and the proper cartographic methods elaborated by a number of experimental surveys, it remains to carry out the work on the large scale. Great interest was taken in Prof. Smith's paper, and in the course of the discussion which followed Major Craigie gave the satisfactory assurance that when the survey is put on a definite basis it will receive assistance from the Board of Agriculture in the way of supplying details.

In the afternoon Dr. Francisco Moreno read an important communication on the anthropogeography of Argentina, in which he summed up the existing evidence as to the origin and distribution of different races of mankind in South America, and stated a number of problems awaiting further investigation. Mr. Hesketh Prichard gave an account of his journey in Patagonia, undertaken recently for the *Daily Express*. At the close of the meeting, Mr. Reclus-Guyou exhibited a specimen of the maps on natural curvature prepared by M. Elisee Reclus. These maps are drawn on a sheet of aluminium stamped to the curvature of a globe whose radius has the proportion to that of the Earth of the natural scale of the map.

On Monday morning Captain Lemaire gave an account of the Belgian expedition to Ka-Tanga under his command. The first part of Captain Lemaire's paper described the scientific results of the expedition, amongst the most important being an exhaustive investigation of barometric methods of determining altitudes in low latitudes; the second part consisted of an exhibition of part of the excellent collection of photographs made by the expedition. The expedition mapped more than 6600 kilometres of itinerary on a large scale, and one of the most remarkable features of the expedition was that "they left behind them no cause for complaint, or any ground for ill-will, among the native populations." Captain Lemaire's work was very appropriately described as a model and a guide for all modern explorers in Central Africa. In connection with this paper an exhibition of water-colour sketches by M. Dardennes, artist to the expedition, was held in the gallery of the Glasgow School of Art.

Dr. Vaughan Cornish presented the first report of the Committee on terrestrial surface waves, which dealt chiefly with observations of snow waves and ripples, and snow drifts and snow caps, made by Dr. Cornish during last winter in Canada. Considerable difficulties were met with in obtaining satisfactory photographs of the details of snow surfaces, but Dr. Cornish's admirable slides showed that these have been successfully surmounted.

Mr. H. N. Dickson read a paper on the mean temperature of the atmosphere and the causes of glacial periods, in which he drew attention to the fact that any change which may have occurred in the mean temperature of the atmosphere was probably accompanied by change in the temperature gradient between equatorial and polar regions, and therefore by modifications of the atmospheric circulation. It was suggested that this had not been sufficiently taken into account in discussing glacial and other phenomena connected with secular changes of climate, and that by taking it into consideration a comparatively small gain or loss of heat would suffice to produce the changes of temperature deduced from the geological record, while the changes in circulation at the earth's surface would account for many peculiar features of distribution.

On Monday morning a joint meeting was held with Sections C (geology) and D (zoology), to discuss the objects and methods of the scientific study of the lakes of the British Islands with special reference to the scheme of survey about to be carried out by Sir John Murray and Mr. Lawrence Pullar. Dr. Mill, who presided, read the following letter from Sir John Murray explaining the scope of the proposed survey, and stated that it had been undertaken as a memorial to the late Mr. F. P. Pullar:—

"I am sorry it is not possible for me to be present at the meeting of the British Association this year. I am very pleased to learn that a discussion has been arranged with reference to the proposed bathymetrical, physical, and biological survey of the fresh-water lakes of the United Kingdom. I have not, as yet, definitely settled anything with regard to the undertaking, but my idea is to endeavour to obtain the cooperation of three young university men who would take a real interest in the investigation and be likely to make something out of the researches in the way of experience and reputation; one to be a physicist, one a zoologist, and one a botanist. I propose to offer for the first year a salary of 100*l.* and expenses while actually engaged in field work at a rate a little better than is given to members of the Geological Survey. The principal work will be to sound the lakes and prepare the bathymetrical charts. While this is going on observations will be made concerning the temperature of the water at different depths and different seasons of the year, as well as how the distribution of temperature in the lakes is affected by wind and other conditions. Observations will also be made on the distribution of plants and animals in the different lakes at various depths and seasons, and on the deposits at the bottom of the lakes. The geological structure of the district in which the lakes are situated, the rainfall, and other allied phenomena will likewise receive attention. I would expect those who take part in the work at a salary to give their whole time to these investigations, and to work under my direction, but they will receive full credit for their work, and will be allowed to publish results in their own names. It may be possible to receive assistance from others who cannot give their whole time to the researches, and also to make collections and observations for those who are engaged in the study of special branches of limnology. It is probable that I will arrange to publish separately the results obtained in each catchment as soon as the survey of each basin has been completed, and then to publish a general account of the fresh-water lakes of the United Kingdom when the practical work of the survey has been finished. I propose to commence the organisation of the undertaking soon after my return to Scotland, and I hope to complete the whole work in five or six years."

A full debate followed, in which both geologists and biologists took part. Mr. John Horne intimated that the Geological Survey would, given the formal approval of the Board of Education, place any information in their possession at the disposal of Sir John Murray and his colleagues, and Colonel D. A. Johnston, of the Ordnance Survey, expressed his warm interest in the undertaking. A formal resolution expressing the great gratification of the meeting at the decision to carry on the work under the direction of Sir John Murray, and its sense of the munificence of Mr. Lawrence Pullar, was moved by Mr. Horne, seconded by Mr. Peach, and carried unanimously.

The proceedings on Monday afternoon opened with the report of a Committee—consisting of Sir T. H. Holdich, Colonel G. E. Church, Mr. E. G. Ravenstein and Mr. H. N. Dickson—which was appointed at the Bradford meeting to draw up a scheme for the survey of British protectorates, particularly in Africa. The Committee specially urges the importance of laying down a main triangulation so as to provide fixed points from which local surveys by explorers and others may begin, and of providing means of training native surveyors and topographers similar to those existing in India, such surveyors to be attached to exploring and similar expeditions as opportunities offer.

An important paper by Dr. R. Bell, of the Geological Survey of Canada, was next read by Mr. Mackinder. This paper dealt with the topography and resources of northern Ontario, or "New Ontario," and described the immense region lying north-west of the line of Lake Nipissing and the French River. The paper was accompanied by material for the construction of an adequate map of the district, which has not hitherto been represented with any detail.

