Nature

A WEEKLY

ILLUSTRATED JOURNAL OF SCIENCE

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"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH

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REVIEWS AND OUR BOOKSHELF.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

THURSDAY, JULY 1, 1909.

THE IMPERIAL GAZETTEER ATLAS OF INDIA.

The Imperial Gazetteer of India. Vol. xxvi. Atlas. New edition. Pp. vii+45; 64 plates. (Oxford: Clarendon Press, 1909.)

THIS atlas, which forms the twenty-sixth volume of the series, is practically an epitome of all the information contained in the "Gazetteer," and, as such, it presents to the reader in a concrete form of illustration most of the physiographical conditions of the Indian Empire. The authorities for the information contained in it are of the very highest, and the publisher is Mr. J. G. Bartholomew, which is in itself a guarantee that the maps are of the very best. Geology, meteorology, ethnology, language distribution, and archæology are all included; there are four special maps illustrating the position of the British frontier at different periods, and a series of admirable city maps which might have been extended with advantage.

In the first general map which presents itself the singular position of Ceylon as forming no part of the Indian Empire is curiously anomalous; and inasmuch as Ceylon cannot be wholly left out of account (as in the railway maps, for instance), it would, we think, have added to the appearance, if not to the usefulness of the atlas, to have included it generally. With this doubtful exception the general maps are complete, clear, and most instructive. The special maps are also good, although, of course, it would be easy to suggest other and possibly better methods of presenting the physical features of India than those which have been adopted. The one special map which deals with the subject of vegetation is perhaps the most open to criticism. Here the classification of area by colour, exhibiting the nature of vegetable growth, or the want of it, seems inadequate. There is one green tint in particular, which denotes "grass or sparsely cultivated," which is rather too comprehensive. We find it, for instance, covering wide tracts to the north and south of the Indravati affluent of the Godavari river in the Central Provinces. Undoubtedly this is a grass country, and it is also sparsely cultivated. The grass in the cold-weather seasons is thick and rank along the low-lying flats, bunched with tangled masses of dew-soaked undergrowth, and almost impassable in the hot weather by reason of the stuffy atmosphere which envelops it; but it is always associated with a low scrub (chiefly of various species of dwarf palm) and sheltered by a more or less scattered tree jungle which occasionally rises to the dignity of forest and is never altogether wanting although it thins out on the higher land. This is, in fact, the nature of the "jungle" which covers half the surface of India, distinct from the official forest areas, which contain timber of commercial value or fringe the foot-hills of the Himalayas.

Again, we find the same tint of green overlying many hundreds of square miles of the Baluch highlands where never a tree has been seen for a century, and where it would be vain to look for a blade of grass after the close of summer. It is true that in the spring months a green tint does actually steal gradually over the hill-sides, and it fills in the spaces between the wormwood scrub of the flats. Then, indeed, the flowers bloom freely, and for a period Baluchistan is gay. Then, too, the shepherd takes his sheep to the hills, and the landscape becomes dotted with white specks of scattered flocks. There is grass undoubtedly —for a time—and equally true it is that the land is "sparsely cultivated"; but about the season that the Indravati basin is rank with cane-brakes and undergrowth and swarming with game, the hills of Baluchistan take on their normal aspect of dead, dull stony desolation, and the "dasht" becomes grey and insipid. So far as vegetable growth is concerned the two countries are in utter contrast, although it is true of both that grass grows in them, and that cultivation is sparse. A very considerable extension of the "steppe-desert" tint is required in Baluchistan (where it is not introduced at all), nor is it quite reasonable to ignore the magnificent cultivation of the valleys of the Hari Rud, near Herat, and of the Helmand; or to paint the summit of the Sulaiman range with the colour

of the "sandy desert or barren land," considering that the chilghosa forests of these mountains (which are all about these summits) are of great economic importance to the tribes people who make use of them. It will be observed that these criticisms point, not to the maps of India with which the "Gazetteer" is principally concerned, but to the maps of the Indian frontier and trans-frontier. Of the maps of India it is enough to say that they are all admirably clear and most instructive, each in its distinct and separate line of illustration; but inasmuch as the frontier is now very rightly included in all works dealing seriously with Indian problems, it is time that the public were supplied with map information of a class equal to that of the Indian peninsula generally. This is not quite the case in this atlas.

Take, for instance, the map of Baluchistan amongst the "district" series. Were no attempt made at reproducing the orography of that remarkable country the map might pass sufficiently well as a sketch; but the crude representation of the mountain features which at present disfigures the map is absolutely misleading. All the beauty (and it is very beautiful) of nature's arrangement of sweeping flexures and folds which border the trans-Indus highlands; the orderly curves of their looping up where the inset of the Kach Gandava desert occurs (just like the looped-up flexures in hanging drapery) pushing back and forming the massive mountain entourage of Quetta; then sweeping away in graceful flexures seamed with a thousand wrinkles to Karachi, or through Makran to Persia—all this is lost in the graceless disposition of a few fat slug-shaped forms over the yellow surface of the map. This is not the orography of Baluchistan, or Makran, and it is misleading. The traveller who trusted, by following this map, to turn the northern end of the Kirthar range and to walk into Khozdar on the flat plains would be grievously disappointed. The wall of the frontier hills is not even represented as continuous, and even if the scale of the map does not admit of giving full value to many important, but minor, features, there is at least no excuse for fundamental errors such as this. The map is certainly not overcrowded with names, and this fact renders it all the more desirable that those which exist should be correct. The "Central Makran" range is an invention which is hardly permissible. Not only is it not near the centre of Makran, but it is doubtful whether it is, all of it, even in Makran. As regards the frontier, we must, however, be thankful for small mercies. It is something to find a map of Baluchistan which is correct in its political boundaries, and it is a great deal to find a map of Afghanistan which is in almost every respect a far better illustration of the country it represents than that which we have just criticised.

The city maps at the end of the series are wholly admirable, and so are the railway maps which precede them. It would have added greatly to the interest of the series could we have had maps of some of the most ancient, and, historically, the most important, of the cities of the past; Chitor, Ujjain, Udaipur, and many another that we could mention, will always possess an undying interest for the student of India. On the whole, this atlas is an admirable addition to the "Gazetteer," and as it is probably the most useful volume for reference in the whole series, so may we hope that in due time it will become the most accurate.

T. H. H.

ESSAYS ON LEONARDO DA VINCI.

Etudes sur Léonard de Vinci, ceux qu'il a lus et ceux qui l'ont lu. By Pierre Duhem. Seconde Série. Pp. iv+474. (Paris: A. Hermann, 1909.) Price 15 francs.

THIS volume contains four essays, on Leonardo da Vinci's views on the infinitely great and the infinitely small, on his ideas on the plurality of worlds, on his dependence on the philosophy of Nicolaus de Cusa, and on his ideas on the origin of fossils.

When endeavouring to estimate the value of the notes and jottings of the great painter it is necessary to consider the books accessible to him and the problems under discussion among philosophers of his day. M. Duhem has made a detailed study of the works of mediæval thinkers, and he traces the development of the ideas by which Leonardo's mind was influenced, and the advances he made, by which, unfortunately, the world did not profit since they remained locked up in his note-books. The foundation on which every speculation rested was still the philosophy of Aristotle, viewed in many cases through the spectacles of the scholastics, and often influenced by the commentaries of Arabian philosophers. But Leonardo reasoned independently on every subject, and though he often adopted opinions held by his predecessors, he never followed slavishly in their footsteps. This is well illustrated by his attitude with regard to the question whether there might be more worlds than the one of which the earth was the central part, and which was bounded by the starry sphere. Aristotle had denied that there could be more than one universe, because a body can only be at rest in its natural place, so that the earth of a second world would fall down on our earth, and no body can therefore exist outside the starry sphere. The question was a difficult one to the scholastics, because to deny the possibility of the plurality of worlds seemed to involve denying the omnipotence of God; but a curious compromise was proposed by Albert of Saxony, that if there were another world it would have to be concentric with ours, because the centres of gravity of our earth and the other one would have to coincide if there were to be equilibrium, and this could only be the case if the other earth were in the form of a spherical shell—unless we assume a permanent miracle. Undeterred by this, Leonardo in a note considers what would happen if there were, not one, but two centres of gravity. He assumes two worlds of equal size and a heavy body outside the line joining their centres, but at equal distances from these; and he asks how will this body move and where will it come to rest? The answer is that it will move along the perpendicular to the line joining the centres, and be in equilibrium at the point midway between them. Here, as in many other places, he shows that he had

a clear idea of the composition of forces, at a time when the fundamental principles of dynamics were unknown.

The writings of the German philosopher Nicolaus de Cusa seem to have made a profound impression on Leonardo, and M. Duhem shows how suggestive they were to him in his studies on the motion of bodies. Leonardo discussed the motion of an arrow shot vertically upwards from the earth, assuming the latter to rotate in twenty-four hours, not because he wanted to prove or disprove the rotation of the earth, but merely as a problem of dynamics. Here, as well as in his general investigation of the motion of a projectile, he found it hard to free himself from old ideas; he believed, for instance, that a cannon ball at first moves in a straight line while influenced by a "violent force," next in a curved path while that force and gravity are struggling for supremacy, until it finally drops to the earth in a straight line. Though he cannot be considered a precursor of Copernicus (he says repeatedly that the earth is at the centre of the universe), he reasons as freely as Cusa about the nature of the stars, and rejects the Aristotelean distinction between the terrestrial elements and celestial matter. He believed the moon to be composed of the four elements which it supports in space in itself and by itself, as the earth does with its component parts. This is much the same as the statement of Copernicus that gravity is a natural tendency of all particles to join themselves into a whole in the form of a sphere, a tendency which is innate in the sun, moon, and planets.

The fourth essay deals with speculations on the origin of fossils. Leonardo did not consider them to be "plays of nature," or to have been carried to the tops of mountains by a deluge, but recognised that they are the remains of animals which actually lived on the spot where the fossils are found.

PARA RUBBER.

Hevea brasiliensis, or Para Rubber. Its Botany, Cultivation, Chemistry, and Diseases. By Herbert Wright. Third edition. Pp. xviii+204. (Colombo: A. M. and J. Ferguson; London: MacLaren and Sons, 1908.) Price 10*s.* net.

A REVIEW of Mr. Herbert Wright's valuable work on Para rubber appeared in NATURE about two years ago. The present edition (third) has been considerably enlarged, and in Mr. Wright's words "has been compiled in consequence of the many advances which have been recently made in methods of cultivation and tapping, coagulating and curing." The text has been increased from 177 pages to 304 pages, and the really well reproduced and instructive illustrations from 86 to 272. Many of the chapters have been re-written and expanded, especially the one on uses of rubber. There is now a separate chapter on the botany of the Para tree, *Hevea brasiliensis*, and one on the effect of tapping on the trees.

Chapter iv. contains a great deal of useful and up-to-date information on planting operations and on catch crops. The advantages and disadvantages of close planting are fully considered. The most general distance now employed is from 15 feet to 20 feet. The main justification for close planting is the increased tapping area which is available in the first few years, but there is a note of warning in the following passage:—

"No one who has seen the uncultivated thirty-year-old trees at Henaratgoda can doubt that such specimens require at the very least a distance of thirty to forty feet if they are to be allowed to continue in their growth and maintain a healthy constitution."

Catch crops, says Mr. Wright, are all very exhausting, and their profitable cultivation is limited to about the first four years.

Considerable space is devoted to a description of the various methods of tapping and tapping implements, but, apparently, the systems employed are far from perfect, as the following passage implies:—

"The adoption of better systems of tapping which obviate the necessity of paring away the tissues wherein the milk accumulates, and drawing supplies of latex by merely cutting and not excising the laticiferous tissues is bound to result in an increased yield since the life of the tapping area is so much prolonged."

At present the average yield per tree per year for the Malay States would appear to be about 2 lb. Most of the trees, however, are still young. The cost of production is about 1*s.* 6*d.* per lb. Various methods of coagulating and treating latex are described: the use of centrifugal machines is more or less experimental; "the principle . . . . of causing a separation of the caoutchouc globules by mechanical means is one which cannot be too strongly impressed on the experimentalist."

There is very little doubt, from Mr. Wright's remarks and his inquiries amongst manufacturers, that plantation Para is inferior in quality to fine hard (wild) Para. A wise manufacturer would not dare to buy 50 tons of cultivated rubber and store for six months, for fear of grave deterioration in quality, but he would buy thousands of tons of up-river fine Para with a full knowledge that it would grow better in storage. Mr. Wright appears to have very little faith in the so-called "synthetic rubber."

Natural rubber consists chemically of very complicated compounds. The "resins" and "proteins" are in themselves highly complex bodies, the components of which are but little understood.

"How can it then be possible, since we do not fully understand the chemical composition of the various components of natural rubber, to have synthetic rubber already on the market?"

Mr. Wright's book is perhaps the most comprehensive and up-to-date work on Para rubber published in this country, and has proved of great utility to practical men in the various branches of the rubber industry.

L. C. B.

ALTITUDE TABLES FOR NAVIGATORS.

Altitude Tables, computed for Intervals of Four Minutes between the Parallels of Latitude 24° and 60°, and Parallels of Declination 24° and 60°, designed for the Determination of the Position Line at all Hour Angles without Logarithmic Computation. By Frederic Ball. Pp. xxxvii+313. (London: J. D. Potter, 1909.) Price 15*s.* net.

THERE are many circumstances connected with actual navigation which tend to make calculation on board ship difficult to the inexpert, and we naturally welcome any effort intended to shorten an onerous task and to introduce greater simplicity. The substitution of tables which give an approximate solution of a spherical triangle, involving only a very easy interpolation, is the form that assistance usually takes, and the main feature in the book before us is to make tables, already published, available for wider limits of latitude and declination. As tables extend, and contrive, perhaps, to serve more than one purpose, complications are likely to arise, and however great an ingenuity is displayed in adapting trigonometrical formulæ to tabular arrangement, if simplicity is sacrificed to ingenuity, the ultimate gain is questionable.

Accuracy is as necessary as brevity of calculation, and it is possible to be so enamoured with the apparent advantages of tables that the chances of misusing them are overlooked. We have a slight fear that the author has not sufficiently considered this point. It is a mistake to cumber the work with many rules, which put too great a strain on the memory. For instance, the rules for determining the "name" of the azimuth; using different methods within ten degrees of the meridian or of the prime vertical; interchanging latitude for declination under certain conditions; all these things are apt to be a little burdensome in a moment of stress or excitement. Further than this, there must come a time when tables do not shorten the work, for the number of interpolations becomes excessive. Tables of double entry are always inconvenient to the computer, and when, as in nautical problems, we get three arguments, latitude, declination, and hour angle, for other values than those in the tables, the process becomes very laborious. In an example given, it is necessary to take out four altitudes with arguments of even degrees of latitude, and of declination, and to make three interpolations between these altitudes. Not a word is said about the signs of the corrections, and it is quite possible to use an incorrect sign. In any case, the attention is kept on the strain more than if a direct calculation of altitude was made from the ordinary trigonometrical formula.

We may ask, too, whether the use of logs. for solving the simplest question in rule of three is not a little overdone. We have a problem, in which is given the difference of altitude for 60′, and it is required to find the proportional amount for 41′6′. The correction is worked out by logs. involving three entries.

But these are little technical points, on which, no doubt, the author's information is a safe guide. He has actual experience to lead him aright, and we are prepared to surrender our opinion to his practical judgment. On a more important point we are entirely with Mr. Ball. We recognise that this is part of an effort to impress, especially, on the Mercantile Marine, the necessity and the advantage of employing modern methods of tried excellence, and the desirability of abandoning obsolete processes. In these days of rapid locomotion at sea, it is more than ever necessary to produce a correct result in the shortest possible time, and when the expenses of ship management are so enormous, it is a matter of prime importance to know the exact position of the vessel, and to ensure accurate landfall. No time must be lost in groping about to pick up a light, no hesitation must be allowed in determining the ship's course and speed. We trust the author will be successful in enforcing the lesson he has at heart.

OUR BOOK SHELF.

Guide to the Whales, Porpoises, and Dolphins (Order Cetacea), exhibited in the Department of Zoology, British Museum (Natural History), Cromwell Road, London, S.W. Pp. 47. (London: British Museum [N.H.], 1909.) Price 4*d.*

THE whale-room in the Natural History Museum is one of the most notable and interesting features of the national collection, and the publication of a new guide to its contents calls for a word of comment. Within fifty pages Mr. Lydekker has compressed not only a series of clues to the models, skins, and other preparations, but has furnished students of zoology generally with a most useful and well-illustrated summary of the chief characters of the Cetacea and of their presumable ancestors. In a prefatory note, Dr. Harmer gives reason for confining exhibits of this order to skeletons and models, but it is to be hoped that the public will always have an opportunity of seeing the skins of some of these impressive animals, in order to judge of their proportions. The only feature of this excellent guide that we could have wished more fully expounded, relates to the puzzling vernacular names of whales that are used by fishermen. The members of our own branch of the international sea investigation are often quite at a loss to know what these names correspond to in scientific nomenclature, and their experience is not unique. The matter has some importance since the cetacean fauna of the north-western seas is probably more familiar to fishermen than to naturalists, and the fisherman's records cannot be stated precisely until we are able to understand the vernacular terms in use.

La Naissance de l'Intelligence. By Dr. Georges Bohn. Pp. 350. (Paris: Ernest Flammarion, 1909.) Price 3.50 francs.

THIS book is the latest addition to the well-known series of volumes entitled the "Bibliothèque de Philosophie scientifique," and, in both matter and style, easily reaches the high standard of excellence set by its predecessors. The author restricts his attention to the psychology of the lower organisms, and has succeeded in giving an extremely interesting account of a part of modern comparative psychology hitherto rendered attractive only at the expense of truth. An implacable foe to the "anthropomorphism" of the last generation of comparative psychologists, Dr. Bohn devotes a large part of the earlier chapters of his book to a full statement and vigorous defence of Loeb's theory of tropisms, relieving it of several

serious misconceptions on the part of the critics by distinguishing it from and relating it to the theories of "differential sensibility" and "associative memory," respectively, which were adumbrated by Loeb himself, and are equally necessary to the explanation of many forms of behaviour of lower organisms. From this general standpoint he finds himself in a position to criticise, on the one hand, the modern mechanistic school of the Germans (Beer, Bethe, Uexküll, &c.), who deny *sensations* to animals only to be forced, later on in the argument, to attribute *intellect* to them, and, on the other hand, Jennings and his American supporters, whose theory of "trial and error" is accused (somewhat unjustly, we think) of an anthropomorphic taint. Other interesting points in the book are discussions on the vital rhythms of marine animals, on the criteria of psychism (where the author rejects Yerkes's various criteria—discrimination, docility, initiative—in favour of that suggested by Loeb, viz. associative memory), on the laws of associative phenomena, and on instinct, a term which the author scornfully expels from comparative psychology as being "metaphysical" and useless. Such a method of getting rid of difficulties should not be encouraged. W. B.

The Dyeing and Cleaning of Textile Fabrics. A Handbook for the Amateur and the Professional. By F. A. Owen. Based partly on notes of H. C. Standage. Pp. vi+253. (New York: Wiley and Sons; London: Chapman and Hall, Ltd., 1909.) Price 8*s*. 6*d*. net.

A HANDBOOK was published some time ago under some such title as "Every Man His Own Lawyer." To what particular class of people such a book is useful it is not easy to say, but it is fairly safe to assume that the work of the legal profession was not materially lessened by its publication. The book above mentioned might with equal aptness have been termed "Every Man His Own Dyer," but the probability is that the people who are successful in dyeing their own clothes will be even smaller in number than those who are satisfied with the result of their own legal efforts.

The first portion of the book is taken up with such general matters as solution, maceration, &c., and here the author drifts into pharmacy. "The ordinary dose of such infusions is 1 to 2 ozs., three or four times per day." He does not explain, however, the connection between the internal application of infusions and the renovation of garments. His remarks on maceration are equally illuminating. "Its object is usually to impregnate alcohol with the principles of a substance which would be but slowly extracted without the aid of heat, such as the *sun or other warm situation*."

It is a matter for regret that the book should have been published in its present form. It contains many trustworthy and useful recipes for the removal of stains, the cleaning of gloves, &c., but these are associated with so much useless and even misleading matter that their value is greatly discounted.

WALTER M. GARDNER.

Codex of Resolutions adopted at International Meteorological Meetings, 1872–1907. Prepared at the request of the International Meteorological Committee by H. H. Hildebrandsson and G. Hellmann. Pp. 80. (London: H.M.'s Stationery Office, 1909.) Price 1*s*. 3*d*.

PROGRESS in the observational sciences depends to a great extent on cooperation among those engaged in collecting and making generally available the observational data, and in no subject is this more true than in meteorology, in which the number of individuals who have to be brought within the meshes of the general organisation is exceptionally great. Much has been accomplished in the direction of drawing up rules for general guidance, but the lack of a satisfactory index to the various reports in which these are embodied has hitherto made it difficult to find the information bearing on any given point. Recognising this difficulty, the International Meteorological Committee, at its meeting at Southport in 1903, requested the authors to prepare a summary of what had been already accomplished.

The manuscript of the "Codex," which takes the form of a reprint from the minutes of the meetings of all important resolutions, with short explanatory paragraphs interspersed, was submitted for approval at the International Conference of Directors of Observatories and Offices, held at Innsbruck in 1905. Subsequently Dr. Hellmann incorporated the decisions adopted at that meeting, and the German edition of the work was issued by the Royal Prussian Meteorological Institute in 1907. In the English edition, Dr. Shaw has incorporated the resolutions adopted by the International Committee at Paris in 1907, and we have thus a complete summary of the work accomplished by the seventeen international meetings which have been held since 1872, the date of the first conference, held at Leipzig. In view of the large area over which the English-speaking peoples hold sway, the publication of an English edition of the work is very welcome, and should prove of great service to all engaged in meteorological or magnetic work. A full index to the "reports on progress" in particular branches, and to the scientific papers which have appeared as appendices to the minutes of the meetings, is not the least valuable part of the book.

The Balance of Nature, and Modern Conditions of Cultivation: A Practical Manual of Animal Foes and Friends, for the Country Gentleman, the Farmer, the Forester, the Gardener, and the Sportsman. By George Abbey. Pp. xlvii+278. (London: Routledge and Sons, Ltd.; New York: E. P. Dutton and Co., 1909.) Price 7*s*. 6*d*. net.

IN his preface the author, who appears to have had a very large experience in trapping vermin, states that the only natural-history works he has consulted are "Wood's Natural History" and "The Popular Encyclopædia." All we can say is the more's the pity, for had he undertaken a somewhat wider and more modern course of reading we might have been spared such out-of-date statements as that the hedgehog is a member of the same family as the one which includes the mole and the shrewmouse, or that there are two British species of dormice and also of water-shrews. Such errors are possibly excusable in a writer who is not a zoologist; but what can be said of a so-called sportsman or outdoor naturalist who states that only tame red deer are hunted in England, and that wild roebuck are unknown south of Scotland?