Mr. A. Lawrence Rotch described some results of the exploration of the upper strata of the atmosphere by means of kites, and discussed specially the application of the method at sea. On land the wind is sometimes insufficient to raise the kites, but on board a steamship the artificial wind due to the motion of the vessel obviates this difficulty, and by altering the course relatively to the direction of the wind the action of the wind on the kite can be regulated to a very considerable extent. Successful experiments have been made at sea on board an Atlantic liner, and the value of extended investigations in the tropics, made from a ship which could be specially detailed for the purpose, can hardly be overestimated. The Association has appointed a strong Committee, with a money grant, to cooperate in these experiments.

The report of the Committee on changes of the land-level

of the Phlegræan Fields, drawn up by Mr. Günther, was presented. Mr. Günther's work being still in progress, the report was of a preliminary nature, but it is satisfactory to note that the materials for the investigation have proved more valuable and abundant than was anticipated.

On Tuesday morning Mr. W. N. Shaw, F.R.S., exhibited a complete series of the weather maps published daily by various countries. Most of these bore the date January 1, 1901; others June 1, 1901. The list is interesting as showing the position of this branch of meteorology at the beginning of the twentieth century:—Austria, Bavaria, Belgium, British Isles, Denmark, France, Germany, Holland, Italy, Portugal, Russia, Saxony, Spain, Switzerland, Algeria, Australasia, Canada, India, Bay of Bengal, Japan, Mexico, United States, Roumania.

The rest of the morning was devoted to papers on the Antarctic expeditions. Dr. J. Scott Keltie described the organisation and equipment of the National Antarctic Expedition, and Dr. H. R. Mill gave an account of the voyage of the *Discovery* as far as Madeira, to which point he accompanied the vessel for the purpose of working out the details of the meteorological and oceanographical routine. Mr. W. S. Bruce then read a paper on the methods and plans of the Scottish National Antarctic Expedition, in which he announced that sufficient funds had been subscribed, entirely by Scotsmen, for one complete year's work in the Antarctic. It is proposed to purchase a whaler of about five hundred tons, and to leave this country in about a year's time. The ship will carry a scientific staff of five, five officers, and a crew of twenty. An attempt will be made to push as far south as possible in the Weddell Sea, and the deep reported by Ross in lat. 68° S., long. 13° W., will be specially investigated. The expedition will confine itself almost entirely to marine work, and it is not intended to winter in the ice.

In the afternoon Mr. H. Yule Oldham read a paper on the experimental demonstration of the curvature of the earth's surface. Mr. Yule Oldham has repeated Wallace's Bedford level experiment on the old Bedford River between Welney Bridge and Denver Bridge, a perfectly straight stretch of six miles. A mark was set up midway between the bridges, at the same height above water level as marks on the two bridges, and found to stand six feet above the line of sight. Records of the experiment have been obtained by the use of a special telephotographic lens.

Dr. R. Logan Jack then gave an account of an expedition in Western China, in which the Chengtu Plain was crossed five times, and a good deal of mapping done of the margins of the plain, and the courses of the rivers reaching it from the north. At the Maha gold mines the party received information of the massacres at Pekin, and were advised to make for Burma. Bhamo, in Upper Burma, was reached after many difficulties.

A paper, by Mr. Archibald Little, on the Crux of the Upper Yang-tse, was read by Mrs. Little. The paper contained an extremely graphic account of an ascent of the river during the flood season, and the condition of the country and of river navigation was compared with that obtaining during the winter.

The last paper was by M. Galeron, designer of the great celestial globe at the Paris Exhibition, on the representation of the heavens in the teaching of cosmography. After pointing out the difficulty experienced by the student in realising the apparent positions and motions of the heavenly bodies from a study of the ordinary celestial globe, in which the celestial sphere was represented as seen from the "outside," M. Galeron exhibited and described an apparatus in which a celestial globe is made of thin muslin, and sufficiently large for the head of the observer to be placed at the centre. The apparatus, which can be constructed very simply and cheaply, enables the chief phenomena to be demonstrated with great clearness.

It is noteworthy that the Artisan's Lecture this year, although geographical, was not an account of travel and exploration, but an exposition of the application of geographical principles. In his lecture on "The Movements of Men by Land and Sea," Mr. Mackinder showed how the progress of civilisation has been affected by the configuration of the Earth's surface, and pointed out the profound changes going on in political and social life under our eyes, as the result of the development of the great ocean lines of communication and of the transcontinental railways. The lecture was a perfect illustration of the aims and methods of the "new geography," and should do much to make those better understood and appreciated.

EDUCATIONAL SCIENCE AT THE BRITISH ASSOCIATION.

THOUGH the new Section of the British Association was only appointed for a year, the success of the meetings at Glasgow was of so decided a character that the Section will probably become a permanent part of the Association. It can scarcely be said at present that an educational science exists, but the statement of methods and results, and the discussion of the relationships between principles and practice, apart from all political considerations, should do something to organise the conclusions of people who have given serious attention to educational problems. The Section will exert the greatest influence in connection with scientific studies; and there is no reason why it should not lead to improvements in methods of teaching as valuable as those which have been produced by the scheme for a course of work in chemistry, drawn up by Dr. H. E. Armstrong for the British Association Committee on the methods of teaching chemistry. It is not too much to say that this scheme started a revolution which gathers strength every day. The system of science instruction by didactic methods still exists in places, but only because the machinery for carrying on the work on more rational principles has not been obtained. Wherever the object is education, the methods of research have been introduced, and it is recognised that real scientific knowledge can only be gained by individual experience.

Educational Experiment and Research.

Sir John Gorst accepted the principle of research in education in his address as president of the Section, and Dr. Armstrong emphasised it in an early paper. The power of research, the art of acquiring information for oneself, must, he pointed out, be cultivated in all because it is the power on which advance in life depends. The chief work of the Section will be to teach this doctrine, and impress it upon the teachers. A science of education must be shaped, and a national programme must be constructed in which research methods are encouraged and teachers are trained to have sympathy with them. The humanists must enter into an alliance with the naturalists, and the union should take place on equal terms. At present our educational system is entirely one-sided. The schools still at best suffer science; they do not love it and the old universities do not even regard it as a necessary element of culture.

Reform will be brought about by the development of workshop and laboratory methods. The experimental method of teaching is adapted to the curiosity and activity of the average boy, and should be the basis of instruction at the earliest stages. Prof. L. C. Miall gave strong support to the experimental method, which he described as the most complete embodiment of the methodised art of trying, of ignoring failures and improving successes, and perpetually going on until the goal was reached. This is the habit it is desired to set up and which will take an important place in future educational work. Sir Michael Foster emphasised the view that science is not learnt in the lecture room, but in the laboratory. The first aim should be to teach a boy to think, and this can be done by practical work properly arranged. It has been stated over and over again that pupils who have been prepared by the older learning take to science more readily when they are brought to it than those who have been trained from the very beginnings in science. This, Sir Michael said, was easy to understand, because teachers in the humanities have been trained to teach for generations, while men of science are only now beginning to learn how to teach.