But if the text be bad the illustrations, which the author declares to be diagrammatic, are ten times worse, the climax being reached in the figure of the roebuck, which is represented with a long tail!

As regards the economic portions of the work, the author appears to know more of his subject, and we trust his observations will be found of use to the country gentlemen and farmers for whom the volume is specially intended. We must, however, express surprise at the merciless manner in which he advocates trapping and other methods of destruction; and we are still more concerned at the statement on p. 201 that fish-preservation societies scruple not to destroy the kingfisher, especially if they countenance the use of the cruel pole-trap depicted on the same page.

R. L.

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.*]

Diurnal Variation of Temperature in the Free Atmosphere.

THE following results, which I have recently obtained by a discussion of temperatures obtained in kite and captive balloon ascents, may be of interest in connection with Prof. Clayton's letter (NATURE, February 4) and Mr. Dines's remark that at a height of 1 km. the daily temperature variation becomes insignificant (NATURE, June 17). The daily variation of temperature at a height of 1 km. over Berlin, deduced from 2232 observations made during the five years 1903–7, is given in degrees C. by

$$T = T_s - (4{\cdot}40 \pm 0{\cdot}08) + (0{\cdot}87 \pm 0{\cdot}13)\sin(nt + \theta_1) + (0{\cdot}14 \pm 0{\cdot}10)\sin(2nt + \theta_2),$$

where T_s is the mean surface temperature, and the probable errors are deduced by the method of least squares. The most probable values for θ_1, θ_2, are 197° and 123° respectively, the time being measured from midnight.

The variation deduced from 962 observations, made during the four years 1903–6, in which the wind at a height of 1 km. was 8 metres per sec. and upwards, is given by

$$T = T_s - (3{\cdot}97 \pm 0{\cdot}15) + (0{\cdot}84 \pm 0{\cdot}23)\sin(nt + \theta_1') + (0{\cdot}35 \pm 0{\cdot}15)\sin(2nt + \theta_2').$$

The most probable values of θ_1, θ_2, are 173° and 102° respectively.

The close agreement in the values for the amplitude of the whole day wave for the two cases proves that there is no large error due to the influence of solar radiation on the instruments, and that the variation is a real variation of the temperature of the atmosphere.

The mean daily range is, then, 1·7° C. (or 3·1° F.), compared with a mean daily range of about 5° C. at Kew, where the temperature variation is given by

$$T = T_s + 2{\cdot}56\sin(nt + 226°) + 0{\cdot}42\sin(2nt + 45°).$$

The maximum temperature at a height of 1 km. appears to occur from two to three hours later than at the surface in the whole day wave, and two to three hours earlier in the semi-diurnal wave.

The variation at a height of 2 km., deduced from all (1132) observations, is given by

$$T = T_s - (9{\cdot}84 \pm 0{\cdot}23) + (0{\cdot}64 \pm 0{\cdot}31)\sin(nt + \theta_1) + (0{\cdot}25 \pm 0{\cdot}23)\sin(2nt + \theta_2),$$

the most probable values for θ_1, θ_2, being 270° and 72° respectively.

The magnitude of the probable errors precludes the results from being regarded as final. More observations are needed. But it appears certain that we do not get, on this side of the Atlantic, the remarkable diminution in amplitude and change of phase in the diurnal component which Prof. Clayton found in the first 1000 m. at Blue Hill. The amplitude of the semi-diurnal component does show an increase at 2 km. over its value at 1 km., but, having regard to the relatively large probable errors, one cannot attach any real significance to the result. At the same time, it is of interest to find that at 1 km. and 2 km. altitude in these latitudes the temperature variation is as great as it is over the ocean near the equator, where the value of the daily range is about 1·5° C.

Cambridge, June 20. E. GOLD.

Temperature of the Upper Atmosphere.

AN explanation of the existence of an isothermal layer may possibly be found in the fact that carbon dioxide condenses and freezes at low temperatures even when the pressure is low. The strata in which CO_2 circulates, falling as small drops and then evaporating, must be comparable in the irregularity of their temperature gradients with the strata near the earth in which water circulates. The temperature of the bottom of the mist of CO_2 must be approximately a function of the pressure, so it is to be expected that the height of the mist will vary from day to day and from place to place. In particular, it appears that the change of temperature gradient should occur in the tropics at a greater altitude and lower temperature than elsewhere. The observations to which Mr. Cave refers (NATURE, June 17) confirm this part of the theory.

F. J. W. WHIPPLE.

Merchant Taylors' School, E.C., June 28.

The Aëronautical Society.

IN reference to Prof. Bryan's remarks on the aims and objects of the Aëronautical Society of Great Britain in NATURE of May 27, I would point out that the general scientific character of the proceedings of a society is not annulled because one or more writers have fallen into error, any more than it would be reasonable to say that Prof. Bryan is not a profound mathematician because, in a Friday evening discourse at the Royal Institution, he fell into inaccuracy in scientific history, and said that the Aëronautical Society of Great Britain was at one time called the Balloon Society, and changed its name to its present title, the fact being that the Balloon Society was quite a separate affair, which had its meetings at the Westminster Aquarium and discussed every subject under the sun. In that remark Prof. Bryan showed he had not closely followed the work and career of the Aëronautical Society of Great Britain.

During my eight years of honorary secretaryship of the society, amongst the readers of papers and those who made communications will be found Dr. W. N. Shaw, F.R.S., Mr. W. H. Dines, F.R.S., Prof. C. V. Boys, F.R.S., the late Prof. G. F. Fitzgerald, F.R.S., Prof. Bryan himself, Sir Hiram Maxim, Mr. Lawrence Rotch, Dr. Hergesell, Mr. F. H. Wenham, Captain R. F. Scott, Lieut. E. H. Shackleton, Mr. Orville Wright, Mr. Charles Harding, Mr. W. F. Reid, &c. These names vouch for the general high standard of the proceedings of the society in recent years.

While making these criticisms on Prof. Bryan's remarks, I sincerely hope he will continue his own epoch-making aëronautical researches, for the sake of aëronautical science and for the honour of the Aëronautical Society, of which he is a member.

Airth, Sunningdale, June 14. ERIC STUART BRUCE.

I HAVE no desire to do injustice to the Aëronautical Society, neither do I expect its proceedings to be free from all errors. But in view of the fact that mathematical formulæ and physical considerations now frequently enter into papers bearing on aëronautics, I consider that the time has come when the society should realise the importance of dealing more efficiently with papers of a theoretical character than was necessary formerly. As I have communicated my views on this point to the society through Mr. Bruce, a detailed reply may be unnecessary.

I do not wish all aëronauts to be profound mathematicians. I consider that papers dealing with practical aëronautics have been the most valuable feature of the society's work. Many of the eminent writers to whom Mr. Bruce refers have dealt with the practical and experimental rather than the theoretical side of the subject. Further, a distinction must be drawn between inaccuracies made in discourses or discussions at meetings and those which are allowed to find their way uncorrected into print. But when papers are published in a scientific society's journal which deal with questions of a theoretical character or contain formulæ, it is not unreasonable to expect that the authors shall correctly state and properly apply such principles of mathematics, physics, and mechanics as are found in ordinary text-books, and I trust that, as the result of this correspondence, the exceptions will be less frequent in the future than they have been in the past.

May I, in answer to very numerous inquiries, state with regret that it has been impossible, as yet, to publish a detailed account of my Royal Institution lectures, and some time will elapse before the work in which I am interested is in a suitable form for publication?

G. H. BRYAN.

THE DARWIN CELEBRATIONS AT CAMBRIDGE.

A GENERAL account of the proceedings of the Darwin celebrations at Cambridge on June 22–24, and a list of distinguished delegates and other representatives of science who came from the four corners of the earth to proclaim the greatness of Charles Darwin and his work, was given in last week's NATURE. As the chief speeches were delivered on the day we went to press, and on Thursday last, we were prevented from including any report of them in the article, which, however, we are now able to supplement. Short speeches were made in the Senate House on June 23, when the delegates were received by the Chancellor, Lord Rayleigh, and the addresses were presented; and also at the banquet given in the evening of that day.

Eloquent as this testimony was of the universal recognition of Darwin's influence upon scientific work and thought, the scenes in the Senate House and in the new examination hall where the great banquet was held were even more impressive. In each place there was an assembly of naturalists gathered from far and near charged with the spirit which animated Darwin, and alert to respond to any note of appreciation of the man or his work. As more than one speaker remarked, what Newton did to reduce celestial movements to law and order by his discovery of the law of gravitation, Darwin did for the more complex world of animate things. All bodies in the material universe are bound together by the bond of gravitational attraction which decides their past, present, or future paths; and in a similar way the unifying influence in the organic world is the principle of evolution established upon the foundation of natural selection.

The character and dignity of the celebration made a permanent impression upon the minds of all who were fortunate enough to take part in it, and the occasion has been made memorable for the scientific world in general by the publication of a number of works relating to it. One of these, on "Darwin and Modern Science," was noticed in detail last week, and we now take the opportunity of referring to others.

PUBLICATIONS OF THE DARWIN CENTENARY.

Each delegate was furnished with a copy of two publications which will be of lasting value as souvenirs of this memorable occasion. Perhaps the most remarkable of the publications is the beautifully printed volume issued by the Cambridge University Press under the title of "The Foundations of the Origin of Species." This contains the brief abstract of the theory of natural selection written by Charles Darwin in June, 1842, sixteen years before the famous meeting of the Linnean Society at which the theory was first made known to the scientific world. The MS. of 1842, which was afterwards expanded by its author into the essay of 1844, consists of thirty-five pages written in pencil. It had been "hidden in a cupboard under the stairs, and only came to light in 1896 when the house at Down was vacated." It was, as the editor says, evidently written rapidly, and is in Darwin's most elliptical style, with much erasure and correction, the whole being "more like hasty memoranda of what was clear to himself than material for the convincing of others." Mr. Francis Darwin has laid the scientific public under an immense obligation by his admirable introduction and notes, and by the care he has taken that readers should be able to study the sketch exactly as it stood in its original form. Each of the delegates present at the celebration received a copy of this most valuable work, the importance of which in the history of evolutionary theory it would hardly be possible to overestimate.

In addition to this work, a second volume, admirably printed by the University Press, was put into the hands of the guests at the commemoration. This production, which is purchasable by the public at the price of two shillings and sixpence, is entitled "Order of the Proceedings at the Darwin Celebration held at Cambridge, June 22–June 24, 1909; with a Sketch of Darwin's Life." It opens with a brief preface, which records the names of the committee—to whom many congratulations are due for the successful issue of their labours—and also narrates the steps that were taken, beginning with a meeting of the council of the Senate in December, 1907, to organise a celebration worthy of the man who has revolutionised science, and whose influence has made itself felt as a power and an inspiration in every department of intellectual activity. Following the programme of the commemoration proceedings comes a very interesting sketch of Darwin's life, which gives in brief compass the principal events of his career, and the dates of the publication of his various works. This short biography, in the preparation of which the secretaries to the committee acknowledge the assistance they have received from Mr. Francis Darwin, is rendered especially valuable by well-chosen quotations from the "Life and Letters," and from the appreciative comments of Judd, Lyell, Huxley, Schwalbe, Goebel, and Thiselton-Dyer. Good photographic views are given of Darwin's birthplace at Shrewsbury, of the exterior of his rooms at Christ's College, of his house and favourite "Sandwalk" at Down. There are also reproductions of several of the well-known portraits of Darwin and of his wife, including a picture of Charles Darwin and his sister Catherine as children. An excellent likeness of Sir Joseph Hooker, taken in 1897, and an interesting print of H.M.S. *Beagle* in the Straits of Magellan, complete the series.

The Rede lecture on "Charles Darwin as Geologist," delivered by Sir Archibald Geikie, K.C.B., on June 24, has been published also by the University Press, with notes, at the price of two shillings net. Reference was first made in the lecture to the early geological interests of Darwin and the formative influence of Lyell upon his mind. The first volume of Lyell's "Principles of Geology" was published early in 1830. Darwin took the book with him on his voyage in the *Beagle* and studied it, with a result that changed his opinions and began the life-long indebtedness to Lyell which he so sincerely felt and never ceased to express. In four distinct departments Darwin enriched the science of geology with new material during the voyage of the *Beagle*. First, he added to our knowledge of the volcanic history of the globe. Secondly, he brought forward a body of striking evidence as to the upward and downward movements of the terrestrial crust, and drew from this evidence some of the most impressive deductions to be found in the whole range of geological literature. In the third place, he made important observations on the geology of South America; and, finally, he furnished new and interesting illustrations of the potent part taken by the denuding agents of nature in effecting the decay and disintegration of the land. Sir Archibald Geikie proceeded to review Darwin's work under each of these four heads, and to express his appreciation of it. Finally, he sketched the later geological work carried out by Darwin and the geological side of "The Origin of Species."

Another noteworthy outcome of the present commemoration is the special Darwin centenary number of the *Christ's College Magazine*.

The proceedings on June 23 were opened in the Senate House by the following address from the Chancellor of the University, Lord Rayleigh.

THE CHANCELLOR'S ADDRESS.

In opening the proceedings to-day I must first, in the name of the University, bid welcome to the delegates and other guests who have honoured us by their presence. A glance at the list will show that we have assembled here distinguished men from all parts of the world who have willingly responded to our invitation; and, indeed, the occasion is no ordinary one. We have met to celebrate the centenary of the birth of Charles Darwin and the fiftieth anniversary of the publication of the "Origin of Species." I am old enough to remember something of the stir caused by the latter event. To many the results of Darwin's speculations were unwelcome, and it must be confessed remain so, at least in their application to the origin of man. Fifty years ago it would have been thought a strange prophesy if anyone had predicted to-day's celebration. We may perhaps take it as proven that Cambridge is not held so fast in the bonds of mediævalism as some would have us suppose. We are prepared to face whatever strict methods of investigation may teach to be the truth. I need not remind you that on many important questions raised by Darwin's labours opinions still differ, and I imagine that he would proudly recognise as disciples some of the distinguished biologists who meet here to do honour to his name. I do not attempt even the briefest survey of these labours. We shall presently hear appreciations from men of distinction well qualified to instruct us. What appeals to all is the character of the man, loved by everyone who knew him, and admired by everyone with a spark of the scientific spirit. It is a pleasure and a stimulus to think of him, working on in spite of ill-health in his study, in his garden, and in his hot-houses, and from his retirement moving the minds of thinking men in a manner almost without parallel. I esteem myself fortunate that a visit nearly forty-one years ago, which I owed to my friend, now Sir G. Darwin, allows me to picture the scene. I was struck, as were others, with his wonderful modesty. On my propounding some difficulty in connection with colour vision and the theory which attributed the colours of flowers to the preference of insects, I remember that he asked time for consideration before making a reply. His enthusiasm also impressed me much. This characteristic must have remained. Commenting on it only a short time before the death of both of them, Frank Balfour, himself a strenuous and sympathetic worker, remarked to me that he wished he could be as much interested in his own subject as Darwin was in other people's subjects.

During the last generation Cambridge has been active in biological work. We have the men and the ideas, but the difficulty has always been lack of funds. At the present time it is desired, among other things, to establish a chair of genetics, a subject closely associated with the name of Darwin and of his relative Francis Galton, and of the greatest possible importance, whether it be regarded from the purely scientific or from the practical side. I should like to think that the interest aroused by this celebration would have a practical outcome in better provision for the further cultivation in his own university and in that of his sons of the field wherein Darwin laboured.

At the conclusion of the Chancellor's address the presentation took place of the addresses by delegates from America, Austria-Hungary, Belgium, Denmark, Egypt, France, Germany, Greece, Holland, and Italy. Short speeches were then delivered by Prof. O. Hertwig and Prof. E. Metchnikoff.

PROF. HERTWIG referred to the influence of Darwin's work upon German biology, particularly at Jena. It was through Haeckel, who hailed Darwinism with delight, and said that evolution was the key of man's destiny, that the theory became predominant in German science. It had been the starting point for all the researches of the younger men, and had entered into the life of the German people. Earlier this year festivals in commemoration of Darwin's work were held in Hamburg, Munich, Frankfurt, and other towns in Germany. The celebration at Cambridge was the acme of these festivals, and would give an immense stimulus to the scientific work of the delegates privileged to be present at it. The influence of Cambridge upon Darwin was great and beneficial, and particular mention must be made of the encouragement received from Henslow. Three bright stars had appeared in the scientific firmament of the University, the last being Darwin and the two others Harvey and Newton.

PROF. METCHNIKOFF in his address referred to the debt which medical science owes to the theory of organic evolution founded by Darwin. Diseases undergo evolution in accordance with the Darwinian law, and the recognition of this fact led to the science of comparative pathology. It is possible definitely to show that inflammation is an act of defence on the part of the organism against morbid agents, and that this reaction is effected by certain cellular elements, together with a complicated and wonderful nervous and vascular mechanism. The same elements play an important part in resisting disease. The preponderating influence of the cellular action in the mechanism of immunity is admitted by the great majority of observers. Recently experimental medicine has been investigating the phenomena of adaptation in pathogenic microbes, by virtue of which we are able to attack the organism in spite of its defensive powers, and this is most probably effected by the selection of individual microbes endowed with special properties. This has happened with the micro-organism of recurrent fever. With regard to cancer, the theory must be rejected that it is caused by stray embryonic cells, shut off and remaining latent, on the ground of evolution, because the lower animals, which also possess embryonic cells, never suffer from malignant growths except when they are provoked by external agents. It is therefore very probable that cancer in man is equally caused by some external agent, some virus which has been diligently sought, but has not yet been found.

Addresses were then presented by delegates from Japan, Norway, Portugal, Russia, Spain, Sweden, and Switzerland, and by delegates from the British colonies and the British Isles. After the English delegates had been presented, Sir Archibald Geikie, K.C.B., president of the Royal Society, said that the society desired to mark the importance of that occasion by having a special copy of the Darwin medal struck in gold for the acceptance of the University. It will be remembered that the medal owes its existence to the committee of the International Darwin Memorial Fund, which in 1885 transferred to the Royal Society the balance of the fund, in trust, to devote the proceeds from time to time toward the promotion of biological studies and research. The first award was made to Dr. Alfred Russel Wallace in 1890. Lord Rayleigh was the secretary of the society when the medal was cast. It was, therefore, Sir Archibald Geikie continued, a very great pleasure to the Royal Society to have it in its power to hand to Lord Rayleigh, for acceptance of the University, a copy of the Darwin medal.

The following address was then delivered by Dr. Henry Fairfield Osborn, the delegate of the American Philosophical Society:—

PROF. HENRY F. OSBORN.

Crossing the Atlantic in honour of Darwin and rejoicing in the privilege of uniting in this celebration of his birth, we desire, first of all, to render our tribute to the University of Cambridge.

To no other institution in any country may we turn with such a sense of filial gratitude. In ever widening growth has been the influence of the Cambridge heritage, as pictured more than four centuries ago in the generous mind of Sir Walter Mildmay, the founder of Emmanuel. "Sir Walter," remarked Queen Elizabeth, "I hear that you have erected a Puritan foundation." "No, madam,"

he replied, "far be it from me to countenance anything contrary to your established laws; but I have set an acorn, which, when it becomes an oak, God alone knows what will be the fruit thereof." Through John Harvard, of Emmanuel, Cambridge became the mother of our colleges. Did not Emmanuel beget Harvard, and Harvard beget Yale, and Harvard and Yale beget Princeton and other descendants to the third and fourth generation? We thus salute to-day the venerable but ever youthful ancestor of many of the American universities, academies, and institutes of science, national and State museums, represented here, and in large part guided by true sons of the true daughters of the Alma Mater on the Cam. Through the survival of the best our political guidance is also passing more and more into the hands of men trained in these same daughter colleges. A son of Yale succeeds a son of Harvard as President of the United States. If your university men are leading the Empire ours are leading the nation.

Noble offspring, too, of the many pious foundations of the old University, of Trinity, of Christ's, are the great men too numerous to name, among whom there especially rise in our minds Newton, Clerk-Maxwell, Balfour, and, above all, Darwin. Newton opened to us the new heavens and Darwin the new earth. Clerk-Maxwell, with Hertz, enabled us to converse across the sea through the blue æther. The well-beloved Balfour set forth Darwinism in embryology; would that his life had been spared for the more difficult problems of our day. If in our hours of struggle with the mysteries of nature these are our leaders and companions, so in our hours of ease and relaxation do we not turn again to sons of Cambridge for spiritual refreshment, to the verse of Milton, of Byron, of Wordsworth and Tennyson, all richly imbued with the nature spirit, or to the no less masterly prose of Thackeray and Macaulay?

Far away are the giant forces of our Republic, the roar of her machinery and her world of trade, yet more apparent than real is the independence of her development. There still prevails the potent unifying influence of mind and motive, bred in quiet places like this, ever creating new generations of leaders in science, in literature, and in government, and ever renewing the strong bonds of friendship and of union.

What can we add to the chorus of appreciation of the great pupil of Christ's, which has come from American college, Press, and pulpit, since the opening of this anniversary year? Only a few words of personal impression.

To us Darwin, more perhaps than any other naturalist, seems greatest in the union of a high order of genius with rare simplicity and transparency of thought. Dwelling on this lucid quality and on the vast range of his observation, from the most minute to the grandest relations in nature, does not the image arise of a perfected optical instrument, in which all personal equation, aberration, and refraction is eliminated, and through which, as it were, we gaze with a new vision into the marvellous forms and processes of the living world? With this wondrous lens our countrymen Cope and Marsh penetrated far deeper into fossil life than their predecessor Joseph Leidy—thus the arid deserts of the Rocky Mountains gave up their petrified dead as proofs of Darwinism. Through its new powers Hyatt, Morse, Packard, and Brooks saw far more than their master Louis Agassiz, and drew fresh proofs of the law of descent from the historic waters of New England. From the very end of the new world, where the youthful Darwin received his first impressions of the mutability of the forms of life, came a clearer vision of the ancient life of Patagonia.

The new vision opened upon a period of great men; and this again suggests a reminiscence. Thirty years ago two of the present delegates arrived in Cambridge as students. They heard Clerk-Maxwell developing his theories before the Cambridge Philosophical Society. Michael Foster was in his prime and lecturing in his inimitable manner. Francis Maitland Balfour had just completed his "Elasmobranch Fishes," and was working five hours a day on his "Comparative Embryology"; his lectures were brilliant and inspiring; his relations with students altogether ideal; in his rooms, among many others, one met Lankester and Moseley, and enjoyed a rare flow of conversation on all subjects except biology. Either as students or as young instructors were Sedgwick, Forbes, Shipley, Weldon, Haddon, Harmer, and others. In this Senate House Robert Browning, Spottiswoode, president of the Royal Society, and Huxley received their honorary degrees. Throughout the winter Huxley was delivering his remarkable lectures, "Darwinism in Comparative Anatomy," suggestive and with occasional flashes of humour, still strong and full of fire, but beginning to show the effect of years of overwork, of public service, and research. About once a week he came among his students. One day an unusual stir or thrill passed along the tables as with him entered Darwin, his first and only visit to a modern biological laboratory. Darwin paused for a few moments' conversation, and one received the strong impression of a ruddy face, benevolent blue eyes, very deep-set beneath the massive overhanging brow—a wonderful effect of kindliness and of the far-off world survey of a great naturalist.