Methods of teaching are of great importance, and the British Association can be the means of producing improvements in them. Prof. H. L. Withers, however, in a paper on the scope of educational science, expressed the opinion that before deciding how this or that subject should be taught it is desirable to formulate a theory of the curriculum, that is, to arrive at some conclusion as to the proportional value of subjects. Mr. P. A. Barnett also took this view, the main argument of his paper being that the criterion of success in education must be, not what people have been taught to do or to make, but what they are and how they bear themselves in all the relationships of life. But the educational value of a subject even considered from this point of view depends upon the scope of the subject and the methods of teaching, so that a reasonable curriculum cannot be drawn up until a decision has been arrived at as to what is implied by the name of each subject.

As instances of differences of opinion as to what should be included in a subject and how the subject should be taught, the discussions on the teaching of elementary mathematics and of botany may be cited. In each case a whole morning was devoted to the expression of expert opinion and the statement of experience in relation to the subject under discussion. For the discussion of the former subject, a joint meeting was arranged with the mathematical department of Section A, and for the latter a joint meeting was held with the Section of Botany.

The Teaching of Mathematics.

In urging a reform of mathematical teaching, Prof. Perry remarked that he would teach mathematics—at all events advanced mathematics—in different ways to different students. In any case he thought the system of teaching boys elementary mathematics as if they were all going to be pure mathematicians must be altered. We taught all boys what is called mathematical philosophy that we might catch in our net the one demigod, the pure mathematician, and we did our best to ruin all the others. In his experience there was scarcely any man who might not become an advancer of knowledge, and the earlier the age at which you gave him the chances of exercising his individuality the better. Educate through the experience already possessed by a boy; look at things from his point of view—that is, lead him to educate himself. Through his whole mathematical course let him be taught through his own experiments, and do not call it waste of time to plot the stream lines, for example, after the algebraic academic answer of a problem has been arrived at. The unpractical nature of mathematical teaching, he held, caused men to leave common sense out of their teaching, and he instanced the great continental Polytechnics, where an elaborate course of many months, or a year, was often devoted to a subject, of which the general principles could be grasped in a practical course of a few weeks.

All advocates of orthodox methods seemed willing to sacrifice every form of usefulness of mathematics to the mind-training inherent in a perfect logical system—a huge complex deduced logically from simple fundamental truths. Where would be the harm in letting a boy accept the truth of many propositions of the first four books of Euclid, partly by faith, partly by trial; of giving him the whole fifth book by simple algebra; and in letting him assume the sixth book as axiomatic? He would allow him, in fact, to begin his severer studies where he was now in the habit of leaving off; and would let him put aside much more than is usually done, so that he would get quickly to the solution of partial differential equations and other useful parts of mathematics. He had been speaking of the training of the mathematician, and he might be wrong; but as to the educational training of the man who was to use his mathematics in the study of pure and applied physical science, he had no doubt whatever of the importance of skipping judiciously in all early mathematic work. In these days all men ought to study natural science, and in such study they required to have the knowledge of algebraic formulæ and the power to use them; to be familiar with the use of logarithms in computation; with the use of squared paper, and with the methods of the calculus. He held that dexterity in these is learned by quite young boys, and he felt sure that such dexterity could not hinder, and could only further, the mathematical study of the exceptionally clever student.

Mathematics was a powerful weapon to unlock the mysteries of Nature. If a man knew how to use the method, that would be enough; he could leave to others, who delight in that, the forging and complete study of the weapon. The average young engineer might be made to possess a power of using the methods of mathematics, which would be as easy to him as reading or writing or using any hand tool—a power which would never grow rusty, because it would be exercised every day of his life; and his present hatred of mathematics and theory of engineering was leading to disaster. Higher mathematics had become a very useful thing. As in the case of all other generally useful things, the complete study of its philosophy in the orthodox manner was not a necessary part of the school or college curriculum. In concluding his remarks, Prof. Perry defended himself against the charge which his engineering friends had brought against him, that he had an exaggerated notion of the importance to all men of possessing a love for mathematics.

The discussion upon the paper was commenced by Prof. Hudson. He said that a too common fault in teaching mathematics consisted in allowing the pupil to learn by heart propositions, formulæ and rules, instead of using them as a means of training the reasoning powers. He trusted that Prof. Perry did not really wish to recommend that method, but he was afraid that its advocates might quote Prof. Perry in their support. Elementary teaching should be so conducted as to prepare for more advanced teaching; nothing should have to be unlearnt. Geometry should be based on the observation and handling of models of solid figures, and thus could be begun at a much earlier age than was generally supposed. Prof. Forsyth criticised the vehemence of the attack which Prof. Perry had made upon the mathematician while sympathising to a considerable extent with his aims. He pointed out that subjects do not necessarily progress on the lines of direct usefulness, and that very many of the applications of the theories of pure mathematics had come many years—sometimes centuries—after the discoveries themselves; the weapon had lain ready to hand, but the man had not been there to use it. He also indicated briefly his views on the teaching of elementary mathematics, and advocated the inclusion of a course on practical geometry early in the pupil's career. With this suggestion, that the pupil should be led to pure geometry only after he had been accustomed to handle and to work with the figures with which geometry is concerned, all the subsequent speakers cordially agreed. Prof. Forsyth further desired to point out the need of a proper system of training teachers so that when they began their profession they would not have to devote their time to practising upon their earliest pupils the method that happened to suit their own particular temperament. Major MacMahon—the president of Section A—joined in the discussion, but confined his remarks to the subject of elementary teaching without entering upon the more important questions raised by the address, which he had already dealt with in his opening address to the Section. Prof. Rücker said that there seemed to be a general agreement among all the speakers that, in the case at all events of the younger children, the teacher ought to approach the subject as far as possible from the concrete side. He also held, with Prof. Perry, that a somewhat rapid advance was advisable in the first case, the various qualifications with which the general statements had to be guarded being entered upon later. While not attacking the system of examinations—which had come in for severe criticism by other speakers—he considered that it had its weak points, but that it was a necessary part of our educational apparatus. Prof. Silvanus Thompson and Prof. Henrici were in entire accord with Prof. Perry; and the latter expressed the hope that qualified mathematicians would prepare text-books upon the lines laid down in the address. Prof. Everett pointed out the need of distinguishing between technical and liberal education, and Prof. Miall criticised the system in which the needs of the pupil and teacher were sacrificed to the demands of the examiner and inspector. Mrs. W. N. Shaw spoke upon the bearing of the discussion on the education of girls; and there also joined in the debate, Mr. J. Parker Smith, M.P., Prof. Greenhill, Prof. Alfred Lodge, Prof. Minchin, Mr. E. M. Langley, and others.