What of Darwin's influence in the future? While it is doubtful if human speculation about life can ever again be so tangential or so astray on ultimate causes as in the pre-Darwinian past of fifty years ago, it is probable, in fact it is daily becoming more evident, that the destiny of speculation is less the tangent than the maze—the maze of several lesser principles, with as many prophets calling to us to seek this turning or that. There are those who, in loyal advocacy of his system, feel that we shall not get much nearer life than Darwin did; but this is to abandon his progressive leadership, for if ever a master defined the unknown and pointed the way of investigation, certainly it was Darwin. In the wonderful round of addresses in his honour of this centennial year and in the renewed critical study of his life and writings, the recognition that Darwin opened the way has come to many with the force of a fresh discovery. It is true that he left a system, and that he loved it as his own, but his forceful, self-unsparing, and suggestive criticisms show that if he were living in these days of Waagen, of Welsmann, of Mendel, and of de Vries, he would be in the front line of inquiry, armed with inventive genius, with matchless assemblage of fact, with experiment and verification, and not least with incomparable candour and good-will. This bequest of a noble method is hardly less precious than the immortal content of the "Origin of Species" itself.

In conclusion, we delegates, naturalists, and friends, desire to present to Christ's College, as a memorial of our visit, a portrait of Charles Darwin in bronze, the work of our countryman William Couper, a portrait which we trust will convey to this and future generations of Cambridge students some impression of the rugged simplicity, as well as of the intellectual grandeur, of the man we revere and honour.

The speech next delivered by Sir Ray Lankester was an eloquent appreciation of Darwin's work and an unequivocal vindication of the theory of the origin of species by the preservation of minute variations favourable to existence under prevailing natural conditions.

SIR RAY LANKESTER, K.C.B., F.R.S.

I feel it a great honour to be called upon to speak here to-day, and to stand, on behalf of the naturalists of the British Empire, by the side of the distinguished men whose orations you have just heard.

I think that the one thing about Charles Darwin which the large majority of British naturalists would wish to be to-day proclaimed, in the first place—with no doubtful or qualifying phrase—is that, in their judgment, after these fifty years of examination and testing, his "theory of the origin of species by means of natural selection or the preservation of favoured races in the struggle for life" remains whole and sound and convincing, in spite of every attempt to upset it.

I am not stating more than the simple truth when I say that, in the judgment of those who are best acquainted with living things in their actual living surroundings, "natural selection" retains the position which Mr. Darwin

claimed for it of being the main means of the modification of organic forms.

Our admiration for the vast series of beautiful observations and interesting inquiries carried out by Darwin during his long life must not lead us to forget that they were devised by him in order to test the truth of his theory and to meet objections to it, and that they were triumphantly successful. They, together with the work of Alfred Russel Wallace and many of their followers, have more and more firmly established Darwin's theory. On the other hand, no attempt to amend that theory in any essential particular has been successful.

The nature of organic variation and of the character of the variations upon which natural selection can and does act was not, as we are sometimes asked to believe, neglected or misapprehended by Darwin. The notion that these variations are large and sudden was considered by him, and for reasons set forth by him at considerable length rejected. That notion has in recent years been resuscitated, but its truth has not been rendered probable by evidence either of such an accurate character or of such pertinence as would justify the rejection of Darwin's fundamental conception of the importance of minute and ubiquitous variations.

Further, in regard to the important facts of heredity connected with the cross-breeding of cultivated varieties, especially in regard to the blending or non-blending of their characters in their offspring and as to prepotency, it seems to me important that we should now and here call to mind the full and careful consideration given to this subject by Darwin. We cannot doubt that he would have been deeply interested in the numerical and statistical results associated with the name of Mendel. Those results tend to throw light on the mechanisms concerned in hereditary transmission, but it cannot be shown that they are opposed in any way to the truth of Darwin's great theoretical structure—his doctrine of the origin of species.

It has often been urged against Darwin that he did not explain the origin of variation, and especially that he has not shown how variations of sufficient moment to be selected for preservation in the struggle for existence have in the first place originated. The brief reply to the first objection is that variation is a common attribute of many natural substances of which living matter is only one. In regard to the second point, I desire to remind this assembly that Darwin described with special emphasis instances of what he calls "correlated variability." In my opinion he has thus furnished the key to the explanation of what are called useless specific characters and of incipient organs. That key consists in the fact that a general physiological property or character of utility is often selected and perpetuated, which carries with it distinct, even remote, correlated growths and peculiarities obvious to our eyes, yet having no functional value. At a later stage in the history of such a form these correlated growths may acquire value and become the subject of selection.

It is thus, as it seems to me, and as, I believe, to the great body of my brother naturalists, that Darwin's theory stands after fifty years of trial and application.

The greatness of Charles Darwin's work is, and will be for ever, one of the glories of the University of Cambridge. It is fitting on the present occasion that one who speaks on behalf of English men of science should call to mind the nature of his connection with this great University and the peculiarly English features of his life-story and of that fine character which endears his memory to all of us as much as his genius excites our admiration and reverence. Darwin was not, like so many a distinguished son of Cambridge, a scholar or a fellow of his college, nor a professor of the University. His connection with the University and the influence which it had upon his life belong to a tradition and a system which have survived longer in our old English universities than in those of other lands. Darwin entered the University, not seeking a special course of study with the view of professional training, nor aiming at success in competitive examinations for honours and emolument. He came to Cambridge intending to become a clergyman, but blessed with sufficient means and leisure to enable him to pursue his own devices, to collect beetles, to explore the fen country, and to cultivate his love of nature. It was thus that he became acquainted with that rare spirit Henslow, the Cambridge professor of botany, and it is through Henslow and the influence of his splendid abilities and high personal character upon Darwin that Cambridge acquired the right to claim the author of the "Origin of Species" as a product of her beneficence and activity as a seat of learning.

As an Oxford man and a member of Exeter College, I may remind this assembly that in precisely the same way Darwin's dearest friend and elder brother in science, Charles Lyell, had a few years earlier entered at Exeter College, and by happy chance fallen under the influence of the enthusiastic Buckland, the University reader in geology and a Canon of Christ Church. The wise freedom of study permitted and provided for in those long-passed days by Oxford and Cambridge is what has given the right to claim the discovery, if not the making, of Lyell to the one and of Darwin to the other.

Darwin's love of living nature and of the country life are especially English characteristics; so, too, I venture to think, are the unflinching determination and simple courage—I may even say the audacity—with which he acquired, after he had left the University, the wide range of detailed knowledge in various branches of science which he found necessary in order to deal with the problem of the origin of the species of plants and animals, the investigation of which became his passion.

The unselfish generosity and delicacy of feeling which marked Darwin's relations with a younger naturalist, Alfred Russel Wallace, are known to all. I cannot let this occasion pass without citing those words of his which tell us most clearly what manner of man he was and add to his splendid achievements as an intellectual force—a light and a beauty of which every Englishman must be proud. When in old age he surveyed his life's work he wrote:—"I believe that I have acted rightly in steadily following and devoting my life to science."

To have desired to act "rightly" and to be able to think of success in life as measured by the fulfilment of that desire is the indication and warrant of true greatness of character. We Englishmen have ever loved to recognise this noble kind of devotion in our national heroes.

In connection with the celebration, several learned bodies conferred honours upon the Chancellor, and upon Mr. Francis Darwin, F.R.S., and Sir George Darwin, K.C.B., F.R.S. Among these marks of recognition were the following:—Lord Rayleigh (Chancellor), corresponding member of the Senkenbergische Naturforschende Gesellschaft, Frankfurt-am-Main, and honorary member of the University of Moscow; Mr. Francis Darwin, member of the American Philosophical Society, foreign member of the Société Hollandaise des Sciences, corresponding member of the Senkenbergische Naturforschende Gesellschaft, Frankfurt-am-Main, honorary member of the Soc. Cæs. Naturæ Curiosorum, Moscow, honorary member of the University of Moscow, and Fellow of the Kaiserliche Leopoldinisch-Carolinische Deutsche Akademie der Naturforscher, Halle; Sir George Darwin, corresponding member of the Senkenbergische Naturforschende Gesellschaft, honorary member of the Soc. Cæs. Naturæ Curiosorum, Moscow, honorary member of the University of Moscow, and Fellow of the Kaiserliche Leopoldinisch-Carolinische Deutsche Akademie der Naturforscher, Halle.

Speeches at the Banquet.

At the banquet on June 23 Mr. Balfour and Prof. Svante Arrhenius proposed the toast which was drunk in silence to the memory of Darwin. In the course of his remarks Mr. Balfour said:—

Charles Darwin's performances have now become part of the common intellectual inheritance of every man of education wherever he lives or whatever his occupation or

trade in life. To him we trace in the main the view which has affected, not merely our ideas of the development of living organisms, but our ideas upon politics, upon sociology, ideas which cover the whole domain of human terrestrial activity. He is the fount and origin, and he will stand for all time as the man who has made this great, and, as I think, beneficent revolution in the mode in which educated men can see the history, not merely of their own institutions, not merely of their own race, but of everything which has that unexplained attribute of life, everything that lives on the surface of the globe or within the depths of the ocean. He is the Newton of this great department of human research, and to him we look, as we looked to Newton, to measure out heavens or to weigh suns and their attendant planets. After all, the branch of research which he initiated is surely the most difficult of all. I talk of measuring heavens and weighing suns, but surely these are tasks incomparably easy compared with the problem that attracts the physiologist and the morphologist in dealing with the living cell, be it plant, or animal, or man. That problem of life is one which it is impossible for us to evade, which it may be impossible for us ultimately to solve, but in dealing with which in its larger manifestations Charles Darwin made greater strides than any man in the history of the world has made before or any man has made since.

Prof. Arrhenius then spoke as follows :—

Evolutional ideas are as old as human civilisation. We find traces of them in old Egyptian legends of the growth of mankind, in Hindu myths, as well as in the cosmogony of Herod and in Ovid's Metamorphoses. During the lapse of centuries they were developed by philosophers and astronomers, *i.e.* by the men of the oldest sciences; and in the eighteenth century, when most modern sciences took a distinct shape, those ideas formed important parts of the scientific work of Kant, and still more in the admirable theoretical speculations of Lamarck. But still the finalist school, founded on primitive and mediæval considerations, was in the highest degree preponderant; and the leading biologist at the end of that century, Cuvier, had no conception of evolutionism. Even in Kant's works we find the finalistic ideas prevailing.

To accomplish the now prevailing evolutionary ideas a great work was necessary, in order that these should be developed into a system embracing all the biological sciences with the strictest logic and severest criticism. The attempts made at the beginning of the nineteenth century by many scientific men, amongst whom the name of Charles Darwin's grandfather, Erasmus Darwin, may be recalled, were far from sufficient. The epoch-making work was delivered by Charles Darwin, who, with an unrivalled patience and diligence, as well as a rare impartiality, during nearly thirty years, collected and sifted the enormous material upon which is based his masterly work "The Origin of Species."

It must be said that the time was ripe for the triumph of the conception of evolution, as is clearly indicated by the simultaneous work of Wallace on biology and by the publication of Herbert Spencer's philosophical investigations. Charles Darwin was also immediately followed by enthusiastic and prominent adherers, such as Huxley and Haeckel, who propagated and worked out the new doctrines.

This rapid success also caused a strong reaction from the side of the representatives of the old finalistic ideas, grown strong through centuries. The battle fought between the two parties carried the new ideas into common life, far from the men of science and the philosophers' study. During the last decade of his life Darwin had the good fortune to see his ideas brought to definite victory and generally accepted, not only in the vast domain of biology, which has been spoken of so eloquently this morning, but even by scientific men in general, and by the enlightened public opinion.

Charles Darwin had a clear perception of the far-reaching importance of his ideas. He applied them in elaborate investigations concerning the development of the intellectual and reflective faculties, to the formation of primitive social ideas amongst animals and men, to the genesis of the most elementary moral and religious conceptions, as well as to the fundamental problems of anthropology.

The more these various questions have been discussed the more the doctrine of evolution has grown in strength, and the greater has been the extent to which science has been brought under its beneficent influence. Nowadays there is hardly a science which has not been affected and in many cases thoroughly permeated by it. The sociological and statistical sciences now rest on an evolutional basis; history, and especially the history of culture, has found through it new lines of development; the linguist tries to find the natural laws of development of languages; the lawyer sees the legislative work of past generations and foresees their future modifications from the standpoint of evolution; the criminalist seeks the sources of crime in the influence of heredity and environment; and even the theologian, who for so long a time rejected the new ideas, finds now in them essential points of high ethical charm which he seeks to reconcile with true religion. At the same time, the investigators in exact sciences, where the doctrine of evolution had been adopted earlier than in biological sciences, were inspired to new and successful efforts to use it, as is, for example, obvious from the researches of Sir George Darwin, who, as well as the other members of the family, is a brilliant example of the heredity of intellectual properties.

Science is international; and this momentous movement has been felt in every country in the civilised world. Therefore we, representatives of all sciences, have come from all parts of the world to join you in doing homage to the memory of the greatest of all evolutionists.

All of us are profoundly sensible that the great intellectual revolution which is due to the introduction of evolutionism is the most important event in the development of the human mind, since the mighty political movement which began with the storming of the Bastille 120 years ago. There is, however, this significant difference between that time and this, that whereas in such a period every mighty change in the social, political, and intellectual development of mankind was only effected by strife and horrors of war, to-day, thanks to the civilising progress, this change has been accomplished by reason and persuasion. "The pen has been mightier than the sword." How much may we not congratulate ourselves that we have lived in such a period? In reality, the doctrine of evolution is inconsistent with violence, and we may hope, therefore, that it will give a mighty impetus to the maintenance of peace and a good understanding between civilised nations.

In conclusion, let me say that in thus venerating Darwin's memory all men of science regard him, not only as an ideal man of science, but as a man of science whose power and influence have been enhanced by his integrity and moral worth.

In replying to the toast, Mr. W. Erasmus Darwin related some interesting incidents as to Darwin's kindly and considerate nature in his home life. The toast of "The University of Cambridge" was proposed by Prof. E. B. Poulton, F.R.S., who asked whether the comparative freedom enjoyed by Darwin in his college life would be possible in these days of examination pressure. The vice-chancellor, in responding to the toast, said it was hoped that Dr. Wallace would attend the celebration and receive an honorary degree at Cambridge, but his health would not permit him to accept the invitation. The suggestion had been made (we understand it came from Prof. Meldola) that a message should be sent to Dr. Wallace; and the vice-chancellor announced that the following telegram had been sent:—"The naturalists, assembled at Cambridge for the Darwin celebration, cannot forget your share in the great work which they are commemorating, and regret your inability to be present."

On Thursday, June 24, the concluding day of the celebration, honorary degrees were conferred upon twenty-one of the delegates, and Sir Archibald Geikie delivered the Rede lecture already mentioned. The

Public Orator, Dr. Sandys, spoke as follows in presenting the several distinguished recipients of the degree of Doctor of Science *honoris causa* :—

PRINCE ROLAND BONAPARTE.—Agmen honorum nostrorum ducit hodie imperatoris magni fratris natu minoris nepos, cuius avunculi insignes scientiarum e provinciis inter se diversis palmas plurimas tulerunt. Ipse, Francogallorum in Republica maxima, et Instituti celeberrimi socius et Societatis Geographicae praeses iure optimo est electus. Olim geologiae, botanicae, zoologiae, anthropologiae studiis non sine gloria deditus, non modo gentis suae incunabula, insulam Corsicam, sed etiam orientem versus solem insulas remotiores victor felix exploravit. Idem orbis veteris e scientiarum castris trans aequor Atlanticum pacis satelles est profectus, velut alter Caesar

"victrices aquilas alium laturus in orbem."[1]

EDOUARD VAN BENEDEN, PROFESSOR OF ZOOLOGY AT LIÈGE.—Ductori nostro proximus progreditur Belgarum e gente vicina, Leodiensium ex Universitate insigni, professor praeclarus, Biologiae Archivorum fundator, cytologiae hodiernae conditor, qui, in opere singulari de *Ascaride megalocephala* conscripto, utriusque sexus cellularum nucleos etiam in morphologia idem valere diligenter demonstravit. Idem de vespertilionum, rodentium, crustaceorum, tunicatorum embryologia, deque *Dicyemidorum* formis egregie disputavit. Atqui haec omnia nonnullis vestrum quam nobis notiora sunt; illud autem nobis non ignotum, zoologiae professorem tam illustrem Francisci Balfourii nostri amicum olim fidelem fuisse.

OTTO BÜTSCHLI, PROFESSOR OF ZOOLOGY AT HEIDELBERG.—Zoologiae professorem Heidelbergensem ovi cellulae in auctu investigando plurimis praecursorem praeclarum exstitisse constat. Idem *Infusoriorum* de vita tota, cellularum binarum praesertim de coniugatione, opus egregium conscripsit; in aliorum et sui ipsius circa *Protozoa* laboribus recensendis, ceteros superavit; etiam bacteriorum ipsam structuram explicavit; porro, in *Protozois* et *Protophytis* illis quae nomine uno *Protista* appellantur, amylum quomodo conformatum, quomodo distributum sit, aperte demonstravit; olim denique, non sine labore multo et minuto, *protoplasma* non iam reticulatam sed alveolarem quandam formam spumeam habere comprobavit. Nonnullorum fama cito peritura, velut spuma in fluctibus summis evanescit; viri huius in rerum natura penitus exploranda virtutem, "merses profundo; pulchrior evenit."[2]

ROBERT CHODAT, PROFESSOR OF BOTANY AT GENEVA.—Genevensi in Universitate, abhinc annos plus quam centum, plantarum physiologiae chemicae scientiam condidit vir illustris, Horatius Benedictus de Saussure. In eadem doctrinae sede viri tanti vestigiis summa cum laude insistit botanicae professor insignis, quem hodie salutamus. Scientiae illius de principiis praeclare disputavit; experimentis plurimis adhibitis, plantarum cotidie crescentium leges explicavit; fermentorum denique in plantis naturam ipsam patefecit. Idem, florum in scientia universa sollertissimus, non modo herbario celeberrimo inter populares suos praefuit, sed etiam algas virides minutissimas illas, quae patriae pulcherrimae lacus immensos incolunt, arte eximia depinxit, libro egregio descripsit.

FRANCIS DARWIN, HONORARY FELLOW OF CHRIST'S COLLEGE.—Patris illustris e filiis insignibus adest unus, qui patris cum operibus consociatus ultimis, viri tanti vitam et litteras diei in lucem non sine laude protulit. Botanicae provincia physiologica et libris et experimentis suis inter nosmet ipsos praeclare propagata, patris a Collegio propterea honoris causa socius merito est nominatus. Nuper, in libro egregio patris sui in honorem a plurimis conscripto, ipse et patris et sua et aliorum de motibus plantarum inventa luculenter perlustravit. Idem in anno praeterito Societatis Britannicae scientiarum finibus proferendis disputationes oratione egregia auspicatus, plantarum in motibus explicandis, plantis ipsis annorum volventium in serie memoriam quandam tribuebat. Hanc potissimum ob causam, non modo patris, sed etiam proavi, Florae poëtae eximii, ingenium praeclarum utriusque in progenie revixisse crediderim.

KARL F. VON GOEBEL, PROFESSOR OF BOTANY IN MUNICH.—Bavaria ad nos misit Florae ministrum insignem Monacensem, qui, post peregrinationes longinquas in India, in Venezuela, in Australia toleratas, de studiis suis pulcherrimis cum oratore Romano potest dicere :—"haec studia delectant domi; haec studia nobiscum peregrinantur."[1] Florum de biologia universo, florum de formis inter se diversis et originis et loci e natura varia exortis, florum de partibus minutissimis accuratissime describendis, quam praeclare meritus est! Darwini nostri de florum scientia inventa insignia quam penitus perscrutatus est; etiam ipse rerum naturae provinciae illius pulcherrimae in penetralia intima quam feliciter penetravit!

LUDWIG VON GRAFF, PROFESSOR OF ZOOLOGY AT GRAZ.—Salutamus deinceps virum genere insigni natum, Academiae et Berolinensis et Vindobonensis socium, in Universitate Graecina zoologiae professorem iucundissimum, qui liliorum marinorum parasiti cuiusdam anatomiam impeditam primus explicavit; quique non modo opera tria egregia de *Turbellariis* conscripsit, sed etiam de animalium parasitis in universum praeclare disputavit. Hodie vero magis iucundum, immo magis opportunum est, orationem illam eximiam recordari, quam abhinc annos tredecim zoologiae post Darwinum nostrum fortunis describendis dedicavit. Quod autem ad annum proximum attinet, auguramur virum tanta benignitate, tanta comitate praeditum, gentium omnium zoologis in Universitatem suam convocatis praesidem fore sine dubio acceptissimum.

RICHARD HERTWIG, PROFESSOR OF ZOOLOGY IN MUNICH.—Zoologiae professorem insignem Monacensem deinceps contemplatus, protinus videor mihi ante oculos ponere "par nobile fratrum."[2] Cum fratre suo illustri Berolinensi consociatus, quem hodie praesentem honoris causa salutamus, *Medusarum* et *Polyporum* de nervis sensibusque, anemones marinae de embryologia et anatomia, cellularum in universum de morphologia et physiologia, animantium denique de corporis inferioris intervallo quodam interiore quod κοῖλον nominatur, plurima praeclare conscripsit. Ipse, non modo zoologiae studiosis encheiridion doctrinae variae plenum donavit, sed etiam peritiorum in usum de *Radiolariorum* morphologia, de *Actiniariis* a nostratibus e profundo mari reportatis, de *Protozoorum* denique structura vitaque tota, erudite disputavit. Per orbem terrarum totum nota est praeceptoris tanti schola zoologica Monacensis, ex qua, "tamquam ex equo Troiano,"[3] tot milites optimi exierunt.

HARALD HÖFFDING, PROFESSOR OF PHILOSOPHY AT COPENHAGEN.—Philosophiae professorem insignem Hauniensem Darwini in honorem legatum esse missum nemo mirabitur, qui ex opere eius novissimo didicit inter philosophiam et rerum naturae scientiam prorsus distinguere perquam esse arduum. Philosophiae in historia sua in tot linguas reddita, quid potissimum spectet, fortasse requiritis. Respondeo :—philosophi cuiusque personam. Etiam in psychologiae studio, quid praesertim praesumit? Personam. Deinde, religionis in philosophia, et officiorum in finibus proponendis, quid demum magis indies ante oculos nostros positum esse existimat? Ordinis magis continui adpetitio, partim in unaquaque persona, partim inter se diversis in personis. Quid denique professorem ipsum, non modo Reginae nostrae, populari suae, sed etiam amicis suis omnibus, tam amabilem reddit? Ipsius persona. Videtis virum sagacem, qui caritate summa adversus omnes imbutus, "omnia sperat";[4] quique ingenio bene temperato, animo bene librato praeditus, monitum illud Horatianum constanter conservat :—"aequam memento rebus in arduis servare mentem."[5]

JACQUES LOEB, PROFESSOR OF PHYSIOLOGY IN THE UNIVERSITY OF CALIFORNIA.—Oceani Pacifici a litore legatus ad nos advectus est Californiae in Universitate physiologiae professor, veritatis indagator pertinax, qui, experimentis exquisitis adhibitis, rerum earum, quarum in medio animalia versantur, effectus inter se diversos distinguere est conatus. Non modo de caloris sed etiam de coloris et luminis vi, de geminorum origine, echinorum denique de ovi maturitate aut sanguine iniecto aut sale infuso in maius exaucta, quam subtiliter disputavit! Etiam in alia rerum provincia, Horati in saeculo, Epicuri

[1] Lucan, v. 238. [2] Horace, *Carm.* iv. 4, 65.

[1] Cp. Cicero, *pro Archia*, 16. [2] Horace, *Serm.* ii. 3, 243.
[3] Cicero, *De Oratore*, ii. 04. [4] S. Pauli *Ep. ad Cor.* i, xiii. 7.
[5] *Carm.* ii. 3, 1.

(nisi fallor) sectator quidam tractabat "echinos, ut melius, muria."[1]

EDMOND PERRIER, DIRECTOR OF THE NATURAL HISTORY MUSEUM, PARIS.—Sequitur deinceps Francogallorum Instituti celeberrimi et Academiae Medicae socius insignis, qui historiae naturalis Museum Parisiense tutelae suae creditum optime ordinavit. Olim, in philosophiae zoologicae incrementis enarrandis, populari suo, Stephano Godofredo Saint-Hilaire, inter Darwini nostri praenuntios locum praeclarum vindicavit. Ipse postea zoologiae universae describendae opus eximium consecravit. Quid dicam de animalium coloniis ab eodem accuratissime examinatis? quid de vermibus terrenis, quid de maris Mediterranei liliis dilucide descriptis? Illud unum dixerim: mari profundo penitus explorando plus quam semel peregre praefuit, interque rerum naturae interpretes optimos exstitit, qui patriae in gloriam numquam perituram

"referebant navibus altis
occulta spolia, et plures de pace triumphos."[2]

GUSTAV ALBERT SCHWALBE, PROFESSOR OF ANATOMY AT STRASSBURG.—Anatomiae professor Argentoratensis, in Aegypto et in America Septentrionali orbis novi et orbis antiqui explorator, anthropologiae provinciam totam peragravit; sensuum humanorum rationem universam explicavit; hominum antiquissimorum capita et ossa hic et illic reperta accuratissime descripsit. Homo est; humani nil a se alienum putat.[3] Stilo perquam lucido praeditus, non modo *Hominem primigenium* sed etiam *Pithecanthropum erectum* litterarum monumentis mandavit. Atqui, si antiquas quoque litteras licet hodie recordari, non de hominis propinquo quodam paupere, non de simia quadam mentis sublimioris nescia, sed de homine ipso donis optimis divinitus donato poëtae antiqui verba illa dicta sunt:—

"os homini sublime dedit, caelumque tueri
iussit, et erectos ad sidera tollere vultus."[4]

HERMANN GRAF ZU SOLMS-LAUBACH, PROFESSOR OF BOTANY AT STRASSBURG.—Salutamus etiam botanicae professorem Argentoratensem, virum genere antiquo, genere per annos prope octingentos nobili oriundum, qui arborum et plantarum reliquias antiquissimas saxorum in latebris conservatas opere in illo eximio descripsit, quod etiam in Britannia palaeophytologiae ad studium aditus faciliores plurimis patefecit. Idem, non modo Actis Botanicis edendis iam per annos viginti feliciter interfuit, sed etiam ipse de geographiae botanicae principiis, de floribus parasitis, de fungis et algis, de sinus Neapolitani corallinis, de fragaria, de tritico, de tulipa, de ficu, de aliis denique hortorum nostrorum plantis plurima non sine gloria conscripsit.

"Patriam obruit olim
gloria paucorum, et laudis titulique cupido
haesuri saxis cinerum custodibus, ad quae
discutienda valent sterilis mala robora ficus";[5]

haec autem generis nobilis progenies, vir iucundus, lepidus, modestus, titulo nostro dignissimus, tot rebus ingenio summo penitus exploratis, omnium bonorum in laude "monumentum aere perennius" invenit.

CLEMENT TIMIRIAZEFF, PROFESSOR OF BOTANY IN MOSCOW.—Meministis fabulosum illum Collegiorum nostrorum unius alumnum, qui ad insulam *Laputa* peregrinatus, incolas eius omnes solis de salute cotidie sollicitos invenit, inque Academia celeberrima Lagadensi professorem quendam venerabilem vidit, qui solis radiis e cucumerum cellulis eliciendis annorum octo labores incassum impenderat. Consilium tam mirum non prorsus absurdum fuisse botanicae professor quidam Moscuensis coram Regia Societate nostra non sine lepore indicavit. Scilicet per longos labores ipse comprobavit non modo solis radios in cucumi esse inclusos, sed etiam fructuum frondiumque omnium partem viridem solis e lumine radios illos tremulos eligere, quorum auxilio carbonium (ut aiunt) in aëre toto diffusum in materiam quandam vivam permutat. Idem spectri (quod dicitur) e parte rubra radios illos exortos esse docuit, qui frondium in vitam mutati, omnium hominum, omnium animalium corpora per tot saecula aluerunt. Ergo de spectri illius exemplo pulcherrimo, de arcu caelesti, verba olim divinitus dicta saeculo nostro sensu novo denuo commendata sunt—"Erit arcus in nubibus, et recordabor foederis sempiterni quod pactum est inter Deum et omnem animam viventem universae carnis, quae est super terram."[1]

FRANTIŠEK VEJDOVSKÝ, PROFESSOR OF ZOOLOGY IN PRAGUE.—Bohemorum in Universitate Pragensi zoologiae professor praeclarus, patriae inter flumina lacusque, spongillarum vermiumque in varietate maxima, studiorum suorum argumenta plurima invenit. Idem, bacteriorum in structura investiganda, etiam nucleum secundum ipsam normam invenisse dicitur. Deinde, de nucleorum natura in universum, deque ovi fecundi reddendi ratione omni, nunc maxime inquirit. Denique, ne laudationis nostrae in fine aculeum quendam desideretis, ne scorpionum quidem genus intactum reliquit.

MAX VERWORN, PROFESSOR OF PHYSIOLOGY AT GÖTTINGEN.—Goettingensis Universitas, vinculo antiquo cum Britannis coniuncta, legatum ad nos misit physiologiae professorem insignem, virum ingenio versatili et multiplici praeditum, qui non modo archaeologiae regionem antiquissimam, aevi medii artes, scientiam denique numismaticam temporis subsicivi in deliciis habuit, sed etiam ante omnia scientiae illi magnae quae vitam universam investigat vitam prope totam dedicavit. Peritis notum est (ne minora commemorem) opus illud ingens annorum quattuordecim in spatio iam quinquies in lucem editum, in quo a cellulis singulis exorsus physiologiae provinciam totam ita peragravit, ut non modo scientiae ipsius historiam, philosophiam, psychologiam ipse suo Marte tractaverit, sed etiam aliorum inventa praeclara ingenii sui lumine illustraverit.

HERMANN VON VÖCHTING, PROFESSOR OF BOTANY AT TÜBINGEN.—Florae in sacerdote celeberrimo Tuebingensi Darwini nostri discipulum praeclarum agnoscimus, qui plantarum in motibus accuratissime examinandis felicissimus, docet libramento quam exquisito nutet tremulae flos violae, caput aureolum exserat narcissus; quanta sollertia herba quaeque viridis frondes suas ita explicet, ut solis lumen vitale quam plurimum accipiat. Idem, "polaritatis" secundum legem quandam, ostendit in arborum ramis amputatis quantum a parte summa pars ima discrepet; quot quaestiones subtilissimas sapientissimo cuique subiciat rusticus ille simplex, qui ex omni hominum memoria in perpetuum conservat,

"quos ipse via sibi repperit usus:
hic plantas tenero abscindens de corpore matrum
deposuit sulcis, hic stirpes obruit arvo."[2]

HUGO DE VRIES, PROFESSOR OF BOTANY AT AMSTERDAM.—Darwini nostri in memoriam decoramus hodie botanicae professorem Amstelodamensem, virum a Societate Regia numismate aureo Darwini in honorem instituto donatum. Quam pulchre ostendit, quam varium, quam mutabile sit florum genus illud pulchrum quod primula vespertina vel potius *Oenothera* nominatur! Alii, inter quos honoris causa Raium nostrum[3] nominamus, aiunt; "Natura non facit saltus"; hic autem speciem unamquamque, non e fluctuatione tam tarda ut oculorum aciem effugiat, sed e mutatione subita censet exoriri. Natura saltus igitur nonnumquam facit.

CHARLES DOOLITTLE WALCOTT, SECRETARY OF THE SMITHSONIAN INSTITUTE, WASHINGTON.—Trans aequor Atlanticum alter ad nos venit legatus insignis, Instituti celeberrimi Washingtonensis administrator indefessus, Americanorum in Republica maxima explorationi geologicae universae quondam praepositus. Zonae Olenelli, rupium illarum antiquissimarum, in quibus vitae formae fossiles (ut aiunt) repertae sunt, de incolis extinctis praeclare disputavit. Idem Cambriae in saxis, non modo *Brachiopoda* subtilissime examinavit, sed etiam *Trilobites* illos, quorum in oculo uno saxi in caligine aeterna clauso radiorum lucidorum sex milia olim scintillabant. Rerum natura, in magnis magna, in minimis quam immensa!

EDMUND BEECHER WILSON, PROFESSOR OF ZOOLOGY IN THE COLUMBIA UNIVERSITY, NEW YORK.—Populari suo proximus adsurgit Novi Eboraci in Universitate Colum-

[1] *Serm.* ii. 8, 52 f. [2] Juvenal, viii. 106 f. [3] Terence, *Heaut.* 77. [4] Ovid, *Met.* i. 85 f. [5] Juvenal, x. 143 f.

[1] *Genesis*, ix. 16. [2] Virg. *Georg.* ii. 22 f.

[3] John Ray, *Historia Plantarum*, i. (1686) 50, "Cum enim *Natura* (ut dici solet) *non faciat saltus*, nec *ab extremo ad extremum transeat, nisi per medium* . . ."; cp. Linnaeus, *Philosophia Botanica* (1770), p. 27, § 77.

biana zoologiae professor, qui saltationes illas *karyokinesis* nomine nuncupatas descripsit, quas ovorum in cellulis dividendis nucleorum fragmenta certatim exercent. In insectis autem nonnullis, docente doctore nostro novo, determinatur sexus, prout nucleorum fragmentum unum aut adest aut abest. Genus femininum tot fragmenta efficiunt; fragmenta uno tantum minora masculinum. Videtis, Academici, discrimine quam tenui genus masculinum a genere feminino separetur, ne dicam superetur.

CHARLES RENÉ ZEILLER, PROFESSOR OF PALÆOBOTANY IN PARIS.—E tot doctoribus supremus adest Francogallorum Instituti celeberrimi socius, palaeobotanicae professor praeclarus Parisiensis, qui iam per annos triginta plantas fossiles (ut aiunt) accuratissime examinavit; Africae, Americae, Indiae, Asiae Minoris flores extinctos non sine summo iudicio, non sine summo ingenio, investigavit. Viri huius auxilio, Florae antiquae e monumentis non iam unum alterumve capitulum perbreve, non iam paginae cuiusque lineae paucissimae, sed novae paginae plurimae, orbis terrarum quasi vitae perpetuae ad catenam continuam anulos novos addiderunt.

> "Sic unumquicquid paulatim protrahit aetas
> in medium, ratioque in luminis erigit oras.
> namque alid ex alio clarescere et ordine debet
> *omnibus*, ad summum donec venere cacumen."[1]

Rerum naturae seriem aeternam claudit *Homo sapiens*: honorum nostrorum seriem hodiernam claudit vir in Flora antiqua sapientissimus, Carolus Renatus Zeiller.

A NEW ANALYTICAL ENGINE.

THE April number of the Scientific Proceedings of the Royal Dublin Society contains an interesting and very original paper by Mr. Percy E. Ludgate on a proposed analytical machine. Of all calculating machines, the analytical machine or engine is the most comprehensive in its powers. Cash till reckoners and adding machines merely add or add and print results. Arithmometers are used for multiplying and dividing, which they really only accomplish by rapidly repeated addition or subtraction, with the exception alone, perhaps, of the arithmometer of Bollée, which, in a way, works by means of a mechanical multiplication table. Difference engines originated by Babbage produce and print tables of figures of almost any variety, but the process is one of addition of successive differences. The analytical engine proposed by Babbage was intended to have powers of calculation so extensive as to seem a long way outside the capacity of mere mechanism, but this was to be brought about by the use of operation cards supplied by the director or user, which, like the cards determining the pattern in a Jacquard loom, should direct the successive operations of the machine, much as the timing cam of an automatic lathe directs the successive movements of the different tools and feeding and chucking devices. However elaborate the mechanism of Babbage, if completed, might have been, the individual elements of operation would, so far as the writer has been able to understand it, have been actually operations of addition or subtraction only, and, with the exception of the method of multiplication created by Bollée, the writer does not recall any case in which mechanism has been used to compute numerical results except by the use of the processes of addition or subtraction, simple or cumulative. Of course, harmonic analysers and other instruments depending on geometry are not included in the category of machines which operate on numbers.

The simplicity of the logarithmic method of multiplying must have made many inventors regret the inherent incommensurability of the function to any simple base, or, if commensurability is attained for any particular number and its powers by the use of an incommensurable base, the incommensurability of the corresponding logarithms of numbers prime to those first selected. On this account the writer has always imagined that the logarithmic method was unsuited to mechanism, or, if applied at all, could only be so applied at the expense of complication, which would more than compensate for the directness of the process of logarithmic multiplication.

Mr. Ludgate, however, in effect, uses for each of the prime numbers below ten a logarithmic system with a different incommensurable base, which as a fact never appears, and is able to take advantage of the additive principle, or, rather, it is so applied that the machine may use it. These mixed or Irish logarithms, or index numbers, as the author calls them, are very surprising at first, but, if the index numbers of zero be excepted, it is not difficult to follow the mode by which they have been selected. The index numbers of the ten digits are as follows:—

Digit	0	1	2	3	4	5	6	7	8	9
Index number.	50	0	1	7	2	23	8	33	3	14

When two numbers are to be multiplied, the index numbers of the several digits are mechanically added to the index numbers of each of the digits of the other, and, the process of carrying the tens being carried on simultaneously, the time required is very small. For instance, the author gives as an example the multiplication of two numbers of 20 digits each, which will require 40 of these additions, which he shows will require 9½ time units if a time unit is one-tenth of the time of revolution of a figure wheel.

Unfortunately, while the principle on which the proposed machine is to work is described, only the barest idea of the mechanical construction is given, so that it is difficult to judge of the practicability of the intended construction. Whatever this may be, the originality of the method of mixed commensurable logarithms to incommensurable bases seems to the writer so great and the conception so bold as to be worthy of special attention.

Division has hitherto always been effected by the process of rapid but repeated subtraction, following in this respect the method practised with pencil and paper. Having discovered how to harness the logarithm to mechanism, Mr. Ludgate would, it would be expected, have managed to effect division by a logarithmic method, and possibly he could have done so, but here again he has left the beaten track, and by his ingenuity has made division a direct, and not, as hitherto, an indirect or trial-and-error process. Starting with a table of reciprocals of all numbers from 100 to 999, which in a mechanical form is intended to be stored in the machine, he imagines both numerator and denominator of the required fraction p/q to be multiplied by the reciprocal A of the first three digits of q so as to become Ap/Aq. Aq must, then, in every case begin with the digits 100, and it may be written $1+x$, where x is a small fraction. Then $p/q = Ap(1-x)(1+x^2)(1+x^6)(1+x^8)$ . . . a highly convergent series of which five terms will give a result correct to twenty figures at least, and so division is intended to be effected by a process of direct multiplication.

Until more detail as to the proposed construction and drawings are available it is not possible to form any opinion as to the practicability or utility of the machine as a whole, but it is to be hoped that if the author receives, as he deserves, encouragement to proceed with his task, he will not allow himself to become swamped in the complexity which must be necessary if he aims at the wide generality of a complete analytical engine. If he will, in the first instance, produce his design for a machine of restricted

[1] Lucretius, v. *ad finem*.

capacity, even if it does no more than an arithmometer, he will, by demonstrating its practicability and advantages, be more likely to be enabled to proceed step by step to the more perfect instrument than he will if, as Babbage did, he imagines his whole machine at once. In the writer's opinion, the ingenuity required to arrange a complete analytical engine is really in great part misplaced. Such a machine can only be used and kept in order by someone who really understands it, and it would seem to the writer of this notice more practicable to allow the user's attention to replace the action of operation cards, and leave to the machine the more direct numerical evaluations.

C. V. BOYS.

PROF. D. J. CUNNINGHAM, F.R.S.

THE death of this eminent anatomist occurred on Wednesday of last week, June 23. It was known that Prof. Cunningham had been ill for several months, but the fatal nature of the illness was not at first recognised, and the news of his untimely death in the full vigour of his powers will have come as a shock to many of his friends, and their name is legion.

Daniel John Cunningham was born in April, 1850, at Crieff, where his distinguished father, who was later to become principal of St. Andrew's University, was then the minister. His school days were passed at Crieff Academy. At the age of seventeen he was sent to Edinburgh University, and began the study of medicine. Here he had a brilliant career as a student, and in 1874 took his M.B. degree with first-class honours. In 1876 he proceeded to the M.D. degree, the subject of his thesis being "The Anatomy of the Cetacea"; for this he was awarded a gold medal. His work on this subject was performed in the anatomical department of the university, where he was acting as assistant demonstrator to Prof. Turner; the influence of the master is apparent in the work of the pupil.

In 1876 Cunningham became principal demonstrator of anatomy, a position of much responsibility, as well as of great advantage to the holder from the experience in anatomical work and in teaching which it offers. Of this experience he took full advantage, and his high qualifications were recognised when he was appointed in 1882 to the chair of anatomy in the Royal College of Surgeons in Dublin. This appointment was not long held by him, for in the following year his services were transferred to the much more important chair of anatomy in Trinity College. Here he remained until 1903, when, on the retirement of Sir William Turner from the professorship of anatomy in the University of Edinburgh, it was felt that there was only one man worthy to succeed him, and the invitation which was tendered to him by the Curators of Patronage was, not without some hesitancy, accepted by him.

The hesitancy—even in view of the higher emolument and larger sphere of usefulness which the appointment to his Alma Mater involved—is not difficult to understand. For Cunningham had endeared himself to Dublin by many close ties; he was the centre of a large circle of intimate friends, and his influence and interests were in no way confined within the walls of the university, but extended to all circles of society. For several years he acted as secretary, and for some time as president, to the Royal Zoological Society of Ireland, and the effect of his work is apparent in the splendid condition of their menagerie, which is, for its size, probably the most successful in Europe. He was a constant attendant at the famous Saturday morning breakfasts of the council, and on leaving Dublin for Edinburgh was the recipient of a silver bowl engraved with the signatures of his fellow-members, a testimonial which he prized with pleasurable pride. During four years he was honorary secretary to the Royal Dublin Society. He was frequently consulted on scientific questions by the Viceregal Government, who in 1900 appointed him a member of the commission to inquiry into the condition of the inland fisheries of Ireland. In the same year he was sent out to South Africa as a member of the Royal Commission to inquire into the care of the sick and wounded in the war. He also served on a War Office committee to report on the physical standards required for candidates for commissions and recruits.

But the performance of these public duties was not allowed to interfere with his scientific work. Both before and after his appointment to Dublin his communications on anatomical subjects were numerous and important. His text-books on "Practical Anatomy" and on "Systematic Anatomy"—the latter edited and in part written by himself—have a large circulation. His "Memoir on Cornelius McGrath, the Irish Giant," which was published by the Royal Irish Academy in 1891, is a model of exact anatomical description, and was influential in pointing to the analogies between the conditions of gigantism and those met with in acromegaly, a disease to which attention had shortly before been directed by Marie, who was the first to associate it with tumour of the pituitary body. No less important is his "Memoir on the Surface Anatomy of the Cerebral Hemispheres," which was published in 1892. In 1902 he delivered the Huxley memorial lecture before the Anthropological Institute, the subject of the lecture being "Right-handedness and Left-brainedness."

On his transference to Edinburgh in 1903, Cunningham's activities were in no way diminished, and his influence was immediately felt both in the university and in scientific and medical circles of the city. His genial personality at once won the hearts of the students, who were no less attracted by his powers of exposition. The confidence of his colleagues was manifested by his early election to fill the position of dean of the faculty of medicine. This confidence proved well-merited, for, under his auspices, the scheme of reform of the medical curriculum which had been for years in a condition of suspended animation was re-invigorated, and before long passed through all its stages, which in a Scotch university are more complex and difficult than those of a Bill in Parliament. As a member of the council and as secretary of the meetings, he took an active part in the work of the Royal Society of Edinburgh, and was instrumental in improving the form and character of its published Proceedings. He effected a similar change in the *Journal of Anatomy and Physiology*, of which he became acting editor, and to which he had always, either personally or through his pupils, been in the habit of contributing articles. He continued to take a keen interest in the public services, and was prominent in the movement for the establishment of a medical equipment of the Territorial Force in the East of Scotland.

Cunningham's eminence in science has been recognised on many occasions. He was elected in 1891 to the Fellowship of the Royal Society, and in 1898 served on its council. The Universities of Dublin, Oxford, St. Andrews, and Glasgow conferred upon him their honorary degrees. He was president of the Anatomical Society and of the anthropological section of the British Association, and at various times was examiner in most of the universities of the United Kingdom.

Of Cunningham's personal character it is impossible

to speak too highly. Of his fine, manly figure; his frank, open countenance; his clear, honest, kindly eyes; his disposition, genial but firm; his humour, devoid of cynicism; his loyalty to his friends; his gentleness even to opponents, all who had the privilege of knowing him will for ever retain a bright remembrance. As a writer in the *Scotsman* truly says:—"To the University and to science his death is nothing short of a calamity, while to his friends it has brought a sense of desolation."

He was interred on Saturday afternoon at Edinburgh. His remains were escorted from the Church of St. Cuthbert by a long line of students, colleagues, representatives of learned societies, and personal friends, the melancholy procession offering a strong contrast to the gaiety of the city, the traffic of which was arrested by its passage. He lies in the beautiful Dean Cemetery, than which few places contain more distinguished dust. *Requiescat in pace.*

DR. G. F. DEACON.