An immediate result of Prof. Perry's address has been the appointment of an influential committee of the Association, with Prof. Forsyth as president and Prof. Perry as secretary, to report upon improvements that might be effected in the teaching of mathematics.

The Teaching of Botany.

The joint discussion on the teaching of botany was held in the rooms of Section K, Prof. Bayley Balfour being in the chair. Mr. Harold Wager introduced the discussion by reading a paper on the teaching of botany in schools. He said that more attention should be paid to methods of teaching if the subject was to take its proper place in the school curriculum as a part of the general scientific training. Too much time should not be spent in mere descriptive work; and the use of the compound microscope should not be encouraged. The right selection of topics was important. Such subjects as experimental plant physiology, the structure and germination of seeds, and the structure and function of the flower were specially to be commended. A good grip of fundamental principles and not an imperfect acquaintance with a vast number of facts was wanted in school teaching.

Prof. Bower read a paper on the teaching of botany in universities. He also urged that the use of the microscope in schools should not be allowed. It should be left to the university course. Thoroughness in special branches should be

aimed at with advanced students, not encyclopædic knowledge. Method was far more important than mere information. Advanced students should be left to work independently as much as possible. Research should be encouraged, but futile investigations were a mistake. Stress should be laid upon writing up the results of any piece of work in good literary form.

In the subsequent discussion, Prof. Miall said that in his elementary teaching at the Yorkshire College the laboratory work was the most important part of the work. Lectures were not given, but after a period in the laboratory a discussion on the facts observed took place in the lecture room, and the students were expected themselves to give an account of their work. They very soon learnt to express themselves clearly and easily, and had little difficulty in passing examinations. Prof. Marshall Ward agreed that observations formed a very important part of elementary botany, and children could be taught to reason from facts observed. With advanced students research was a powerful stimulus in developing interest in the subject. Prof. Withers believed that the study of science might well begin with natural history. Chemistry and physics should then be taken, and such a subject as botany might again be taken up in the higher forms. But as a training in scientific method he thought the value of botany was often extremely small.

Prof. Armstrong considered that more attention might be given to systematic botany, and science altogether should be taken more seriously in schools, and at least half the school time should be given to practical work. Chemistry and physics, as well as botany, were required in order to give the student a good knowledge of scientific method. Dr. D. H. Scott said that there was often too much specialisation in the syllabuses drawn up for elementary classes. His experience as an examiner had shown him that the subject could be easily crammed without developing any real knowledge of the subject. Dr. Kimmins gave the opinion, as the result of his experience, that botany was often very badly taught in schools because of the want of properly trained teachers. He thought it was a pity that there was a tendency to replace it altogether by physics and chemistry.

Sir John Gorst said that it seemed to him that one of the best science subjects for purposes of general education was botany, especially for rural schools. The provision of laboratories and apparatus was a difficulty. Perhaps the County Councils might help with these. Properly trained teachers were required, and the subject should have attention in Training Colleges. Too many rural teachers at the present time were not properly qualified to give simple lessons in botany.

The chairman in closing the discussion said that it had been of great interest, and he felt that improvement would take place as soon as a good supply of properly trained teachers could be obtained.

Organisation and Administration.

The other subjects dealt with in the Section belong more to the organisation and administrative side of education than to the aims, scope and methods of science teaching, so a brief mention of them will be sufficient in these columns. Sir Henry Roscoe introduced the subject of the organisation of technical and secondary education, and in commenting upon it Sir Michael Foster said that whatever legislation was brought forward it was to be hoped that no distinction would be made between primary and secondary education. Sir Philip Magnus spoke in favour of the unification of educational effort by the creation of local authorities to be responsible for education in their areas. A paper by the Bishop of Hereford on the influence of the universities and examining bodies upon the work of schools contained a plea for the recognition of science and modern languages as substitutes for Greek in Responsions. It was pointed out that the existing requirement of Greek from every candidate desiring to enter the older universities, together with the accompanying exclusion of modern languages and science, practically dissociates the whole class of modern schools or modern departments in schools from direct university influence, and the effect is found to be specially unfortunate in the modern departments of the large secondary schools. The paper will be printed in full by the Association. Among other subjects discussed were commercial education, and the mechanism of education in Scotland. Dr. J. H. Gladstone also read his annual report on the teaching of science in elementary schools, hitherto presented to the chemistry section, but there were few other papers, the system adopted in the arrangement of the programme being to accept only one or two papers for each meeting, and these to be on definite topics requiring discussion. By this means attention was concentrated upon particular aspects of educational work instead of being directed this way and that by a variety of papers. The system has worked so successfully that it will probably be followed at future meetings of the Section.

FORTHCOMING BOOKS OF SCIENCE.

Mr. Félix Alcan (Paris) gives notice of:—"Les maladies de l'orientation et de l'équilibre," by Prof. J. Grasset; "Manuel d'Histologie pathologique," by Profs. V. Cornil and L. Ranvier, illustrated, tome second.

Among Mr. Edward Arnold's forthcoming books are:—"The Balancing of Engines," by Prof. W. E Dalby, illustrated; "A Handbook on Fermentation and the Fermentation Industries," by Charles G. Matthews, illustrated; "Human Embryology and Morphology," by Dr. A. Keith, illustrated; "A Text-Book of Zoology," by G. P. Mudge, illustrated.

Messrs. George Bell and Sons give notice of:—"Elementary Science," by D. E. Jones and Dr. D. S. Macnair; "Inorganic Chemistry," by Prof. James Walker, F.R.S.; "An Introduction to the Comparative Anatomy of Animals," by Dr. G. C. Bourne, vol. ii.:—*The Coelomata*; "Elementary Differential Calculus," by Prof. A. Lodge, with an introduction by Prof. Oliver J. Lodge, F.R.S.; "An Elementary Treatise on Cubic and Quartic Curves," by A. B. Basset, F.R.S.