THE death of Mr. G. F. Deacon, a member of the council of the Institution of Civil Engineers, and eminent for his scientific work in engineering, was announced in last week's NATURE. Mr. Deacon, during his comparatively short life—he died at the age of sixty-six—obtained a considerable reputation as a water-works engineer, and is best known by his connection with the Vyrnwy Reservoir for the supply of Liverpool. In 1876 the need had arisen for an additional supply of water, and Mr. Deacon, who was then acting as municipal and water engineer, was instructed by the corporation to make an investigation as to the locality from which an additional supply could be obtained. After a survey of several sources he finally advised that this could be best obtained from the River Vyrnwy, a tributary of the Severn, situated in North Wales. Mr. Deacon's recommendation was submitted to Mr. Thomas Hawksley and Mr. Bateman, who approved this choice. The Bill promoted by the corporation having received the sanction of Parliament, Mr. Deacon was appointed joint engineer with Mr. Hawksley to prepare the plans and carry out the work. When the works were about half finished, Mr. Hawksley retired, and Mr. Deacon was left in sole charge.

The Vyrnwy works are remarkable as having the largest reservoir in England, and the first to have a high water-tight masonry dam. This dam was formed with blocks of clay slate from the Caradoc beds of the lower Silurian formation, some of which weighed 10 tons. These were set in mortar composed of Portland cement and slate stone crushed fine enough to pass through meshes of one-eighth of an inch. The dam is 1350 feet long, 136 feet high, and impounds the water in a reservoir 5 miles long and covering 1121 acres. The cost of these works was 2½ million pounds, and they were carried out under Mr. Deacon's supervision without the aid of a contractor. A full account of the Vyrnwy works is given in a paper read by Mr. Deacon at the Institution of Civil Engineers in 1896, and contained in vol. cxxvi. of the Minutes of Proceedings.

Mr. Deacon was educated at the Glasgow University, which subsequently conferred upon him the honorary degree of LL.D. He served his time in Napier's shipyard, which led to his becoming one of Lord Kelvin's assistants on the *Great Eastern* when an attempt was made to lay an Atlantic cable. At the age of twenty-two he commenced practice as an engineer at Liverpool, and six years afterwards was appointed municipal and water engineer of that borough. One of the most important services he rendered during this time was the invention of the waste-water meter, by means of which it became possible to locate the place where leakage and waste were going on in the mains or from the service pipes, and thus a very great saving was effected in the quantity of water required. He also devised considerable improvements in the instruments used for measuring the velocity of the flow of water in rivers, and applied the use of electrical mechanism to current meters. He took keen interest in devising and improving the means of making the meteorological observations necessary for determining the yield of rain water.

In 1879 Mr. Deacon resigned his appointment as municipal engineer in order to devote his whole time to the Vyrnwy works. On the completion of these he commenced to practise at Westminster as a consulting engineer, and was connected with many important schemes of water supply, and frequently was engaged in giving evidence before parliamentary committees. In addition to his work as a water-works engineer, Mr. Deacon applied a considerable amount of attention to the application of scientific principles to the solution of problems arising out of the practical work of the engineer.

Mr. Deacon was president of the engineering section of the British Association at the meeting held at Toronto in 1897, also of the Municipal and County Engineers at their meeting in 1878. He was a Fellow of the Meteorological Society, and a member of the Institution of Mechanical Engineers.

NOTES.

THE list of honours announced on the occasion of the celebration of the King's birthday on Friday last includes the names of five Fellows of the Royal Society. Mr. Francis Galton, F.R.S., Prof. J. Larmor, F.R.S., Mr. R. H. I. Palgrave, F.R.S., and Prof. T. E. Thorpe, F.R.S., have received the honour of knighthood, and Dr. W. Schlich, F.R.S., has been appointed a Knight Commander of the Order of the Indian Empire (K.C.I.E.). Other men of distinction in the scientific world included in the list are:—Mr. Edgar Thurston, superintendent of the Government Central Museum, Madras, appointed a Companion of the Order of the Indian Empire (C.I.E.); Prof. W. J. R. Simpson, a Companion of the Order of St. Michael and St. George (C.M.G.); Sir Dyce Duckworth and Mr. Henry Morris, president of the Royal College of Surgeons, have had baronetcies of the United Kingdom conferred upon them; and Mr. James Stuart, who founded the system of university extension and the mechanical workshops at Cambridge, has been made a privy councillor.

ON Monday evening Mr. E. H. Shackleton delivered his first lecture since his return home on the results of his South Polar expedition at a special meeting of the Royal Geographical Society in the Royal Albert Hall. The main facts of the expedition have already been recorded in our own columns and elsewhere, but a large and brilliant audience assembled to hear from the explorer's own lips an account of the experiences of his companions and himself during their fourteen months' sojourn within the Antarctic circle. It is not always easy to realise the meaning of distances between places the position of which is only known in terms of latitude and longitude, and Major Leonard Darwin, who presided over the meeting, performed a useful service for his audience by indicating the extent of ground which would have to be covered by a party starting from London northwards on a journey of the same length as that which took Mr. Shackleton

from his winter quarters to within 100 geographical miles of the South Pole. The party would have to march so far as Edinburgh before reaching Captain Scott's record, and onwards to a point 240 miles beyond John o' Groats before reaching the limit of the journey. Mr. Shackleton told his story in a simple and graphic manner, which revealed, without unduly emphasising, the hardships and dangers experienced by his companions and himself on the great southern journey, and by the party under Prof. David which reached the South Magnetic Pole. The Lloyd-Creak dip-circle, he mentioned, worked remarkably well under the severe climatic conditions. The lecture was illustrated by a number of very interesting photographs, while at the close there was a display of "living pictures" —the first ever taken in the Antarctic regions—which afforded a very good idea of the movements of penguins and seals. One scene, which Mr. Shackleton will be well advised to omit in future, illustrated the death of a seal shot by the explorers. After the lecture the Prince of Wales, on behalf of the Royal Geographical Society, presented to Mr. Shackleton a special gold medal, and to a number of other members of the expedition replicas of the medal in silver.

THE next meeting of the French Association for the Advancement of Science will be held at Lille from August 2–7. The secretary of the association should be addressed at 28, rue Serpente, Paris.

THE annual meeting of the Association for the Oral Instruction of the Deaf and Dumb will be held at the Portman Rooms, Baker Street, W., on Tuesday, July 13. Lord Avebury will preside.

MR. F. MUIR and Mr. J. C. Kershaw send home, under date March 12, a description of a Peripatus which they have recently found in Ceram. This is the first time that Peripatus has been found in the Moluccas. The specimens, sixty-three in number, were all females. "In the size of its eggs (0·05 mm.) and in its mode of development and birth it approaches the neotropical group." In its other characters it appears to resemble Melano-Peripatus (the New Britain species found by Dr. Willey). The authors name the species *Peripatus ceramensis*. A description of it, with illustrations, will be published in the forthcoming number of the *Quarterly Journal of Microscopical Science*.

THE issues of the *British Journal of Photography* for June 18 and 25 contain a detailed account of a noteworthy collection of apparatus intended for the easy demonstration of certain optical and visual phenomena specially interesting to photographers. The apparatus, which was designed by Dr. E. Goldberg, of Leipzig, and is now on view at the International Exhibition of Photography at Dresden, is arranged in forty-four small cabinets. Each cabinet is fitted with the requisites for a single experiment, and is accompanied by printed instructions briefly stating the result to be looked for, and indicating the necessary manipulation, which is in every case so simple that the merest tyro can hardly fail of success. The points illustrated include defects of the eye, such as irradiation, chromatic aberration, the blind spot, and Purkinjé's figures; various subjective phenomena of colour; some effects of intermittent illumination; elementary examples of reflection, refraction, dispersion, diffraction, and absorption; colour mixture, with special regard to the devices employed in the modern processes of colour photography.

DURING the course of the discussion on cable rates and Press intercommunication in connection with the Imperial Press Conference, Mr. Marconi gave some interesting information. He remarked it would be injudicious for the Governments concerned to enter into a scheme of State-owned cables without first having investigated the capabilities of a wireless connection between the two countries. In discussing these connections, he said, we should refer to electric communication instead of cable communication. The cost of two stations capable of communicating over distances which have proved practicable—3000 miles—would be about 50,000*l*. for each station. This estimate, of course, is subject to variation. He is, he continued, certainly of opinion that it may be possible in the near future to communicate over greater distances, perhaps 6000 miles, or even more. There is a very interesting theoretical point about communicating a distance of 6000 miles, which is that when the equator is passed the wireless waves may begin to converge again, and it may occur that at the Antipodes messages can be received much easier than half-way to the Antipodes. That remains to be proved. At present the Marconi Company is prepared to take a limited amount of Press messages across the Atlantic at 2½*d*. per word. When the stations are completed it is hoped to take a large amount—15,000 or 20,000 words a day. If the amount is considerable the company would be prepared to give a service at 2*d*. a word from Canada to England.

THE new buildings of the Victoria and Albert Museum, South Kensington, were opened in State by the King on June 26. Mr. Runciman, President of the Board of Education, read an address, in which, on behalf of the Board, he thanked the King and Queen for consenting to open the new buildings, and explained the numerous uses of the museum. The address showed that the first object of the founders of the museum was to encourage a high standard of excellence among the craftsmen, manufacturers, and designers of this country. For many years lack of space prohibited a systematic arrangement and classification of the collections. The completion of the new buildings now makes it possible to display the collections in a manner worthy of the ambition which prompted their formation. With this object in view the Board of Education has formulated a scheme for the future organisation and management of the museum. The collections are classified in eight departments. Each department will have its own expert staff, while a separate staff will have charge of the supplementary collections intended for loans to provincial museums and schools of art. In the course of his reply the King said:—"The placing of an expert staff in charge of each section of the museum will have the double advantage of maintaining and developing the more scientific arrangement which has now become possible, and also of bringing about a more accurate knowledge of the history and beauty of the individual exhibits, and of their educational value."

THERE has, so far, been an entire absence of summer weather, and June has proved wet, cold, and almost sunless over the United Kingdom. In England the weather has been especially bad, and the aggregate rainfall is largely in excess of the average. In London the total measurement of rain, not including yesterday, June 30, was 4·29 inches, whilst the average for the month is 2·21 inches. The duration of bright sunshine is only eighty-seven hours, the average for the month being 167 hours, and in some recent years June has had 240 hours of sunshine; in May the sun was shining brightly in London for 297 hours. At Greenwich there have only been three days with the shade temperature above 70°, and there is only one year, 1860, with so few warm days in June during the last sixty-eight years. In June last year

there were seventeen days with the temperature above 70°, and in May of the present year there were ten such warm days, the thermometer exceeding 80° on three days, whilst in June the highest temperature was 74°.

THE latest contribution of Prof. W. Trelease to the elucidation of the genus Agave, published in the Transactions of the Academy of Science of St. Louis (vol. xviii., No. 3), deals with the Mexican species yielding fibre known as "Zapupe." Although in three cases flowers were not obtainable, five botanical species with local names are distinguished primarily according to the characters of the spines. The species Zapupe, Lespinassei, Deweyana are only known in cultivation, but Endlichiana and aboriginum are indigenous. Bulbils are described for two species, and it is stated that all appear to be freely bulbiferous after flowering, thus affording "pole" plants as well as offsets.

THE list of new garden plants for 1908, issued, according to precedent, as appendix iii. of the *Kew Bulletin* (1909), has only recently been received. It furnishes the correct names with brief diagnoses, gives the reference to the original publication and the introducer, and also indicates which plants are in cultivation at Kew and would probably be available for distribution in the regular course of exchange. About one-third of the entries refer to orchidaceous plants, many being garden hybrids, and others mere varieties or forms. Two natural and several garden hybrids are noted under the genus Saxifraga. Messrs. Sanders are credited with the introduction of three palms and the cycad *Encephalartos Woodii*.

AN investigation of the medullary rays in the beech, the oak and *Aristolochia sipho*, with the object of tracing the contour of the rays, has been carried out by Dr. K. Zijlstra, who communicates his results in *Extrait du Recueil des Travaux botaniques Néerlandais* (vol. v.). The contours of the rays in the oak and beech obtained by a comparison of tangential sections are fairly regular, being interrupted in places by fibre layers. They show an irregular but distinct increase in height towards the cambium. The height of the rays in Aristolochia stems approximates to the length of the internodes, if, as is assumed, the separate overlying portions are regarded as part of one original ray.

DR. P. LOWELL contributes to the Bulletin of the American Geographical Society (May) the first portion of a description of the plateau of the San Francisco peaks with reference to its effect on tree life. The peaks, which are for the most part cones of volcanic origin, rise out of a plateau having an elevation of 7000 feet. The desert nature of the region has kept it free from human destruction and the dry climate has preserved in a remarkable manner the fossil remains. The altitudinal distribution of the trees forms the chief subject of the paper. The zones of vegetation are said to topographise the country as with contour lines. The yellow pine, *Pinus ponderosa*, dominates the slopes from 6500 feet to 8500 feet. Then the Douglas fir, the silver fir, *Abies concolor*, the curious cork fir, *Abies subalpina*, and the aspen share the ground up to an elevation of 10,300 feet. Higher still, the Engelmann spruce and fox-tail pine, *Pinus aristata*, ascend to the tree limit, about 11,500 feet.

MR. J. PARKINSON contributes to the last number of the Journal of the African Society a collection of folk-tales current among the Yoruba-speaking peoples, which form an interesting supplement to the classical account of this people by the late Major Ellis. Like the Basutos, Pondos, and races beyond the African area, lightning is associated with a bird, and the thunderbolt is the subject of a special cult. The tortoise as the wise, helpful animal here takes the place of the hare, jackal, or frog in Bantu and Basuto tradition, several tales dealing with his cleverness and supplying etiological myths to account for the various marks still to be seen on his carapace.

IN the June number of *Man* the Rev. J. Roscoe describes a remarkable cult of the python at Uganda. The floor of its shrine was found to be carpeted with sweet-smelling grass, and on one side was the sanctuary of the serpent and its guardian, the latter being a woman pledged to a life of celibacy. A log and stool for the python, covered with a piece of bark-cloth, lay on the floor of the shrine, and a round hole was cut in the wall for the ingress and egress of the reptile. It had been trained to resort to this shrine, where it was regaled with milk, fowls, and small goats. The snake is supposed to control the river and its fish, and offerings are made to it to ensure success in fishing. During worship a medium is dressed in pieces of bark-cloth, a goat-skin apron, and a cloak of leopard skin. The spirit of the python then is supposed to enter him, when he wriggles about on the ground like a snake and utters prophecies, which are unintelligible to the worshippers, and are explained by an interpreter. The python is also supposed to confer offspring, and if he be neglected punishes his votaries by bringing sickness on their children. When a suitable offering is presented he prescribes the use of certain herbs, which effect a cure. The cult thus presents striking analogies to that of Æsculapius, who, according to Prof. J. G. Frazer, was originally a serpent, the anthropomorphic god provided with a serpent symbol being a later development of the cult.

MISS NINA LAYARD, already well known for her researches in the Saxon cemetery at Ipswich, describes in the June number of *Man* a series of flint implements discovered by her on the sea-coast at Larne, co. Antrim. This site had already been explored by Messrs. Du Noyer, Knowles, and Gray, whose discoveries have led to protracted controversy, and the age and character of the specimens are still matters of uncertainty. They do not correspond closely with either the palæoliths or neoliths of England, and though many acres of land are covered by these raised beaches, nothing in the shape of a ground weapon has been found. The presence of many flints in a rolled condition leads to the inference that they are older than the formation in which they were found, and the occurrence of these specimens, which many authorities hold to be Neolithic, at such enormous depths in gravel is subversive of all English experience. Miss Layard, in the circumstances, is content to designate them "the older series," because since they were dropped on this shore there must have occurred, not only a gradual sinking of the beach and the formation of gravels 20 feet in depth containing the worked flints, but also a subsequent elevation until the surface of the gravel stands no less than 20 feet above high-water mark. In the same connection, the account in the same number by Mr. Worthington G. Smith of a Palæolithic implement found near the British Museum in 1902 is interesting. It is remarkable in this specimen that an oval flint pebble forms part of the basis of the implement, the maker of the tool, by clever flaking, having designedly left this pebble intact.

THE geological section of the Belfast Naturalists' Field Club organised on June 19 an excursion to Scawt Hill for the study of the volcanic neck there. The geological structure of the district is that common to the plateau

basalts of County Antrim, and consists of basic lava flows covering Mesozoic beds, and at Scawt Hill occurs the "neck" of one of the volcanoes from which the lavas came. A few years ago one of the members of the section came unexpectedly on a basic dyke traversing the dolerite neck. The neck has been found to be a fine-grained ophitic dolerite. The dyke is a granitoid basic rock, and may be classed as a diabase without olivine. A section of the chalk taken two yards from the dyke showed it to be converted into a typical crystalline limestone with large crystals of calcite. The geologists of the Belfast Naturalists' Field Club made during the excursion the observation that even at a distance from the dyke the band of chalk in contact with the dolerite neck seemed to have undergone a similar change, and to have been converted into hornstone.

IN the *U.S. Monthly Weather Review* of January last references are made to interesting communications by Mr. R. F. Stupart, director of the Canadian Meteorological Service (dated March, 1909), relating (1) to the establishment of new stations in Newfoundland and Labrador, and the proposed extension of storm warnings and weather forecasts to Newfoundland, and (2) to the supply of a complete equipment to several stations in the north of Canada, extending as far as Fort Macpherson (lat. 67° 27′, long. 134° 57′ W.). In connection with the source of "cold waves" frequently experienced in North America, Mr. Stupart thinks that the study of the far north with trustworthy barometer readings will be most valuable. He remarks that the persistent high pressures found there in some seasons apparently owe their origin to upper currents from the equator coming to earth farther north than usual, and that "we may very probably in the future connect the situation in the equatorial regions and trade-wind belts with that in the high latitudes."

THE first complete account of the new method which has been adopted by the Gesellschaft für drahtlose Telegraphie to secure an almost undamped series of oscillations in the secondary circuit of the sender is given by Prof. Fleming in the *Electrician* for June 11. The primary spark is divided into eleven very short sparks of about 0·01 inch in length, which are formed between twelve discs of copper, which may be water-cooled. The damping is so great that not more than two or three oscillations occur in the primary circuit, and the oscillations in the secondary are therefore free oscillations, which are only slightly damped. The device evidently marks a distinct advance in wireless telegraphy.

LAST year in the *Comptes rendus* and in *Le Radium* M. J. Becquerel described experiments on the electric discharge through vacuum tubes which appeared to indicate that, in addition to the canal rays, there existed positive rays which could be deviated by a magnetic field by amounts comparable with those to be expected if the rays were composed of free positive electrons. In the *Journal de Physique* for June, M. A. Dufour describes his own work on the same subject. He has repeated and extended M. Becquerel's experiments, and comes to the conclusion that the observations do not warrant the statement that the deviable rays observed are due to free positive electrons.

MR. R. H. COLLINGHAM contributes an article in *Engineering* for June 18 dealing with Ilgner-operated winding-engines. The principle of the Ilgner system is the employment of a motor-generator set coupled mechanically to a heavy fly-wheel and electrically to the motor driving the mill or winding gear. The motor of the motor-generator is driven off the power mains, and the function of the fly-wheel is to minimise the variation in the load drawn from the source of supply. All the heavy loads which come on the mill are met from the store of energy in the fly-wheel. In order to obtain this result, an automatic slip-regulating device is provided in the rotor circuit of the induction motor driving the motor-generator set, which regulates the amount of slip on the induction motor according to the amperes taken by the stator, the slip-regulating device only coming into operation when the stator current has reached a certain fixed value. When this value has been attained the regulating device increases the slip of the induction motor, causing the speed of the set to drop; the fly-wheel then gives up energy corresponding to the given variation in velocity. By this means the load on the supply mains is kept much more steady than would be the case if no fly-wheel were employed. Mr. Collingham treats especially the mechanics of the problems involved with the view of finding expeditiously the weight of wheel, size of motor, &c., required in given cases.

IN our article upon the Astrographic Congress at Paris (June 10, p. 440) it was stated that Rome was represented by Signor Lias. We are asked by Dr. P. Emanuelli to state that this should have been Signor Lais, who is vice-director of the Vatican Observatory, and was the representative, not of Rome, but of the Vatican.

WE have received from Messrs. Flatters and Garnett, Ltd., of Manchester, a copy of their conveniently arranged catalogue of collecting apparatus, nature-study appliances, cabinets, museum glassware, glass-top boxes, pocket lenses, and so on. The list is well illustrated, and reference to its contents is made easily.

MR. JOHN MURRAY has published a second edition of Mr. R. H. Lock's "Recent Progress in the Study of Variation, Heredity, and Evolution." The first issue of the book was reviewed at length in NATURE of April 18, 1907 (vol. lxxv., p. 578), but it may be pointed out that several alterations and additions have been made in the present edition. A short list of references has been added at the end of each chapter; the different chapters have been revised and supplemented, and a new chapter has been added.

"A SHORT HISTORY OF ENGLISH AGRICULTURE," by Mr. W. H. R. Curtler, is announced by the Oxford University Press for early publication. As the agriculture of the Middle Ages has often been ably described, Mr. Curtler devotes the greater part of his book to the agricultural history of the subsequent period, especially the seventeenth, eighteenth, and nineteenth centuries.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN JULY:—

July 3. 14h. 30m. Uranus in conjunction with the Moon (Uranus 2° 22′ N.).
7. 17h. Mercury at greatest elongation (21° 11′ W.).
8. 3h. 46m. Mars in conjunction with the Moon (Mars 1° 21′ N.).
11. 15h. Uranus at opposition to the Sun.
15. 14h. Saturn at quadrature to the Sun.
18. 17h. 50m. Venus in conjunction with the Moon (Venus 3° 5′ S.).
19. 18h. Mars at greatest heliocentric latitude S.
20. 17h. 39m. Jupiter in conjunction with the Moon (Jupiter 4° 22′ S.).
23. 5h. 17m. Mercury in conjunction with Neptune (Mercury 1° 6′ N.).
25. 19h. Mercury in perihelion.
30. 22h. 4m. Uranus in conjunction with the Moon (Uranus 2° 16′ N.).

COMET 1909*a* (BORRELLY-DANIEL).—Several observations of this comet are recorded, and an ephemeris for it is given, in No. 4333 of the *Astronomische Nachrichten*. Neither photographs nor eye observations show any remarkable features, whilst the ephemeris indicates that the brightness is declining; on July 16 the comet will be but about one-third as bright as when discovered. The distance from the earth is, at present, about 1·09 astronomical units, and is rapidly increasing.

THE SHAPE OF THE PLANET MERCURY.—Referring to a recent statement by Mr. Levander, that the equatorial diameter of Mercury has been shown to exceed the polar diameter, M. R. Jonckheere, in No. 4333 of the *Astronomische Nachrichten*, expresses the belief that the opposite is the case. His observations, made during the most recent transit of Mercury, indicated that the vertical diameter was the greater, the values being, vertical=9·46″, equatorial=8·73″; this is supported by other observers, whose results he gives. At present the positions of the equatorial and polar diameters of the planet are not known, but M. Jonckheere contends that the statement that the greater diameter is the one parallel to the celestial equator is, in the face of the evidence to the contrary, inadmissible.

OBSERVATIONS OF SUN-SPOTS, 1908.—The results of the first year's regular observations of sun-spots at the Royal Observatory at Capodimonte (Naples) are given by Signor E. Guerrieri in No. 6, vol. iii., of the *Rivista di Astronomia* (Turin). The sun was observed on 304 days, and on five days was seen to be free from spots, whilst the mean daily frequency of spot groups for the year was 5·3. The first half of the year showed an excess of groups in the ratio 3/2, but the analogous ratio for single spots was 4/5; altogether, 1606 groups and 9262 individual spots were observed during the year. The observations are tabulated and discussed in several different ways, and, if continued regularly, will form a useful supplement to the work so ably performed by the other Italian observers.

OBSERVATIONS OF SATURN AND ITS RINGS.—In No. 4331 of the *Astronomische Nachrichten*, M. Schaer records the observations of Saturn and its ring system made at the Geneva Observatory, with the 40 cm. Cassegrain reflector constructed by himself, during the period September 18, 1908, to January 24, 1909. The chief feature recorded is the discovery of the new dark ring announced on October 7, 1908. This ring was seen, but thought to be the shadow of the bright rings, on previous occasions, but on October 5 it was seen to extend to the right and left, and was therefore judged to be something more than shadow; on October 6 the dark ring was seen to be separated, and the planet, with its usual colour, was seen through the interstice, which was about 3″ to 4″ long and 0·5″ to 1″ broad. In January of the present year the new ring was seen more easily than during the preceding months.

M. Schaer's observations also suggest the presence of a cloudy, absorbing atmosphere, and the occurrence of slight changes in the white ring between the crape-ring and the Cassini division. The invisibility of the rings when their plane passes through the earth is probably due to the masking effect of the newly discovered outer dark ring.

TABLES FOR THE REDUCTION OF "STANDARD CO-ORDINATES" TO RIGHT ASCENSION AND DECLINATION.—In No. 4329 of the *Astronomische Nachrichten* Herr A. Hnatek published a series of tables for the computation of α and δ from the standard coordinates given in the catalogues of the international *carte du ciel*. A few copies of these tables, printed on stout paper, have been prepared, and may be obtained from the publishers for one mark per copy.

THE TRANSVAAL OBSERVATORY, JOHANNESBURG.—From the *Observatory* (No. 410, p. 262, June) we learn that from July 1 next the institution directed by Mr. R. T. A. Innes is to be known as the Transvaal Observatory, Johannesburg, South Africa. The instrumental equipment is to be increased by the addition of a large refractor for visual work, and a photographic astronomical telescope, the gift of Mr. Franklin Adams, so that this institution will now rank as an astronomical, as well as meteorological, observatory.

THE COMETS OF 1907 AND 1908.—In a brochure published by Prof. Kobold, comet observers will find a very useful summary of the cometary phenomena of 1907 and 1908. Observations of fifteen comets were made during those two years, and for each object Prof. Kobold gives a short summary of the observed phenomena, a set of elements where available, and a table of references to the publications in which the observations were severally recorded.

THE ROYAL SOCIETY CONVERSAZIONE.

THE ladies' conversazione at the Royal Society is always a brilliant function, and last week the presence of delegates and other distinguished foreign guests from the Darwin celebration at Cambridge added to its interest. The conversazione was held on June 24 in the rooms of the society at Burlington House, and the guests were received by Sir Archibald Geikie, K.C.B., president. Many of the exhibits were also shown at the conversazione held in May, and were described in NATURE of May 20 (vol. lxxx., p. 347). Summaries of the other exhibits are given below, based upon the descriptions in the official catalogue, related subjects being here grouped together for convenience of reference.

Dr. W. N. Shaw, F.R.S.: Representation of temperatures and pressures in the atmosphere up to a height of fifteen miles, on July 27 and 29, 1908.—*A. Fowler:* Photographs of the spectrum of scandium. The photographs show the varying intensities of the scandium lines in the arc flame, normal arc, and the arc in hydrogen. Corresponding differences are found in the spectra of sun-spots and prominences.—*Messrs. Zeiss:* Liquid crystals observed under high temperatures with polarised light by micro-projection apparatus.—*Dr. F. Edridge-Green:* Spectroscope for estimating colour perception. In the focus of the instrument are two movable shutters, either of which is capable of moving across the spectrum. By means of the two shutters any given portion of the spectrum can be isolated. Each shutter is controlled by a drum graduated in wave-lengths, so that the position of the edges of the shutters can be known.—*C. E. S. Phillips:* Permanently luminous watch dial and military night compass. The watch dial is transparent (glass), and the figures are painted upon its upper surface. The dial is backed with a compound containing a minute quantity of RaBr$_2$ (radium bromide), which renders it luminous, so that the time may be easily read in the dark. The compass is arranged upon the same principle. By means of a luminous disc and strip, direction may be determined at night.

W. M. Mordey: The effect of electrostatic condensers in preventing or extinguishing arcs. A suitable condenser placed in shunt to an arc, or in shunt to a resistance in series with an arc, will instantly extinguish the arc. If connected in shunt to the contacts before they are separated it will prevent the formation of an arc even in a circuit having considerable electromotive force.—*The Linolite Company:* Metallic filament "tubolite." The metal filament is held at each end by a zig-zag spring to take up the expansion, and is supported by anchors at two intermediate points. The lamp may be placed in any position, and can be run on an alternating current or direct current circuit.—*Hon. C. A. Parsons, F.R.S.:* (1) Model of leakage path device for regulating voltage of alternators. The apparatus depends on the following very simple fact, that while an alternating current cannot *directly produce* a unidirectional field, it can have a strong action in diminishing magnetic flux. When applied to an alternator, the field magnets of the exciter are provided with a leakage path, around which windings carrying alternating current are placed. (2) Some samples of the blades used in steam

turbines of Atlantic liners.—*Hon. R. C. Parsons:* (1) "Panflex" spring wheel for motor vehicles. The "Panflex" spring wheel is an invention which has for its object the easy motion of a vehicle when run at low or high speeds. This ease of motion is due to the springs being capable of deflection in every direction. The wheel is not subject to bursts or punctures, prevalent in the case of wheels fitted with pneumatic tyres. The wear and tear is small, and, should a spring break, which is seldom the case in practice, another can be inserted in a few minutes at a very small cost. (2) Working model apparatus for recording the effects produced upon wheels of various descriptions when passing over obstacles. (3) Seismograph apparatus for registering the jolts felt by the body of a motor vehicle when run on "Panflex" or pneumatic wheels.

The Director, Royal Gardens, Kew: (1) Specimens to illustrate the wood *Lignum nephriticum*, and the fluorescence of its infusion. *Lignum nephriticum* is the wood of "Coatli" (*Eysenhardtia amorphoides*), a small leguminous Mexican tree. An infusion of the wood was used medicinally by the Aztecs. Soon after the conquest of Mexico the Spaniards brought the wood to Europe, where it was used for similar purposes, and excited remark owing to the blue fluorescence of the watery infusion of the wood. The phenomenon was first described more fully by Athanasius Kircher (1646), and J. Bauhin (1651), who used cups made of the wood. It was carefully studied by Boyle (1664). During the next century the wood itself was lost sight of; its origin remained unknown until quite recently. Plukenet (1696) suggested, and Dale (1737) and Linnæus stated, that it was the wood of the horse-radish tree (*Moringa pterygosperma*), which is, however, a native of the Old World. Another source that has been suggested is *Pithecolobium Unguis-Cati*, a native of the West Indies. (In charge of Dr. O. Stapf, F.R.S.) (i.) Wood of true *Lignum nephriticum* and cup turned from the same, and samples of infusions, presented to the Kew Museum as "cuatl." (ii.) Medicinal substitutes of *Lignum nephriticum*:—(*a*) wood of *Moringa pterygosperma*, from Scinde; (*b*) wood of *Pithecolobium Unguis-Cati*, from Florida; (*c*) wood of a tree, possibly a species of Imbricaria (Sapotaceæ), from tropical America, received from Paris in 1851 as *Bois néphritique*. (2) Plants of Ecanda (*Raphionacme utilis*), and sample of rubber prepared at Kew from a tuber of it.—*R. A. Robertson:* Photographs (for identification purposes) of the transverse surface of timbers.—*Prof. R. H. Yapp:* Photographs of tropical vegetation. The photographs were, for the most part, taken during the Skeat Expedition to the Malay Peninsula (1899–1900).—*Prof. F. E. Weiss:* (1) Some alien aquatic plants from the Reddish Canal, near Manchester; (2) some South African aquatics grown in the laboratory, University of Manchester.

R. I. Pocock: Warning coloration in some weasel-like Carnivora. Animals which are nauseous or poisonous or dangerous to meddle with commonly have some means of self-advertisement, such as conspicuous coloration or sounding organs, which appeals to the sense of sight or of hearing of their enemies, warning the latter to let them alone; but most mammals are coloured so as to be concealed either from their enemies or from the prey they feed upon. Such concealment is commonly effected by counter-shading, the upper side being dark to tone down reflected light, and the lower side white to counteract shadow, the result being obliteration of the shape and solidity of the body. Some of the weasel tribe, however, form an exception to this rule, being light above and black below, often with the white of the back, as in skunks, or of the head, as in badgers, emphasised by black stripes; and since these animals are known to possess glands which secrete fluids with a fœtid or suffocating odour, and since, also, they are known to be desperate fighters and fearless and extraordinarily tenacious of life, and to feed, for the most part, upon vegetables or upon animal food, for the capture of which concealment is unnecessary, there are strong reasons for believing them to be conspicuously and warningly coloured.—*H. F. Angus:* Stereoscopic photomicrographs. The series comprise eggs of butterflies, moths, and parasites; botanical objects, such as mycetozoa, leaf hairs, &c.

—*F. Enock:* Living stick-insects (*Bacillus rossi*). The eggs of these stick-insects are less than one-eighth of an inch in diameter, and much resemble a minute vase. On emerging they are half an inch in length, and quickly stretch themselves along a green twig, which they exactly resemble. Most of the specimens have changed their skins five times, the old skin being generally *eaten*. When mature, these stick-insects attain a length of more than 4 inches, and become of a brown colour, which harmonises with the brown twig on which they rest. They are nocturnal feeders, and exceedingly amicable toward each other, treating each other as sticks, several often clinging together.—*Prof. George H. F. Nuttall, F.R.S., and Dr. Seymour Hadwen:* The discovery of a curative treatment for malignant jaundice in the dog and for redwater in cattle, with a demonstration of the effects of trypanblau upon the parasites. The disease known as malignant jaundice (piroplasmosis) in dogs is exceedingly fatal. It has hitherto resisted all forms of treatment. Both trypanblau and trypanrot injected subcutaneously will cure or prevent the disease. The effect of the drugs is exerted directly upon the parasites (*Piroplasma canis*) which cause the disease. The parasites may be observed to degenerate and disappear from the blood within a few hours after treatment. The parasite of redwater in cattle (*Piroplasma bovis*) is likewise affected by trypanblau.

Dr. C. D. Walcott, Secretary of the Smithsonian Institution: Panoramic views in the Rocky Mountains, U.S., and Canada.—*Dr. A. Smith Woodward, F.R.S.:* Skull of Megalosaurus from the Great Oolite of Gloucestershire. This is the first nearly complete skull of a carnivorous dinosaur found in Europe, and agrees with the skull of Ceratosaurus, from the Jurassic of Colorado, U.S.A., in exhibiting a bony horn-core on the nose. The specimen was discovered by Mr. F. L. Bradley near Minchinhampton.—*Dr. C. W. Andrews, F.R.S.:* Remains of rhinoceros and mammoth from the Thames alluvium under the offices of *Lloyd's Weekly News*, Salisbury Square, Fleet Street, E.C. The specimens exhibited were:—(1) a nearly perfect skull of a young individual of the woolly rhinoceros (*Rhinoceros tichorhinus*), in which some of the milk-teeth were still in use; (2) a maxilla and nearly complete mandible of a young mammoth (*Elephas primigenius*); the first and second molars were in wear, the third not yet having appeared.—*Dr. F. A. Bather, F.R.S.:* Sections of seasonal clay from Stockholm. This clay, which was deposited during the melting and retreat of the great ice-sheet in Sweden, may be described as fossil years and seasons. The alternating bands of dark and light can be easily seen, and Baron G. de Geer (from whom the specimens have been received) believes that each cycle represents a year, the lighter rock having been formed during the melting of the snows in spring. He has traced these bands for great distances, and has been able to map the changing limits of the ice-sheet from year to year through a long period. This is the nearest approach to a definite chronology by years that has yet been made by geologists, but it still needs to be linked up to the chronology of human history.—*Dr. Marie Stopes:* The microscopic structure of fossil plants from Japan. The nodules containing the plants were obtained in the river beds of the mountainous region of northern Japan. They are of Cretaceous age, and contain fossil plants with their tissues so well preserved that the cells can be seen in microscopic sections of the stony matrix. All the plants are new to science, and among them are several specimens of the first petrifaction of a flower hitherto discovered. The nodules contain ferns, gymnosperms, and angiosperms, which form an interesting mixed flora, the first of the kind to be described from specimens showing their anatomical structure.—*Prof. Flinders Petrie, F.R.S.:* Ancient modelled heads of various races. These heads were found in the foreign quarter of Memphis, the capital of Egypt, and represent the various peoples who were known there, 500 B.C. to 200 B.C. The Persian Empire, at that time, brought together all races between Scythia and India, and the Mediterranean peoples were familiar with Egypt before that. The modelling was probably done by Græco-Egyptians. Most of these were found in the excavations of the British School of Archæology in Egypt.

SOME PAPERS ON INVERTEBRATES.

COMMENCING with entomology, mention may be made of a paper on new and little-known North American Tipulidæ, by Mr. C. W. Johnson, published in vol. xxxiv., pp. 115–33, of the Proceedings of the Boston Natural History Society. In addition to the description of a number of new species, the paper contains the diagnosis of the new genus Aeshnasoma, proposed for a large tipulid with antennæ of the type of those of Longurio, but with a wing-venation differing from both that genus and Tipula.

To the March number of *Spolia Zeylanica* Mr. T. B. Fletcher communicates the first part of a monograph of the plume-moths of Ceylon, dealing in this instance with the members of the family Pterophoridæ. There are, it will be remembered, two families of plume-moths, the one already mentioned and the Orneodidæ, or 24-plumed group. Both are regarded by the author as very ancient types, but there appears to be little or no near relationship between the two groups, so that their mutual resemblance may probably be attributed to convergence. Although nothing definite is known in regard to the advantage gained by the splitting of the wings in these moths, the author suggests that when pace is not essential, a light framework of wing supplemented by cilia will be superior to the ordinary lepidopterous wing, in that it gives an equal measure of support with less expenditure of muscular force. In the same issue Mr. P. Cameron describes certain new Ichneumonidæ and Braconidæ reared by Mr. Fletcher from Ceylonese plume-moths.

Part v. of the second volume of Records of the Indian Museum is devoted to the revision, by Mr. E. Brunetti, of two groups of Oriental insects, namely, the flies of the families Leptidæ and Bombyliidæ; the latter paper containing a list of the known Oriental species, of which some are described for the first time.

To the Proceedings of the South London Entomological and Natural History Society for 1908–9 Mr. H. S. Fremlin contributes a paper on the results of experiments to show the effect of physical and chemical agencies on butterfly pupæ. The species forming the subject of the experiments were *Vanessa urticae* and *Abraxas grossulariata*, the total number of specimens treated being just over two thousand. Water and high temperature were the agents for the influence of physical conditions, while the chemical agencies employed were nitric and hydrochloric acids, chloride of lime, sulphur, hydrogen sulphide, and carbon disulphide. In the case of *V. urticae*, the death-rate was excessive when the pupæ were exposed to continuous high temperature, hydrogen sulphide, and carbon disulphide. The pupæ of *A. grossulariata* were in great measure destroyed in the water-laden atmosphere, and in the continuous high temperature failed to develop; hydrogen sulphide, on the other hand, was less harmful than in the case of the other species, although it crippled such adults as developed. Chlorine had a marked effect on the red colour of *urticae*, but showed little result in the case of *grossulariata*.

To the June number of the *Entomologists' Monthly Magazine* Mr. R. S. Bagnall contributes an account of four species of Thysanoptera new to the British fauna, among which *Megathrips nobilis* is also new to science. That species, the largest European representative of the group, was first obtained by Dr. D. Sharp in Wicken Fen during 1896.

Leaving insects for arachnids, we find in the April issue of the Proceedings of the Philadelphia Academy Mr. N. Banks cataloguing a collection of spiders from Costa Rica, with descriptions of new species. The new forms are about seventy in number, in addition to which there are about a score of species not mentioned in "Biologia Centrali-Americana." Of the web-making species, a considerable number are common to the United States, but of the other groups few kinds range so far north.

To vol. xxxviii., part iv., of the *Travaux Soc. Imp. Nat. St. Pétersbourg*, Mr. E. K. Suworow contributes an elaborate account of the anatomy of *Ixodes reduvius*, a tick exhibiting sexual dimorphism in a strongly marked degree. The much smaller males are, for instance, distinguished from the females by a peculiar system of divisions in the external envelope of the body, while there are also histological differences in the hypodermis of the males as compared with that of the females, as well as distinctive features in the mouth-organs.

Three papers published by the U.S. National Museum—two in the Proceedings and one in the Bulletins—are devoted to crinoids. In the first of these (Proceedings, vol. xxxvi., pp. 391–410) Mr. A. H. Clark describes a second collection of these organisms obtained by the S.S. *Albatross*, of which fifteen species, together with four left over from the first collection, are regarded as new, and duly named, one of these forming the type of a new genus. *Eudoxocrinus alternicirrus*, hitherto known only by *Challenger* specimens, has been re-discovered, and its habitat definitely determined, but several other *Challenger* forms have not been met with.

In the second of these papers (Bulletin No. 64) Miss Elvira Wood, of Columbia University, gives a critical summary of Dr. Gerard Troost's unpublished monograph of the fossil crinoids of Tennessee. Dr. Troost, who was born in Holland in 1776, settled in Philadelphia in 1810, where he became one of the founders, and the first president, of the Academy of Sciences. In 1827 he removed to Tennessee, where he became professor of geology and mineralogy in Nashville University, holding that chair until his death in 1850. Only about a month before his death the manuscript of the monograph of Tennessee crinoids was sent to the Smithsonian Institution for publication. After passing through various hands for five years, this manuscript came into the possession of Prof. Hall, in whose custody it remained for upwards of forty years. The long period which has elapsed since it was written rendered re-writing practically imperative, but certain portions have been printed direct from the original MS. Many of the original illustrations have been replaced by photographs or new drawings.

In the third paper of this series (Proceedings, vol. xxxvi., pp. 179–90) Mr. Springer describes, under the name of *Isocrinus knighti*, a new crinoid from the Jurassic of Wyoming.

The molluscs collected on the north side of the Bay of Biscay by the *Huxley* in the summer of 1906 form the subject of an article by Mr. A. Reynell in vol. viii., No. 4, of the Journal of the Marine Biological Association. Out of the seventy-five species collected, sixty-two have been recorded from the British area.

In No. 1678 of the Proceedings of the U.S. National Museum (pp. 431–4) Miss H. Richardson describes and figures a specimen of the curious spiny woodlouse (*Acanthoniscus spiniger*) of Jamaica. Although this isopod is stated to be common in its native island, the type-specimen in the British Museum and the one described by Miss Richardson are believed to be the only examples in collections.

THE RESEARCH DEFENCE SOCIETY.

THE speeches at the annual general meeting on June 25 of the Research Defence Society illustrated the wide and manifold interests of its work. It is, indeed, a national society for telling the truth about a matter of national importance. It defends the good name, the honour, of science against reckless and unscrupulous opponents, and we are not surprised at the welcome that it received. The list of its 2500 members includes a very powerful and thoroughly representative collection of great names. The society has already formed a dozen branch societies, has given many lectures, and has distributed much wholesome and honest literature; it has also published a volume of essays, written with authority, and pleasantly free from all controversy. Thus it has begun well; and the report of its committee is justly satisfied with the work of the past year. We note here two of the points made by speakers at the annual meeting.

Sir James Dewar emphasised this fact, that Germany is far ahead of us in the equipment of great laboratories for research in the "borderland between physiology and chemistry." Money is spent lavishly over the investigation of organic chemical bodies, the discovery and the preparation of new organic drugs. The services of a hundred expert and highly qualified men of science are at the command of a single firm. They receive large salaries,

and are free to follow the bent of this or that special study. In the long run, their united work is immensely profitable. Here is commercial rivalry, and more; here is a better understanding of the right conditions of "applied science."

Lord Cromer, president of the society, took as a signal instance of the necessity for experiments on animals the recent discovery of a serum treatment in cases of epidemic cerebro-spinal meningitis, that ghastly disease which goes by the foolish name of "spotted fever." It is an acute septic inflammation of the membranes of the brain and the spinal cord. By experiments on animals it was proved to be due to special germs of the order of diplococci. Flexner and Jobling, working at the Rockefeller Institute, discovered a way of preparing, from immunised horses, a serum containing a direct antidote, and this serum was first used in the spring of 1907. Before that time there was no special treatment of the disease, and the mortality ranged from 68·4 per cent. to 80·5 per cent. The children—it was mostly children—suffered terribly, and died in a few days; and of those who survived many were left, from the intensity of the inflammation, imbecile, paralysed, or blind. By the use of the serum the mortality has been reduced to 36·7 per cent. In Belfast, of 275 cases treated before the use of the serum, 72·3 per cent. died, and of ninety-eight cases treated with the serum 29·6 per cent. died.

The Research Defence Society exists to keep the public informed of such facts as these, and we hope that it will have a long record of such victories over disease.

IS THE ASSOCIATION OF ANTS WITH TREES A TRUE SYMBIOSIS?

THE fact has long been known that some species of ants occur in constant association with certain kinds of trees. Thus members of the dolichoderid genus Azteca are often found inhabiting the interior of the stems of *Cecropia peltata*, and among the Pseudomyrmini *P. bicolor* forms its nests within the spines of the "bull's-horn" acacia. The view has been held by many naturalists, amongst others by Fritz Müller and Bates, that in these cases the benefit is mutual, the tree affording both shelter and sustenance to its occupants, and receiving in return protection from the attacks of the formidable leaf-cutting ants of the genus Atta and of other enemies. Doubts on this point have been expressed by several authorities, among them by Dr. David Sharp, in whose opinion "there is reason to suppose that a critical view of the subject will not support the idea of the association being of supreme importance to the trees."