Messrs. A. and C. Black promise:—"A Treatise on Elementary Statics" (for the use of schools and colleges), by W. J. Dobbs; "New Descriptive Geographies: Africa, Central and South America, North America," edited by Dr. A. J. Herbertson and F. D. Herbertson.

Messrs. Blackie and Son, Ltd., will issue:—"The World of Animal Life, an Introduction to the Wonders of the Animal World," illustrated.

In the list of the Cambridge University Press we notice:—"Fables and Folk Tales from an Eastern Forest," collected and translated by Walter Skeat, illustrated; "Mathematical and Physical Papers," by Sir G. G. Stokes, F.R.S., vol. iii.; "Scientific Papers," by Lord Rayleigh, F.R.S., vol. iii. It is expected that the work will be completed in four volumes. "The Electrical Properties of Gases," by Prof. J. J. Thomson, F.R.S.; "Electric Waves," being an Adams Prize Essay in the University of Cambridge, by H. M. Macdonald; "A Treatise on Determinants," by R. F. Scott. A new edition by G. B. Mathews, F.R.S.; "The Algebra of Invariants," by J. H. Grace and A. Young; "A Primer of Botany," by F. F. Blackman; "Zoological Results based on material from New Britain, New Guinea, Loyalty Islands and elsewhere, collected during the years 1895, 1896 and 1897," by Dr. Arthur Willey. The entire work will be completed with the publication of part vi., which will be issued during 1901, and will contain Dr. Willey's monograph on *Nautilus* and other articles, including an account of the Ascidians by Prof. W. A. Herdman, F.R.S. "Reports of the Anthropological Expedition to Torres Straits by the Members of the Expedition," edited by Prof. A. C. Haddon, F.R.S., vol. ii.:—*Physiology and Psychology*. It is expected that the work will be completed in five volumes. "Biometrika. A Journal for the Statistical Study of Biological Problems," part i.; "The Fauna and Geography of the Maldive and Laccadive Archipelagoes," being the account of the work carried on and of the collections made by an expedition during the years 1899 and 1900 under the leadership of J. Stanley Gardiner, part i. of vol. i.; "Index Nominum Animalium," compiled by C. Davies Sherborn under the supervision of a committee appointed by the British Association and with the support of the British Association, the Royal Society and the Zoological Society, vol. i. (1758–1800); "Fossil Plants," a manual for students of botany and geology, by A. C. Seward, F.R.S., vol. ii.; "Electricity and Magnetism," by Dr. R. T. Glazebrook, F.R.S., "Hegelian Cosmology," by J. McT. E. McTaggart; "Essays on Educational Subjects," by Prof. S. S. Laurie.

Messrs. Cassell and Co., Ltd., will publish:—"The Earth's Beginning," by Sir R. S. Ball, F.R.S., illustrated; and new editions of:—"Tumours, Innocent and Malignant, their Clinical Characters and Appropriate Treatment," by J. Bland Sutton, illustrated; "Surgical Applied Anatomy," by Sir Frederick Treves, K.C.V.O., assisted by Dr. Arthur Keith, illustrated.

Messrs. W. and R. Chambers, Ltd., announce:—"The Nineteenth Century Series," in which we notice "Medicine, Surgery and Hygiene in the Century," by Dr. E. H. Stafford; "Discoveries and Explorations of the Century," by Prof. Charles G. D. Roberts; "Inventions of the Century," by William H. Doolittle; "Progress of Education in the Century," by James Laughlin Hughes and Dr. Louis R. Klemm; "Progress of Science in the Century," by Prof. J. Arthur Thomson.

Among the forthcoming works of Messrs. Chapman and Hall, Ltd., we see:—"Steam Boiler Economy; a Treatise on the Theory and Practice of Fuel Economy in the Operation of Steam Boilers," by William Kent, illustrated; "Elevation and Stadia Tables, for obtaining Differences of Altitude for all Angles and Distances, Horizontal Distances in Stadia Work, &c., with all necessary Corrections, &c.," by Arthur P. Davis; "Specifications for Steel Bridges," by J. A. L. Waddell; "A Manual of Assaying; the Fire Assay of Gold, Silver and Lead, including Amalgamation and Chlorination Tests," by Prof. Alfred Stanley Miller, illustrated; "High Temperature Measurements," by Prof. H. Le Chatelier and O. Boudouard, translated by George K. Burgess, illustrated; "Mechanical Drawing," by Lieut. Commander F. W. Bartlett, illustrated; "Practical Workshop Mechanics," by Wallace Bently; "The Human Figure in Motion; an Electro-photographic Investigation of Consecutive Phases of Muscular Actions," by Eadward Muybridge, illustrated; "Intermediate Practical Physics; a Manual for the use of Intermediate and Preliminary Scientific Students," by John B. Wilkinson; and new editions of "Notes on Thermodynamics," by H. W. Spangler, part i.; "A Text-book of Mechanical Engineering," by Wilfrid J. Lineham, illustrated.

Messrs. J. and A. Churchill's list contains:—"A Manual on Anatomy," by the late Prof. Alfred W. Hughes, edited by Prof. Arthur Keith; "Clinical Essays and Lectures," by Howard Marsh; "Gynæcological Pathology," by Dr. Charles Hubert Roberts, illustrated; "The Bacteriological Examination of Water," by Major Horrocks; "Serum-Therapy," by Prof. R. T. Hewlett; "A Text-Book of Clinical Medicine," by Dr. T. D. Savill; "A Hand-Book of Nursing, Medical and Surgical," by Dr. Hadley; "Elementary Ophthalmic Optics, including Ophthalmoscopy and Retinoscopy," by J. Herbert Parsons; vol. 4 of Groves' and Thorpe's "Chemical Technology"; "Electric Lighting and Photometry," by W. J. Dibdin and G. E. Cooke; and new editions of:—"A Manual of the Practice of Medicine," by Dr. Frederick Taylor; "A Text-Book of Medicine," edited by Dr. Pye-Smith, vol. i.; "Chemistry, Inorganic and Organic," by Prof. John Millar Thomson and Arthur G. Bloxam; "A Short Manual for Monthly Nurses," by Dr. Cullingworth; "A Simple Method of Water Analysis," by Dr. John C. Thresh; "The Pharmacopœia of the Throat Hospital"; "Dissection Outlines for use with Morris's Treatise on Anatomy."

The Clarendon Press announces:—"Micro-Anatomy," by Gustav Mann.

Messrs. J. M. Dent and Co. announce:—"A Primer of Physiology," by Dr. Alex. Hill; "Northern Mythology," by Prof. Kaufmann; "Beautiful Birds," by Edmund Selous.