A careful investigation of the relations subsisting between the arboreal species of Azteca and Pseudomyrma and the trees which they inhabit has lately been conducted in Paraguay by Karl Fiebrig, who has published his results, illustrated by numerous photographic reproductions, in the current volume of the *Biologisches Centralblatt*.[1] His conclusions may be summarised as follows:—

Azteca not only makes use of internodal cavities already existing in the stem of *Cecropia peltata*, but excavates fresh spaces or enlarges existing ones at the expense of living tissues of the tree. Fritz Müller described certain pits in the stem of Cecropia where the wall is much thinner. These spots, he says, are selected by the female ant for the purpose of gaining access to the interior of the stem. But, according to Fiebrig, the ants effect their entrance into new internodal spaces by perforating the partitions in the stem before they have gnawed through the thin bottoms of the pits; moreover, openings to the exterior are often made irrespective of the situation of the pits, and when the latter are perforated the boring is, in certain cases, effected from within, and not from without. Neither the internodal spaces nor the pits can therefore reasonably be considered as myrmecophilous adaptations. Again, the alleged protection against leaf-cutting ants must often be superfluous, since the Cecropia, with its inmates, is apt to be found in marshy situations where these enemies cannot reach it. Most of the trees in Paraguay are subject to the attacks of the leaf-cutting Atta, but, nevertheless, though unprotected by the presence of Azteca, they continue to maintain their existence, even if belonging to introduced, and not native, species. Cecropia itself is not tenanted by ants until it is some years old. The presence of colonies of Azteca does not prevent Cecropia from receiving much damage from the attacks of other insect enemies, and Fiebrig is of opinion that the constant loss suffered by the tree from the depredations of Azteca itself involves a more serious drain upon its vitality than the occasional raids of the leaf-cutters. Finally, the occupation of Cecropia by these ants not only fails to afford protection against enemies other than the leaf-cutters, but even encourages the assaults of such formidable foes as woodpeckers and internally feeding lepidopterous larvæ.

With regard to the association between *Acacia cavena* and *Pseudomyrma fiebrigi*, the author points out that this tree, in common with other species of Acacia, is protected against the ground-haunting Atta by the fact that it grows only in situations which are constantly liable to inundation. The thorns in which the ants take up their abode have frequently been already hollowed out and furnished with apertures of access by lepidopterous larvæ; moreover, the spaces tenanted by the ants are not confined to the thorns, but extend also to the stem. In neither situation do they occur naturally, but in both they are excavated, as in Cecropia, whether by ants or caterpillars, at the expense of the living tissues of the tree.

On these grounds Fiebrig concludes that, at any rate so far as the species observed by him are concerned, the benefits of the association between trees and ants are not mutual, but are enjoyed by the ants alone. There is no doubt that the reasons for his view adduced by Fiebrig are of great weight. At the same time, it cannot be said that these observations are sufficient of themselves to disprove altogether the existence of ant-plant symbiosis.

F. A. D.

[1] "Cecropia peltata und ihr Verhältnis zu Azteca Alfari, zu Atta sexdens und anderen Insekten. Ein kritischer Beitrag zur Ameisenpflanzen-Hypothese." By Karl Fiebrig (San Bernardino, Paraguay).

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The following is the text of the speech delivered by Prof. Love in presenting Dr. G. E. Hale for the degree of D.Sc., *honoris causa*, at the Encænia on June 24:—

Inter Astronomos qui ea quæ in æthere solem circumfuso geruntur investigant nemini cedit Georgius Ellery Hale. Qui vir duodeviginti abhinc annos primus omnium fabricatus est instrumentum illud, ad lucis e solis puncto quovis emissæ naturam cognoscendam aptissimum, quo hodie utuntur omnes fere solis observatores. Hoc subsidio fretus potuit flammas illas excurrentes, quæ solis defectu plerumque cernuntur, sole pleno quasi in pictura exprimere: mox plagas lucidissimo candore fulgentes, quas faculas vocant, eodem modo repræsentare. Idem nuper docuit procellis hunc æthera vexantibus tenuissimas materiæ particulas quasi turbine quodam agitatas vim magneticam miro modo gignere: quæ omnia nemo demonstrare potuit nisi excogitandi peritissimus, in observando patientissimus, in causis cognoscendis sagacissimus. Neque ei satis erat Naturæ arcana reserare, sed Observatoria duo in orbe terræ maxima fere et instructissima condidit atque ornavit: idem Ephemeridem, in qua recentissima de siderum natura ubique reperta pervulgantur, conscribendam curavit. Sodalicium denique maximum instituit quo omnes omnibus ex terris huius militiæ cælestis contubernales congregarentur.

ST. ANDREWS.—Dr. William Nicoll, who has for some years carried out important researches on the parasites of birds, fishes, and other forms at the Gatty Marine Laboratory, has just been elected to the Ernest Hart memorial scholarship.

Dr. J. C. Irvine, lecturer on organic chemistry in the University, has been appointed by the University court to the chair of chemistry in St. Andrews, vacant by the resignation of Prof. Purdie.

THE Viscountess Falmouth will present the prizes at the Horticultural College, Swanley, Kent, on Thursday, July 15. Sir John Cockburn will take the chair at 4 p.m.

A DISTINGUISHED American physicist, Prof. E. F. Nichols, of Columbia University, has been elected president of Dartmouth College, a leading New England institution with more than 1200 students. Dr. Nichols is a graduate of Cornell, and held chairs at Colgate and Dartmouth before being appointed to his present post at Columbia.

THE issue of *The Record*, the magazine of the South-Western Polytechnic Institute, Chelsea, London, for May, contains an account of this year's prize distribution, when Dr. H. A. Miers, F.R.S., the principal of the University of London, delivered an address. The report of the principal of the institute, an abstract of which is printed in the magazine, shows that there were 2573 students under his supervision during 1907–8.

THE King has consented to lay the foundation-stone of the new buildings of the Imperial College of Science and Technology, South Kensington, on July 8. The building is to accommodate the departments of mining and metallurgy of the Royal School of Mines, geology of the Royal College of Science, and the extension of the engineering department (City and Guilds College), and will be situated on the land in Prince Consort Road lying to the east of the Royal College of Music, and extending so far as Exhibition Road.

THE fourth annual issue of the "Girls' School Year Book (Public Schools)" has now appeared. The book becomes year by year more complete, and certainly provides a useful directory for those interested in the education of girls. It is, however, still difficult to understand the editors' method of selection of schools for detailed treatment. Among new features this year are articles on domestic science, teachers' registration, the teaching of music in public secondary schools, and a list of lecturers suitable for schools. The volume is published by the Year Book Press, c/o Messrs. Swan Sonnenschein and Co., Ltd., and its price is 2*s*. 6*d*. net.

A FULLY illustrated description of the college of engineering of the University of Illinois is contained in the issue of the *University of Illinois Bulletin* for March 8. Descriptions are provided of the work and equipment of the eight departments of the college, as well as those of the engineering experiment station and the school of railway engineering and administration. The college has been organised to give such training to young men as will enable them to do efficient work in the branch of engineering or architecture they may select, to meet the demand for highiy specialised instruction and research, and to conduct investigations of value to the industrial enterprises of Illinois and distribute the knowledge gained.

IN the course of his recent presidential address to the Society of Chemical Industry, of which a short abstract appeared in NATURE of June 3, Prof. Meldola made the following appreciative remarks on the modern methods of laboratory instruction in chemistry:—"It is unnecessary here to dwell at too great a length upon the general practical training, although I should like to add that if the level has been raised, and if our teaching has become more philosophical, we are mainly indebted to a former occupant of this chair, Prof. Emerson Reynolds, who is unquestionably the pioneer reformer in the laboratory teaching of chemistry. I am glad of this opportunity of acknowledging the indebtedness of teachers to Prof. Reynolds, because, amidst the later clamour, his share in the development of chemical teaching has been overlooked." This address is published in full in the current number of the journal of the society.

EVIDENCE of the rapid development of the Chinese Empire will be found in an article in *Engineering* for June 18 dealing with the engineering and mining college at Tang Shan, North China. This college was founded in 1906 for the education of Chinese students, and is in connection with the Imperial Railways of North China, both being under imperial administration. The staff consists of a president (Mr. S. S. Young), four English professors in mechanical engineering, civil engineering, mining, and physical faculties respectively, two Chinese *literati*, and a clerical staff. A four years' course was prescribed, and there are now more than 200 students in regular attendance from various parts of the country. Residential accommodation is provided for 160 students, together with houses for the staff, dining hall, and three educational buildings. All technical lectures are delivered in English. While the equipment is as yet far from being complete, it is indisputable that the existence of such an institution is a factor which cannot be disregarded when considering the future position of the Empire.

MR. DAVID BOYLE, the curator of the Provincial Museum of Toronto, had the degree of LL.D. of the University of Toronto conferred on him on June 12, for his eminent services in the cause of archæology and ethnology. Dr. Boyle has been incapacitated for some time, and as he was too ill to attend the regular Convocation, the authorities paid him the unique compliment of holding a special Convocation at his residence, and of conferring the degree while he was lying in bed. Dr. Boyle was presented by Prof. Galbraith, and in the absence of the president, who had sailed for England, the degree was conferred by the vice-president, Prof. Ramsay Wright. Dr. Boyle went to Canada in 1856, and in the face of great difficulties has built up the fine archæological and ethnological collections in the Provincial Museum of Toronto. He is best known to students as the editor of, and chief contributor to, the annual archæological reports of the museum. They were begun in 1898, and form a valuable record of Canadian archæology and ethnology. The later reports have been duly noticed in NATURE. We congratulate Dr. Boyle on this academic honour, which crowns a life of self-sacrificing and poorly remunerated toil for the subjects he has so much at heart.

THE proceedings at the inauguration of Mr. R. C. Maclaurin as president of the Massachusetts Institute of Technology have been reported at considerable length in the American Press. One of the chief speakers was Mr. Bryce, who greeted the new president as a fellow-Briton, a fellow-Scotsman, and a fellow-member of Lincoln's Inn. Mr. Bryce said that Englishmen and Scotsmen would naturally be sorry that Mr. Maclaurin was not serving their country "in one of the new institutions which we have lately founded to try to make up for lost time in the promotion of scientific instruction." Still, "a scientific inquirer and teacher helps the whole world by the work which he does anywhere in it." In his own inaugural address, President Maclaurin emphasised the following articles in his creed as an educator:—(1) that the end of education is to fit men to deal with the affairs of life honestly, intelligently, and efficiently; (2) that in the higher education of a large and increasing section of the community science should play a very prominent, if not a leading, part; (3) that science and culture must go hand in hand, science being studied and taught in such a way as to make for that broad and liberal outlook on the world that is the mark of the really cultured man; and (4) that "above all we must preserve in our students the freshness and vigour of youth, and see to it with all care that their natural powers of initiative are improved and not checked by our training."

IN recent years there has grown up in connection with local education authorities in all parts of the country systems of scholarships providing for the education of boys and girls of varying ages and attending schools of different grades, and also for young men and women anxious to continue their education after school days are over. The report of the higher education subcommittee on the scholarship scheme of the London County Council, recently adopted by the Council, provides an exhaustive account of the educational facilities offered in London to the sons and daughters of parents of limited incomes who have sufficient ability, as tested by examinations, to profit by continued attendance at school and college. The report indicates that in London, as elsewhere, there has been a disposition to multiply unduly the number of scholarships offered for competition, with the result that in certain districts there has had to be a marked lowering of standard

of efficiency so that the scholarships might be filled up. This danger, with others, has been under the consideration of the committee, and steps have been taken in the case of certain classes of scholarship to reduce the number available, so that an efficient standard may be maintained. In framing the regulations which will govern the award of scholarships and exhibitions during the next academic year, the committee has endeavoured to arrange that, so far as possible, "no child or young person shall be debarred by poverty from obtaining the kind of education which will prepare him for the career for which his talents and character best fit him, and that the pecuniary emoluments attaching to the scholarships shall be sufficient to enable students to obtain the kind of education, whether industrial, scientific, or literary, which is best suited to their needs and capacities, but not sufficient to induce them to undertake a particular course of study with the object of securing the pecuniary advantages attaching to the scholarship."

As indicating the wide scope of the London County Council scholarship scheme, which has recently been amended, it may be said that in 1905 the Council awarded (*a*) 2600 junior county scholarships to children between the ages of eleven and twelve, and that the annual cost of awarding one of these scholarships annually was 85*l.*; (*b*) 390 probationer scholarships, each costing 56*l.*, to children of thirteen to fourteen years of age; (*c*) 100 intermediate county scholarships, each costing 129*l.*, to boys and girls of from fifteen to seventeen years of age; (*d*) fifty senior county scholarships, each costing some 200*l.*, to students more than eighteen years of age; and (*e*) various scholarships in science, art, and technology, at an expenditure of more than 18,000*l.* To state the scholarships which are to be offered for competition this year will indicate some of the changes which have been made as the result of four years' experience. There are to be (*a*) 1800 junior county scholarships, costing each the same as in 1905, and 300 supplementary junior scholarships of lower value; (*b*) 300 intermediate county scholarships, but the value of each, for sufficient reasons, has been reduced to 72*l.*; and (*c*) 150 senior county scholarships, each as in 1905, costing 200*l.* But, whereas the total expenditure in 1905 was 283,940*l.*, the amount in 1909 has, notwithstanding the greater wisdom of the conditions of award in the scheme, been reduced to 263,080*l.* The report of the Education Committee gives very satisfactory evidence to show that the object the education authorities in London have in view is to secure a high quality in the results they obtain, rather than to spread an incomplete and rudimentary education far and wide.

A NUMBER of people interested in the teaching of housecraft and domestic science visited Battersea Polytechnic on June 29 to see the domestic economy training department. Since the department was opened in 1894 more than 400 students have obtained diplomas, and are now occupying responsible positions in leading institutions and schools; the present number of students above eighteen years of age in the department is 130. Students of the department attend, in their first year, a course in "science as applied to household work," which includes physics, chemistry, physiology, and hygiene. This course is taken in addition to the purely practical work of the domestic arts. During the second session the scientific basis of knowledge thus obtained is applied in the practice kitchens, laundries, and housewifery rooms and hygiene laboratories. In the third year's course the same subjects are treated in greater detail, special attention being directed to bacteriology and the examination of food-stuffs. The main objects of the science work are:—(*a*) to explain, so far as possible, the chemical composition and properties of the materials dealt with in household work; (*b*) to explain the principal chemical and physical changes taking place in the common household operations involved in cookery, laundrywork, &c.; (*c*) to give a training in the principles of scientific method. Special stress is laid on the fact that household work generally is really an application of a number of facts and principles in chemistry, physics, hygiene, bacteriology, &c., and that, in order to understand the *rationale* of the ordinary household processes, a knowledge of the general principles of the branches of knowledge just mentioned is necessary.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 27.—Sir Archibald Geikie, K.C.B., president, in the chair.—Notes concerning tidal oscillations upon a rotating globe: Lord **Rayleigh**.—The absolute value of the mechanical equivalent of heat in terms of the international electrical units: Prof. H. T. **Barnes**. It is pointed out that the Clark cells used by the author in his determinations of the mechanical equivalent of heat in terms of the electrical units were prepared according to the old specifications. The absolute measurements of the Clark cell now being carried on with such precision in the various standardising laboratories are expressed in terms of the new form of cell with specially prepared mercurous sulphate. There is an important difference between the cells, which Wolff and Waters have shown amounts to 0·03 millivolts. The author has compared a set of modern cells with cells set up according to the old specifications, and finds the same constant difference. Taking 1·4330 international volts at 15° C. as representing the modern cells, then the cells made by the old specifications must be taken as 1·4333 international volts at 15° C. The author's measurements of the mechanical equivalent at different temperatures were calculated on the basis of a value for the Clark cell equal to 1·4342 international volts at 15° C. Re-calculating on the new basis, the value of the mean calorie is found to be 4·1849 joules. This agrees with Reynolds and Moorby's directly determined mean, which, expressed accurately for an interval of temperature between 0° C. and 100° C., comes to 4·1836 joules. Rowland's mean value between 5° C. and 35° C. is 4·185 joules, while the author's value between the same limits of temperature is 4·1826 joules. Thus, assuming the variation of the specific heat of water to be correctly determined, the value of the Clark cell, equal to 1·4330 international volts, brings the electrically determined mechanical equivalent into excellent agreement with the same constant measured by mechanical means.—An approximate determination of the boiling points of metals: H. C. **Greenwood**. Although high temperatures can now be easily attained by means of electric heating, no general investigation of the boiling points of metals has yet been carried out. Moreover, such values as are available have in most cases been deduced indirectly, and are very discordant. In the present investigation apparatus was devised for directly measuring the temperatures of ebullition under atmospheric pressure of a considerable number of metals, allowing of use up to 2700° C. Heating was effected electrically, and the metal, when unaffected by carbon, was contained in a thin-walled graphite crucible on the outside of which the temperature was estimated by means of a Wanner optical pyrometer. The difference in temperature between the internal and external surfaces of the crucible walls was found to be negligible. Accuracy of the temperature measurements was secured by checking the pyrometer against the "black body" melting points of specially purified strips of platinum, rhodium, and iridium. The following values were found:—aluminium, 1800° C.; antimony, 1440° C.; bismuth, 1420° C.; chromium, 2200° C.; copper, 2310° C.; iron, 2450° C.; magnesium, 1120° C.; manganese, 1900° C.; silver, 1955° C.; tin, 2270° C. In dealing with the metals aluminium, chromium, iron, and manganese, which readily combine with carbon, considerable difficulty was experienced in avoiding contact with carbon at the high temperatures in question. This was finally accomplished by the use of graphite crucibles brasqued with previously fused magnesia. In the absence of this protective lining the boiling point was very greatly modified by carburisation. The temperatures indicated for aluminium and manganese were far below those hitherto supposed necessary for ebullition. —Some results in the theory of elimination: A. L. **Dixon**. The eliminant of two quantics $\phi(x)$, $\psi(x)$, each of the n^{th} degree, may be expressed as a determinant the elements of which are (a_s, r_t), where (a, r) is $[\phi(a)\psi(r) - \phi(r)\psi(a)]/(a - r)$, and $a_1, \ldots a_n$, $r_1, \ldots r_n$ are two sets of n arbitrary quantities. For three quantics $\phi(x, y)$, $\psi(x, y)$, $\chi(x, y)$, each of the form $\Sigma A_{rs} x^r y^s$ $(r \leqq n, s \leqq m)$, the eliminant is a determinant the elements of which are $F(a_s, b_s, \alpha_t, \beta_t)$ where $F(a, b, \alpha, \beta) = (\phi(a, b),$

$\psi(\alpha, \beta)$, $\chi(\alpha, \beta))/(a-\alpha)(b-\beta)$, and $a_1, b_1, \ldots, \alpha_1, \beta_1, \ldots$ are two sets of 2 mn pairs of arbitrary quantities. The eliminant of two quantics $\Phi(x)$, $\psi(x)$ may be expressed as a Pfaffian

$$\Sigma\pm[1, 2][3, 4][5, 6] \ldots [2n-1, 2n]$$

where $[r, s]=\{\phi(a_r^2)\psi(a_s^2)-\phi(a_s^2)\psi(a_r^2)\}/(a_r+a_s)$. The eliminant of three quantics $\phi(x, y)$, $\psi(x, y)$, $\chi(x, y)$ of the ordinary standard form $\Sigma A_{rs}x^r y^s$, $(r+s\equiv n)$ is given by the Pfaffian

$$\Sigma\pm[1, 2][3, 4][5, 6] \ldots [2n^2-1, 2n^2]$$

where

$$[r, s]=(\phi(a_r b_r, a_r+b_r), \psi(a_r a_s, a_r+a_s), \chi(a_s b_s, a_s+b_s))/(a_r-b_s)(a_s-b_r).$$

—The liquidus curves of the ternary system aluminium-copper-tin: J. H. **Andrew** and C. A. **Edwards.** The study of the constitution of alloys is of great theoretical interest, and of some practical value; in fact, it may be said that the heat treatment of a given series of alloys cannot be correctly accomplished without an accurate knowledge of the structural changes which occur with varying temperature and concentration. We are now in possession of accurate data bearing on the constitution of a large number of alloys containing only two elements, but very little work has been published on mixtures of three or more metals. The object of the present research was to throw some light on the properties of ternary alloys, and, incidentally, the effect of impurities on binary alloys. The metals from which the alloys were made had the following degree of purity:—

	Per cent.
Aluminium	99·57
Copper	99·98
Tin	99·98

Freezing-point determinations.—The freezing points of the alloys were determined directly after mixing by means of a platinum + 10 per cent. iridium thermo-junction. The free ends of the wires were connected by a mirror galvanometer and balancing arrangement similar to that described by Messrs. Carpenter and Keeling in their work on the iron-carbon alloys. In order to locate the position of the isothermal curves, more than 400 alloys and melting-point determinations were made. *Conclusions.*—The character of the liquidus curves indicates that no well-defined ternary compound is deposited from any of the liquid alloys. The affinity of tin for either aluminium or copper is not sufficient to overcome the affinity of the last two elements for each other. As a consequence of the above, curves of the melting points of alloys containing a constant percentage of tin bear a striking resemblance to the liquidus curve of the aluminium-copper alloys. Tin is insoluble in by far the greater number of the alloys.—Studies on the structure and affinities of Cretaceous plants: Dr. M. C. **Stopes** and Dr. K. **Fujii.** This paper is the first account to be published of the anatomy of Cretaceous plants petrified in calcareous nodules. As an introduction to the flora, eighteen plants are described, all of which are new. The age of these plants is Upper Cretaceous, as is determined from the ammonites which abound in the matrix of the nodules, and the locality of all the specimens described is Hokkaido, northern Japan. The plants include one fungus, three ferns, eight gymnosperms, and six angiosperms. These numbers seem to represent, roughly, the proportions of the flora of the nodules as a whole, of which many more specimens are in the hands of the authors than are described in the present paper. The most interesting of the plants are:—a new type of gymnosperm, Yezonia, of which the vegetative anatomy is different from that of any known genus; a gymnospermic fructification, also new, which there is good reason to believe belonged to Yezonia; an angiosperm which is included in the Sabiaceæ; an angiosperm of the family Saururaceæ; and the first petrified flower, Cretovarium, which has three carpels surrounded by the perianth. The names of the described plants are:—*Petrosphaeria japonica, Fasciostelopteris Tanslei, Schizaeopteris mesozoica, Niponophyllum cordaitiforme, Yezonia vulgaris, Yezostrobus, Oliverii, Araucarioxylon tankoensis, Cedroxylon Matsumurii, C. Yendoii, Cunninghamiostrobus yubariensis, Cryptomeriopsis antiqua, Saururopsis niponensis, Jugloxylon Hamaoanum, Populocaulis yezoensis, Fagoxylon hokkaidense, Sabiocaulis Sakurii, Cretovarium japonicum.* The phylogeny and distribution of these plants is considered so far as possible.