Messrs. Duckworth and Co. will publish:—A new edition in one volume of "The Country Month by Month," by J. A. Owen ("A Son of the Marshes") and Prof. G. S. Boulger, with Notes by the late Lord Lilford.

Mr. Gustav Fischer (Jena) announces:—"Abhandlungen, Geologische und Palæontologische," edited by E. Koken, band v. heft 1; "Geologie der Radstädter Tauern," by Prof. F. Frech, illustrated; "Zur Lehre von der Blutzirkulation in der Schädelhöhle des Menschen, namentlich unter dem Einfluss von Medikamenten," by Dr. Hans Berger; "Fauna Arctica," edited by Dr. Fritz Römer and Dr. Fritz Schaudinn, zweiter band, erste lieferung; "Die Dipsomanie," by Dr. Robert Gaupp; "Die Malaria," by Battista Grassi, zweite vermehrte auflage; "Handbuch der Geschichte der Medizin," edited by Prof. Max Neuburger and Julius Pagel, erste lieferung; "Das Agglutinationsphänomen," by Dr. Fritz Köhler; "Topographischer Atlas der medizinischen Diagnostik," by Prof. Ponfick, zweite lieferung; "Handbuch der Hygiene," edited by Dr. Th. Weyl, erster supplementband, erstes heft; "Bedeutung eines systematischen Studiums des Skleroms," by Dr. von Schrötter; "Lehrbuch der vergleichenden Entwickelungsgeschichte der wirbellosen Thiere," by Profs. E. Korschelt and K. Heider, allgemeiner teil; "Technische Mykologie," by Prof. F. Lafar, zweiter band, erste lieferung; "Normentafeln zur Entwickelungsgeschichte der Wirbeltiere," edited by Prof. Dr. F. Keibel, drittes heft, illustrated; "Tropenhygiene mit spezieller Berücksichtigung der Deutschen Kolonien," by Prof. F. Plehn; "Die Bakterien," by Drs. J. Schmidt and Weis, illustrated.

The announcements of Messrs. Charles Griffin and Co., Ltd., include:—"Trades' Waste, its Treatment and Utilisation, with Special Reference to the Prevention of Rivers' Pollution," by W. Naylor; "The Metallurgy of Steel," by F. W. Harbord, illustrated; "Elementary Coal-Mining, for the Use of Students, Miners, and others preparing for Examinations," by George L. Kerr, illustrated; "A Dictionary of Textile Fibres," by William I. Hannan, illustrated; "Sanitary Engineering, a Practical Manual of Town Drainage and Sewage and Refuse Disposal," by Francis Wood, illustrated; "Ferments and their Action, a Text-book on the Chemistry and Physics of Fermentative Changes," by Dr. Carl Oppenheimer, translated by C. Ainsworth Mitchell; "Tables and Data for the Use of Analysts, Chemical Manufacturers, and Scientific Chemists," by Prof. J. Castell-Evans, in 2 vols.; "A Text-Book of Physics," by Prof. J. H. Poynting, F.R.S., and J. J. Thomson, F.R.S., illustrated, introductory volume on *Properties of Matter*; "Diseases of the Organs of Respiration, an Epitome of the Etiology, Pathology, Diagnosis and Treatment of Diseases of the Lungs and Air Passages," by Dr. Samuel West, illustrated; "Official Year-Book of Scientific and Learned Societies of Great Britain and Ireland," eighteenth annual issue.

Mr. W. Heinemann's list includes:—"The Play of Man," by Prof. Karl Groos, translated with the author's cooperation by Elizabeth L. Baldwin; "The Regions of the World," a series of twelve volumes descriptive of the physical environment of the nations, edited by H. J. Mackinder:—"Britain and the British Seas," by the Editor; "The Near East," by D. G. Hogarth; "Western Europe and the Mediterranean," by Elisée Reclus; "Central Europe," by Dr. Joseph Bastoch; "Scandinavia and the Arctic Ocean," by Sir Clements R. Markham, F.R.S.; "The Russian Empire," by Prince Kropotkin; "Africa," by Dr. J. Scott Keltie; "India," by Colonel Sir Thomas Holdich; "The Far East," by Archibald Little; "North America," by Dr. Israel C. Russell; "South America," by Dr. John C. Branner; "Australasia and Antarctica," by Dr. H. O. Forbes.

Mr. H. K. Lewis's list is as follows:—"A Handbook of Bacteriological Diagnosis for Practitioners, including Instructions for the Clinical Examination of the Blood," by Prof. W. d'Este Emery, illustrated; "Transactions of the Dermatological Society of Great Britain and Ireland," vol. vii.; and new editions of:—"Elements of Practical Medicine," by Prof. A. H. Carter; "The Sanitary Inspector's Handbook," by Albert Taylor, illustrated; "Rough Notes on Remedies," by Dr. William Murray.

Messrs. Crosby Lockwood and Son announce:—"Prospecting for Gold," by D. J. Rankin, illustrated; "Mining Calculations, comprising Arithmetic, Algebra and Mensuration," by T. A. O'Donahue, illustrated; "The Pocket-book of Refrigeration and Ice-Making for 1902, with Diary," edited by A. J. Wallis-Tayler; "The Bacterial Purification of Sewage," by Dr. Sidney Barwise, illustrated; and new editions of "Water and its Purification, a Handbook for the Use of Local Authorities, Sanitary Officers, and others interested in Water Supply," by Dr. S. Rideal, illustrated; "Lockwood's Dictionary of Terms used in the Practice of Mechanical Engineering," edited by Joseph G. Horner; "The Health Officer's Pocket-book, a Guide to Sanitary Practice and Law," by Dr. Edward F. Willoughby, illustrated.

Messrs. Longmans and Co.'s list contains:—"The Great Deserts and Forests of North America," by Paul Fountain; "Human Personality and its Survival of Bodily Death," by Frederic W. H. Myers, 2 vols.; "Dreams and their Meanings," by Horace G. Hutchinson; "Intuitive Suggestion," by J. W. Thomas; "Higher Mathematics for Students of Chemistry and Physics, with Special Reference to Practical Work," by J. W. Mellor; "A Practical Guide to the Administration of Anæsthetics," by Dr. R. J. Probyn-Williams; "A Practical Treatise on Mine Surveying," by Arnold Lupton, illustrated; "Bricklaying and Brick-cutting," by H. W. Richards, illustrated; "The Mind of a Child," by Ennis Richmond.

Messrs. Sampson Low and Co., Ltd., promise:—"The

Nordrach Treatment for Consumptives in this Country," by James Arthur Gibson; and a new edition of "The Student's Chemistry," by R. L. Taylor.

Among the announcements of Messrs. Macmillan and Co., Ltd., we notice:—"The Sherbro and its Hinterland," by T. J. Alldridge, illustrated; "The Scientific Memoirs of Thomas Henry Huxley," edited by Sir M. Foster, K.C.B., F.R.S., and Prof. E. Ray Lankester, F.R.S., in 4 vols., vol. iv.; "Atlas of Practical Elementary Zootomy," being a revised edition of the zoological portion of the "Atlas of Practical Elementary Biology," by Prof. G. B. Howes, F.R.S., with a preface to the first edition by the late Prof. T. H. Huxley, P.C., F.R.S.; "The Scenery of England and the Causes to which it is due," by the Right Hon. Lord Avebury, F.R.S., illustrated; Macmillan's Manuals of Medicine and Surgery: "A Manual of Medicine," edited by Dr. W. H. Allchin, vol. iv. *Diseases of the Respiratory System and of the Circulatory System*, vol. v. *Diseases of the Digestive System and of the Kidneys*; "Assimilation and Digestion," by Sir T. Lauder Brunton, M.D., F.R.S.; "The Climates and Baths of Great Britain," being the Report of a Committee of the Royal Medical and Chirurgical Society of London, vol. ii. *The Midland Counties and Ireland*; "Outlines of Inorganic Chemistry," by Prof. W. Ostwald, translated by Dr. Alex. Findlay; "An Experimental Study of Gases," by Morris W. Travers, with a preface by Prof. William Ramsay, F.R.S.; "Lectures and Essays by the late William Kingdon Clifford, F.R.S.," edited by Leslie Stephen and Frederick Pollock, with an introduction by F. Pollock, third edition, in 2 vols.; "Philosophy, Its Scope and Method," a course of introductory lectures by the late Prof. Henry Sidgwick; "The Growth of Hegel's Logic," by J. B. Baillie; "Mind in Evolution," by L. T. Hobhouse; "Texts for a Course of Elementary Lectures on the History of Greek Philosophy," edited by Dr. Henry Jackson; "Mammals," by F. E. Beddard, F.R.S. (being vol. x. of the Cambridge Natural History); "Insect Life, Souvenirs of a Naturalist," by M. J. H. Fabre, translated from the French by the Author of "Mademoiselle Mori," with a preface by Dr. David Sharp, F.R.S., illustrated; "The Mystic Rose, a Study of Primitive Marriage," by A. E. Crawley; "An Elementary Treatise on the Calculus," by Prof. George A. Gibson; a new edition of "The History of Human Marriage," by Dr. Edward Westermarck, with preface by Dr. A. R. Wallace, F.R.S.; "Upland Game Birds," by Emerson Hough, illustrated; "Salmon, Trout," by Dean Sage and A. Nelson Cheney, illustrated; "The Deer Family," by the Hon. Theodore Roosevelt, T. S. Van Dyke, and H. G. Stone, illustrated; "Municipal Engineering and Sanitation," by M. N. Baker; "An Introduction to Celestial Mechanics," by Dr. Forest Ray Moulton; "Elementary Electricity and Magnetism," by Profs. D. C. Jackson and J. P. Jackson, illustrated; "A Primer of Calculus," by Arthur S. Hathaway, illustrated; "The Practical Methods of Organic Chemistry," by Prof. Ludwig Gattermann, a new edition of the authorised translation by Dr. William B. Shober, illustrated; "The Applications of the Kinetic Theory to Gases, Vapours, Pure Liquids, and Solutions," by Dr. William Pingry Boynton, illustrated; "The Protozoa," by Dr. Gary N. Calkins, illustrated; "The Röntgen Rays in Medicine and Surgery, as an Aid in Diagnosis and as a Therapeutic Agent," by Dr. Francis H. Williams, illustrated; "Cyclopædia of American Horticulture," edited by Prof. L. H. Bailey, illustrated, vol. iv., completing the set; "First Lessons in Agriculture," by Prof. L. H. Bailey; "University Text-book of Botany," by Prof. Douglas Houghton Campbell, illustrated; "The Principles of Stock Breeding, the Application of Biological Laws to the Breeding of Domestic Animals (including Poultry), whether for Fancy or Profit," by Prof. W. H. Brewer; "Dictionary of Philosophy and Psychology," edited by Prof. James Mark Baldwin, with an international body of collaborators, in 3 vols.; "A Student's History of Philosophy," by Prof. Arthur Kenyon Rogers; "An Introduction to Psychology," by Prof. Mary Whiton Calkins; "Mental Growth and Control," by Dr. Nathan Oppenheim; "The College Student and his Problems," by Dr. James H. Canfield; "The Child's First Book in Science," by Dr. Edward S. Holden, illustrated.

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Messrs. George Newnes, Ltd., will publish in the Library of Useful Stories Series:—"The Story of Animal Life," by B. Lindsay, illustrated; "The Story of Euclid," by W. B. Frankland.

In the list of Messrs. Kegan Paul, Trench, Trübner and Co., Ltd., we observe:—"Assyrian Language, Easy Lessons in Cuneiform Inscriptions," by L. W. King; "The Book of the Dead, an English translation of the Theban Recension," with supplementary chapters, hymns, &c., and nearly 400 vignettes which do not appear in the larger edition published in 1897, by Dr. E. A. Wallis Budge; and a new edition of "Text-Book of Physiological and Pathological Chemistry," by G. Bunge, translated from the German edition by Florence Starling.

Messrs. G. P. Putnam's list includes:—"Zuni Folk-Tales," by F. H. Cushing, illustrated; "The Home Life of the Wild Birds," by F. H. Herrick, illustrated; and a new edition of "Thinking, Feeling, Doing," by E. W. Scripture, illustrated.

Mr. Grant Richards announces new editions of "Colin Clout's Calendar," by Grant Allen; and "Logic, Deductive and Inductive," by Carveth Read.

Messrs. Rivingtons announce:—"Chinese Turkestan, with Caravan and Rifle," by Percy W. Church; "Rivingtons' Junior Mathematics," by H. G. Willis, comprising Arithmetic, two parts; Algebra, two parts.

Messrs. F. E. Robinson and Co. will issue:—"Wild Sport in the Outer Hebrides," by C. V. A. Peel.

Mr. Walter Scott announces:—"History of Geology and Palæontology to the End of the Nineteenth Century," by Prof. Karl von Zittel, translated by Dr. M. M. Ogilvie-Gordon, illustrated; "The Study of Religion," by Prof. Morris Jastrow, jun.

Messrs. Seeley and Co., Ltd., promise:—A new and enlarged edition of "The Chemistry of Paints and Painting," by Prof. A. H. Church, F.R.S.

Messrs. Smith, Elder and Co. call attention to:—"Lectures on Chemical Pathology in its Relation to Practical Medicine, delivered at the University and Bellevue Medical School, New York City," by Prof. C. A. Herter.

Messrs. Sonnenschein and Co., Ltd., have in hand:—"Harlyn Bay and the Discovery of its Prehistoric Remains," by the Rev. R. A. Bullen; Heinze's "History of Contemporary Philosophy," translated by Prof. W. Hammond; Wundt's "Physiological Psychology," translated by Prof. E. B. Titchener; "The Student's Text-book of Zoology," by A. Sedgwick, F.R.S., vol. ii.; "Psychology, Normal and Morbid," by Dr. C. A. Mercier; and new editions of Hertwig's "Elements of Embryology," and Walters' "Sanatoria for Consumptives."

Mr. Fisher Unwin will issue:—"Alcoholism—a Study in Heredity," by Dr. G. Archdall Reid.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—A research studentship of 120*l.*, tenable for one year, has been awarded at Emmanuel College to Mr. G. L. Tuck.

THE new pathological laboratory at Oxford is to be opened by Sir William Church on Saturday next.

A NEW science building in connection with Colorado College, and which will cost 300,000 dollars, is in course of construction. Towards the amount required Dr. D. H. Pearsons has contributed 50,000 dollars, and an anonymous donor 100,000 dollars.

THE Calendar of the Royal Technical Institute, Salford, for the sixth session, 1901–2, has reached us, and contains full information respecting the various courses of instruction given at this well-equipped institution.

Science announces that the expenses of a department of anthropology in the University of California will be entirely borne by Mrs. P. Hearst. The department will pay especial attention to the study of the Indians of the Pacific coast.

AMONG recent professorial changes in American universities we notice the following:—Prof. E. M. Wood is to succeed Prof. H. Benner in the chair of mathematics and astronomy of Albion College, Mich., Prof. T. C. Esty will take the place of Prof. Baker as professor of mathematics in the University of Rochester, and Prof. P. Arnold will fill the chair of mathematics in the University of Southern California.

THE annual report of the Glasgow and West of Scotland Technical College has just been issued, and tells of much good work done and progress made during the period under review. The number of students has increased to the utmost capacity of the buildings, and the curriculum has been extended in several directions. After a close inquiry into the standard of instruction, the composition of its staff and the plan of its future operations, the Scotch Education Department and the Treasury have granted to the College a fixed annual subsidy on practically the same conditions as the annual grants to the English University Colleges. The authorities are much embarrassed by the poor class-room and laboratory accommodation, and it is to be hoped, therefore, that the sum required for the proposed building operations will be speedily forthcoming. So crowded is the College that the Governors have been obliged to announce that they are unable to consider any additional applications for admission to quite a number of evening classes.

THE *Alumni Weekly* of the University of Minnesota for September 23 contains an account of the new botanical station which has been built on Vancouver Island for students of botany in Minnesota and the north-west. The seaside station, as it exists, is but a beginning, and many things are required for its suitable equipment, such as a small steam-launch, a steam-pump, a system of water-pipes for fresh- and salt-water, an additional laboratory building and other conveniences; but the start made is an encouraging one. The party of students and others which visited the station during the recent season numbered twenty-nine, and a very successful gathering seems to have been held. The days were spent in studying the products of the shore and forest, and in the evenings brief botanical lectures were delivered by the teachers. The buildings are, it may be mentioned, at present planned to accommodate eighty workers.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, September 30.—M. Bouquet de la Grye in the chair.—The problem of the dissipation of heat in a thick wall with radiating surface, by M. J. Boussinesq.—Remarks on the formation of acids in plants, by MM. Berthelot and André. It has been found that there is no relation between the total amount of vegetable acids contained in a plant, in the free or combined state, and the amount of acid in the juice extracted from the various parts.—On the engraved and painted figures of the Palæolithic period found on the walls of the cave of La Mouthe (Dordogne), by M. Emile Riviere. A minute description of prehistoric drawings, the existence of which was first indicated in 1895. The cave is nearly filled up with débris of prehistoric man, who inhabited the cave at two distinct epochs, which are clearly distinguished by a stalagmitic layer which separates them. The drawings are of three kinds, simple line engravings, others filled with a brownish-red ochre, and a third a kind of striation of the rock. All, with one exception, represent animals, the most perfect being complete figures of a bison and of a kind of antelope. The wild goat and reindeer are also recognisable.—On differential equations of the second order with algebraical coefficients, by M. Paul J. Suchar.—On the variable state of currents, by M. A. Petot.—The calculation of the heat of volatilisation and heat of fusion of some elements, by M. de Forcrand. The relation $(L + S)/T = (l+s)/T = 30$ between the molecular weight M, the heat of fusion S, the heats of volatilisation and fusion L, l, and the temperature, is applied to the cases of phosphorus, arsenic and selenium.—Nitromannite and nitrocellulose, by MM. Leo Vignon and F. Gerin. It has been previously shown by one of the authors that the various nitro-derivatives of cellulose energetically reduce an alkaline copper solution. It is now shown that penta- and hexa-nitromannite behave similarly. This reducing power is not altogether due to the formation of mannose. Nitromannite, reduced by ferrous chloride, gives a mannite devoid of reducing power. From this point of view it behaves differently from the nitro-celluloses.—The formation of an isatin derivative of albumen, by M. Julius Gnezda. A substance giving the reactions of chlorisatin has been obtained from the products of the reaction between hypochlorous acid and peptone.—On the reproduction and development of *Peripatopsis Blainvillei*, by M. E. L. Bouvier.—On stolonisation in the hydroides, by M. Armand Billard.—The fibrovascular elements of the stem and frond of some Filicineacæ, by MM. C. Eg. Bertrand and F. Cornaille.—On the localisation and dissemination of antimony in the organism, by M. G. Pouchet. The toxic action of antimony and its localisation require doses of antimony much larger than with arsenic, the localisation of antimony being different from that of arsenic. The toxic action of arsenic is not diminished by the presence of antimony, but, on the contrary, appears to be somewhat increased.

CONTENTS.