June 17.—Sir Archibald Geikie, K.C.B., president, in the chair.—The nature of the hydrogen flocculi on the sun: Prof. G. E. **Hale.** Photographs of the Hα line in the spectrum of the solar disc, made on Mount Wilson with high dispersion, were shown on the screen. The line appears as follows:—(1) A broad dark line, differing greatly in intensity and width in different regions of the sun. Except in eruptive or rapidly changing phenomena, the differences in width are not very marked. (2) Within the boundaries of the dark line a narrow single or multiple bright line is photographed in many parts of the sun. Sometimes the appearance resembles that of the calcium lines K_2 and K_3—*i.e.* the bright line, lying on its dark background is divided into two components by a central dark line. In other regions the bright line is divided into a larger number of components, varying in width and separation. The images of dark hydrogen flocculi, on spectroheliograph plates taken with camera slit about equal in width to Hα, appear to be due, in the main, to local increase in the intensity of the dark line. In some parts of the sun, particularly those where the line is distorted, variations in the width of the line may also play an important part. The increased intensity of the dark line is probably the result of increased absorption. Slides were shown to illustrate the fact that prominences at the sun's brink are frequently recorded as dark flocculi when photographed in projection against the disc. The possible effects of anomalous dispersion were discussed, and photographs were exhibited of the same region of the sun, taken simultaneously with light from the red and violet edges of Hα. The similarity of these photographs apparently indicates that anomalous dispersion is not the prime factor in producing the hydrogen flocculi. Certain minor differences suggest, however, that it may perhaps play a secondary part in modifying their form.—The origin of certain lines in the spectrum of ε Orionis (Alnitam): Sir Norman **Lockyer,** K.C.B., F.R.S., F. E. **Baxandall,** and C. P. **Butler.** The star ε Orionis (Alnitam) is of great importance as offering a possible transition stage between the helium and bright-line stars, and the only outstanding lines of unknown origin were those at 4097, 4379·8, and a conspicuous double at $\begin{matrix}4647{\cdot}6\\4650{\cdot}8\end{matrix}$. In the case of 4097, the clue to the identification was obtained from a spark spectrum of chromium, showing local intensifications of certain lines at one of the poles. Two of these lines were found to be the previously known silicon (iv) lines, 4089, 4116, probably present as impurities in the fused chromium, while one of the remaining two lines was found to coincide with the ε Orionis line at 4097. These four lines are shown under various conditions in the plate, indicating the steps taken in tracing their origin to nitrogen. In the spectrum of nitrogen, under the special conditions which gave the above lines at 4097, 4103, another line was found at 4379·8, which was greatly strengthened in comparison with its intensity in the ordinary spark, and this line coincides with the unknown line in ε Orionis. During the work on the above lines, one of the photographs taken of an alcohol spectrum showed abnormal intensifications on either side of the oxygen line 4649·2, suggesting the presence of a new double. The wave-lengths of the components of this double were determined as 4647·6, 4650·8, coinciding with the wave-lengths of the components of the strong double in ε Orionis. By a series of comparison photographs of spectra under varied conditions, the origin of the double was traced to carbon, and one of the strips of the plate (carbon spark in hydrogen) shows it quite isolated as it appears in the stellar spectrum. Further evidence of the validity of the identification is afforded by the peculiar nature of the components of the double.—Electric induction through solid insulators: Prof. H. A. **Wilson.** This paper contains an account of a series of experiments on the variation of the capacity of ebonite and other condensers, with the time of charging and with the potential difference. It is shown that the capacity

C after a time of charging t is given by the formula $C=C_0(1+B\log(1+pt))$, where C_0 denotes the capacity when $t=0$ and B and p are constants. In the case of ebonite at 30° C. this formula represents the results obtained to within 1 part in 2000. The values of the constants have been found for several substances at different temperatures. The capacity is shown to be independent of the potential difference within the limits of error. It is shown that after the temperature of an ebonite condenser has been changed, then a very slow change in the capacity goes on which continues for more than 100 hours at constant temperature.—The effect of pressure on the band spectra of the fluorides of the metals of the alkaline earths: R. **Rossi.** It was shown by A. Dufour that the band spectra of the fluorides of the alkaline earths show a marked Zeeman effect, and it was thought interesting to see whether these particular bands would also be displaced by pressure, for it is known that the cyanogen bands, which, like most bands, do not show a Zeeman effect, are not displaced by pressure. The large 21½-feet concave grating spectrograph of the physical laboratory of the Manchester University was used, and the bands of the fluorides of calcium, barium, and strontium were found to be shifted by pressure. The order of magnitude of the displacement is about the same as for line spectra.—The components into which the bands are resolved are widened by pressure, and the linear relation between pressure and displacement found by former observers on line spectra seems to hold also for these bands. There does not seem to be any evident relation between the magnitudes of the Zeeman and pressure-shift effect in the case of these bands.—The ionisation produced by an α particle: Dr. H. **Geiger.** The aim of the experiment was an accurate determination of the number of ions produced by an α particle when completely absorbed in air. The most direct way to find the number of ions would be to measure the whole ionisation produced by the α particles from a known quantity of radium C. Since it is, however, practically impossible to obtain the saturation current due to the α particles at atmospheric pressure, it was necessary to adopt an indirect method. This method was briefly as follows:—The ionisation due to the whole number of α particles expelled from a known quantity of radium C was measured at a low pressure, allowing only a small definite portion of the range of each α particle to be effective. The ratio of the ionisation produced within this small portion of the range to the ionisation produced along the whole path was then found from an accurate determination of the ionisation curve. It was found that the number of ions produced in air by an α particle from radium C along its whole path is $2{\cdot}37\times10^5$. Since the α particles from different radio-active products differ only in their initial velocity, it was possible by the aid of the ionisation curve of radium C to calculate the number of ions produced by the other products.—A diffuse reflection of α particles: Dr. H. **Geiger** and E. **Marsden.** It was observed that a diffuse reflection takes place when α particles are incident on a plate. The reflected particles were counted by the scintillations produced on a zinc sulphide screen. The effect was found to vary with different metals as reflectors, the amount of reflection being approximately proportional to the atomic weight of the reflecting substance. Using different numbers of thin gold foils as reflectors, it was found that the reflection was a volume effect, and thus similar to the reflection of β particles. Taking a measured quantity of radium C as source, and using a plate of platinum as reflector, it was found that, of the incident α particles, about 1 in 8000 suffers reflection.—The decay of surface waves produced by a superposed layer of viscous fluid: W. J. **Harrison.** An estimate is obtained of the effect of a thin layer of viscous liquid on the decay of waves at the surface of a slightly viscous liquid. The period equation for the motion is of the fourth degree, and has two real and two complex roots in the case of waves of less than a certain length, and four complex roots in the case of waves of greater length. The real roots correspond to dead-bent modes, the complex roots to propagated modes. No general expression of any use can be obtained for the damping, but the equation can be solved numerically in any particular case. In the paper the velocity of propagation and the modulus of decay are given for waves of length 2, 5, 10, 20 cm. at the surface of mercury on which is superposed a layer of glycerine 1 mm. in depth. An estimate is also obtained for the damping when the wave-length is small compared with the depth of the layer. Two other problems in the decay of surface waves are discussed.—The passage of electricity through gaseous mixtures: E. M. **Wellisch.** (1) An experimental method (based on Langevin's method) has been devised in order to ascertain whether there are two distinct mobilities for the positive or for the negative ions produced by Röntgen rays in a mixture of two gases, or of a vapour and a gas. (2) No evidence was found of the existence of the two distinct mobilities; accordingly it is necessary to conclude that the motion of the ion through the medium must involve a mechanism of a character such as to produce a statistical average. (3) Experiments were conducted with regard to the effect produced on the ionic mobilities in air by adding small quantities of vapours. The mobilities showed a marked decrease on the addition of alcohol and acetone, but were not sensibly affected by the addition of the heavier vapours of methyl iodide and ethyl bromide. (4) Experiments were performed with regard to the ionic mobilities in mixtures of a gas and a vapour, the ions being formed from the latter constituent only. As a result of the experiments, it was shown that there must be, at all events initially, a transference of the charge (both positive and negative) from the vapour to the gas molecule. (5) Experiments were performed with regard to the stability of the vapour ions in the presence of hydrogen; it was shown that the vapour molecules can accompany the charge to an appreciable extent, even in the presence of a considerable quantity of hydrogen. (6) The mechanism by which the transference of charge from one molecule to another is effected has been discussed; there is reason to believe that the transference takes place by the medium of a detachable unit of positive electricity. (7) From the experimental results a theory of the mechanism underlying the passage of electricity through gases at ordinary temperatures and pressures has been deduced.—A study of the use of photographic plates for the recording of position: Dr. C. E. K. **Mees.**—The coefficients of capacity and the mutual attractions or repulsions of two electrified spherical conductors when close together: Dr. A. **Russell.** The computation of the electrostatic energy of two spherical conductors when close together is an important problem in spark systems of wireless telegraphy. In this case the formulæ previously given for the capacity coefficients are very laborious to evaluate. By extending a mathematical theorem due to Schlömilch, an approximate formula is obtained for the sum of a certain infinite series. By using this theorem, it is shown that when the spheres are close together the ordinary series formulæ for the capacity coefficients can be written in forms which can be readily computed to any required degree of accuracy. The author has re-computed and extended in this way Kelvin's table for the capacity coefficients of two equal spheres when the least distance between them does not exceed half the radius of either. When the spheres are at microscopic distances apart, the formulæ become very simple. Kelvin's table also for the rates at which the capacity coefficients of two equal spheres alter with the distance between them, when this distance does not exceed half the radius of either, has been re-computed and extended. When the spheres are very close together the laws of attraction and repulsion are simple. Let the radius of each sphere be a, let x denote the least distance between them, and suppose that the ratio V_1/V_2 of the potentials of the two spheres is not nearly equal to unity, and that x/a is very small compared with unity. In this case the mutual force between the spheres is attractive, and is given by

$$\frac{a(V_1-V_2)^2}{8x} \text{ approximately.}$$

If the potentials of the spheres be equal, the repulsive force between them is, to a first approximation, given by Kelvin's formula for the repulsive force between two equal

spheres when in contact. When the charges on the spheres are $+q$ and $-q$ respectively, and x/a is small compared with unity, the attractive force between them is given by

$$\frac{2q^2}{ax\{\log_e(a/x)\}^2} \text{ approximately.}$$

—The effect of previous magnetic history on magnetisation: E. **Wilson**, G. E. **O'Dell**, and H. W. K. **Jennings**. It is well known that if a piece of iron be subjected to a considerable magnetising force, and then be tested for permeability corresponding to a lower force, the permeability so obtained may differ widely from the permeability which would have been obtained had the material been previously demagnetised. The principal object of this paper is to examine the effect of previous history upon the dissipation of energy by magnetic hysteresis. A ring of iron was carefully demagnetised, and the hysteresis loop No. 1, corresponding to a force H, was obtained. The force was then increased to a value H, for the purpose of producing previous history, and removed. A hysteresis loop No. 2, corresponding to the force H, was then obtained. As is well known, this loop shows a reduced permeability. The ring was carefully demagnetised, and a hysteresis loop No. 3 obtained as follows. A magnetising force supplied by an additional coil was gradually increased, until on reversal of the original force H a change of magnetic induction exactly equal to that observed in the case of loop No. 2 was obtained. Two loops (Nos. 2 and 3) have now been obtained, each having the same change of magnetic induction and the same net change of force H. The change from loop No. 1 to loop No. 2 has been brought about by inter-molecular force, whereas the change from loop No. 1 to loop No. 3 has been brought about by the application of an externally applied constant force. If the effect of inter-molecular force were capable of being exactly equivalent to that of the externally applied constant force, one would expect to find that the energy required to perform a complete cycle would be the same in each case—that is, the area of loop No. 2 would be equal to the area of loop No. 3. The experiments show that within certain limits the area of loop No. 2 is greater than that of loop No. 3, the difference depending upon the magnitude of the reversed force H and the previous history.

Mineralogical Society, June 15.—Principal H. A. Miers, F.R.S., president, in the chair.—Carnotite and an associated mineral-complex from South Australia: T. **Crook** and G. S. **Blake**. The carnotite of Radium Hill, near Olary, South Australia, occurs in a definitely crystalline condition. The crystals are tabular and orthorhombic in symmetry. The carnotite of Colorado, though not so definitely crystalline, also contains tabular crystals which are orthorhombic in symmetry, and probably identical in mineral characters with those of South Australia. From the general characters of these crystals it appears that carnotite is a mineral belonging to the uranite group, and that it may be regarded as the vanadium analogue of autunite. The black lodestuff in which the Radium Hill carnotite occurs is heterogeneous in constitution. It consists essentially of ilmenite, which is impregnated with magnetite, rutile, carnotite, and a mineral which is possibly tscheffkinite. The evidence provided by a study of the complex does not necessitate the view that new minerals are present, such as that to which the name "davidite" has been given.—The species pilolite, and the analysis of a specimen from China: G. S. **Whitby**. The specimen examined is from a new source, and possesses the formula $Al_2O_3.2SiO_2,2(MgO.2SiO_2),7H_2O$, a formula which is simpler than those given by Heddle and by Friedel to the pilolites which they investigated. The author considered that, for the present, the term pilolite should be applied to those varieties of mountain leather and mountain cork which (1) cannot be referred to asbestos, on account of their large water-content; (2) cannot be identified with serpentinous asbestos, on account of the relatively small amount of magnesia which they contain; and (3) hold their water in such a way that, when it has been expelled by heating, it is gradually re-absorbed to its original amount from the atmosphere.—Phenakite from Brazil: Dr. G. F. Herbert **Smith**. Crystals of phenakite recently discovered at the gold mine, San Miguel de Piracicaba, Brazil, all display the new form {2352}, noted by other observers, and another, {4506}, lying near it. The tetartohedral character of the symmetry is clearly marked.—Preliminary note on the occurrence of gyrolite in Ireland: F. N. A. **Fleischmann**. The mineral gyrolite, though well known as occurring in the basalts of the western islands of Scotland, has not hitherto been recorded from Ireland. Specimens have now been found in the basalts and dolerites in the neighbourhood of Belfast. The mineral occurs in small spherical aggregates, forming a crust on faroelite; it is associated with apophyllite, and occasionally with chabazite. The chemical composition and the optical characters of the mineral agree with those of gyrolite. The mineral is found only in the harder and denser layers of the basalt, and never in the soft, highly amygdaloidal layers.

Zoological Society, June 15.—Dr. A. Smith Woodward, F.R.S., vice-president, in the chair.—The organ of Jacobson in Orycteropus: Dr. R. **Broom**. Orycteropus has a long narrow organ of Jacobson which opens into the naso-palatine canal. The arrangement of the cartilages is quite different from the type found in the higher Eutheria, and there is also a marked difference from the arrangement in Dasypus. The general structure comes nearest to that of the marsupials, though there are a number of striking differences.—Some points in the structure of the lesser anteater (*Tamandua tetradactyla*), with a note on the cerebral arteries of Myrmecophaga: F. E. **Beddard**.—Decapod Crustacea from Christmas Island, collected by Dr. C. W. Andrews: Dr. W. T. **Calman**.—An abnormal individual of the echinoid Amblypneustes: H. L. **Hawkins**.—The decapods of the genus Gennadas collected by H.M.S. *Challenger*: S. **Kemp**.—Notes on a young walrus (*Odobaenus rosmarus*) recently living in the society's gardens: Dr. P. C. **Mitchell**.—Notes on the viscera of a walrus (*Odobaenus rosmarus*): R. H. **Burne**.

Royal Meteorological Society, June 16.—Mr. H. Mellish, president, in the chair.—Interdiurnal variability of temperature in Antarctic and sub-Antarctic regions: R. C. **Mossman**. The author discussed the day-to-day difference in the mean temperature of successive days at a few places in the Antarctic regions for which the necessary detailed daily observations are available. The greatest mean annual temperature variability, viz. 5·9°, was recorded during the "drift" of the *Belgica* in the ice pack, this high value being closely followed by a mean of 5·3° at the South Orkneys. In the Victoria Land region, Ross Island and Cape Adare have a somewhat lower temperature variability of 4·5°, the values of the southern station being higher in summer and autumn and lower in winter and spring than at the northern station. South Georgia occupies an intermediate position between a continental and an oceanic climate in its curve of variability, the mean monthly values varying according to the proximity of the pack ice. At this station the seasonal values show a small variation, and this is also the case at Ushuaia, in Tierra del Fuego. The variability at the Falkland Islands and New Year's Island is very small, pointing to the conserving influence exerted by the insular conditions which prevail at these places. The maximum variability occurs in winter, and the minimum in summer, at the three Antarctic stations, as well as at South Georgia and the South Orkneys. The smallest variability at any season for any station occurs at the South Orkneys in summer, being only 1·4°. It is at this season that cloud amount and fog frequency are at a maximum, while, at the same time, rapidly moving cyclonic disturbances are of infrequent occurrence.—Temperature records during balloon ascents: E. **Gold** and Dr. W. **Schmidt**. The authors described experiments made with the view of ascertaining if appreciable errors could enter into the temperatures recorded in balloon ascents owing to errors in the alcohol-carbonic acid method of testing the apparatus.—The exposure of thermometers: L. C. W. **Bonacina**.

EDINBURGH.

Royal Society, June 7.—Prof. Crum Brown, vice-president, in the chair.—The anatomy of the Weddell seal: Prof. D. **Hepburn**. Dr. W. S. Bruce, leader of the Scottish National Antarctic Expedition, had been fortunate to catch a young male seal only two or three days old, and it was this young specimen of the Weddell seal the anatomy of which was described in detail. Attention was particularly directed to the abdominal cavity, and especially to the peritoneal arrangements and the organs of alimentation. The length of the animal was 51·5 inches, and the length of the intestine 50 feet.—Lower Palæozoic Hyolithidæ from Girvan: F. R. Cowper **Reid**. The description was based on specimens in Mrs. Gray's collection. Nearly all the species were new; ten well-defined species of Hyolithes were established, also three of its subgenus Orthotheca. Two other forms were referred to Ceratotheca, and five new species of Pterotheca were recognised. The affinities of these new species were found to be rather with the Scandinavian than with English members of the group. The rich development of the Hyolithidæ in the Girvan district as compared with other British areas was noticed, and a marked feature of their stratigraphical distribution was the abundance of species in the Blaclatchie beds.—The atomic weight of platinum: Prof. E. H. **Archibald**. The experimental feature of the paper was the extreme care taken to ensure absolute purity of the platinum salts of chloro- and bromo-platinic acids used in the determination. Assuming the values given by the International Committee for the atomic weights concerned in the calculation, the author found the atomic weight of platinum to be not far from 195·25.—Group-velocity and the propagation of waves in a dispersive medium: G. **Green**. The aim of the paper was to develop the idea of group-velocity contained in Kelvin's paper of 1887 on the waves produced by a single impulse in water, &c., and to remove difficulties raised by Kelvin in later papers as to the applicability of Osborne Reynolds's and Rayleigh's dynamical interpretation of group-velocity. The idea of group-velocity used was essentially the same as the principle of "stationary phase" used by Lamb in his investigation of ship waves, but applied in this paper to the Fourier trains which constitute any wave-disturbance. The whole investigation was useful in directing attention to the manner in which group-velocity was concerned in the modification of an initially regular group of waves, or of any disturbance initially confined to a finite portion of a dispersive medium, and in showing, thereby, that the idea of group-velocity contained the explanation of the *modus operandi* of dispersion.—The theory of Jacobians in the historical order of development up to 1860: Dr. T. **Muir**.—*Nematonurus lecointei*, a deep-sea fish first discovered by the *Belgica*, and found again by the Scottish National Antarctic Expedition: Prof. Louis **Dollo**. The one specimen obtained by Dr. W. S. Bruce was found in lat. 62° 10′ S. and long. 41° 20′ W. at a depth of 1775 fathoms, and it constitutes the first macrurid found in the Antarctic seas. The corresponding Arctic zone has yielded eight species in six genera. The results were regarded by Prof. Dollo as unfavourable to the theory of bipolarity.—An experiment with the spark gap of an induction coil: Dr. Dawson **Turner**. When the spark gap is just long enough to prevent the easy passage of the spark, a dielectric rod or plate brought near the positive electrode facilitates the discharge, but when brought similarly near the negative electrode it has no obvious influence on the passage of the spark.

PARIS.

Academy of Sciences, June 21.—M. Bouchard in the chair.—Dimethylcamphor and dimethylcampholic acid: A. **Haller** and Ed. **Bauer**. Camphor forms a sodium derivative when treated with sodium amide, from which the monoalkyl and dialkyl derivatives are readily obtained. The mixture of monoalkyl and dialkyl derivatives can be separated by taking advantage of the fact that only the mono-derivatives combine with hydroxylamine to form an oxime. Dimethylcamphor, heated with sodium amide, gives an amide, probably dimethylcampholamide, from which the corresponding acid has been obtained.—The strata of the island of Elba: Pierre **Termier**.—The new Daniel comet: M. **Javelle**. Observations of this comet were made at Nice on June 16, 17, 18, and 19. The comet was nearly circular, with a diameter of 1·5′. There was a faint nucleus of magnitude 11 to 12.—Observations at the Observatory of Marseilles of the comet 1909*a* (Borrelly): Henry **Bourget**. Nucleus scarcely perceptible, of about 10·5 magnitude.—Observations of the comet 1909*a* (Borrelly-Daniel) made at the Observatory of Besançon with the bent equatorial: P. **Chofardet**. Observations made on June 17 and 19. Diameter, 1·5′; nucleus, very faint; magnitude, 11 to 12.—A question of minimum: S. **Sanielevici**.—The series of Dirichlet: Marcel **Riesz**.—Flight and the shape of the wing: L. **Thouveny**.—An experimental method for aërodynamical researches: A. **Rateau**. The surfaces or models to be studied are placed in a very homogeneous air current moving with a definite velocity. The results of experiments on a thin rectangular plane are shown graphically, and it is shown that there is no possible angle of inclination of the plane between 29° and 36°. This discontinuity was quite unexpected.—The heat of polonium: William **Duane**. The sensitive differential calorimeter used in these experiments has been described in an earlier paper; 0·2 gram of polonium salt gave off 0·0117 calorie per hour. Polonium and radium in quantities which give the same ionisation currents give off practically the same quantities of heat. This fact is favourable to the hypothesis that the heat given off by these bodies is due to the kinetic energy of the α rays.—The ionisation of air by high-tension electric mains: L. **Houllevigue**. The observed case of a hailstorm following exactly the direction of a high-tension cable has been explained by the suggestion that the wire emits torrents of ions carrying large electric charges. Direct experiment fails to confirm this hypothesis. The number of ions, positive and negative, existing in the neighbourhood of a high-tension wire is sensibly *nil*. Indeed, the high-tension lines appear to reduce the number of ions in the immediate neighbourhood rather than increase them.—A new form of the characteristic equation of gases: A. **Leduc**.—A new application of the superposition, without confusion, of small electrical oscillations in the same circuit: E. **Mercadier**. The original experiments were carried out with a complete metallic circuit; similar experiments have now been successfully carried out between Paris and Lyons, using a single telegraph wire with earth return.—A galvanometer for alternating currents: M. **Guinchant**. The galvanometer described was designed to replace the telephone in Kohlrausch's method of measuring the resistance of electrolytes. The accuracy of the measurements is of the same order as when the telephone is used.—The action of some organo-magnesium compounds on methyl-2-pentanone-4: F. **Bodroux** and F. **Taboury**. The reaction is complex, as employing the reagents in molecular proportions there is always a considerable proportion of unaltered ketone in the reaction product, together with the ethylene hydrocarbon corresponding to the tertiary alcohol which should normally have been produced. The tertiary alcohol is formed with a yield varying from 40 per cent. to 60 per cent. of the theoretical.—Some derivatives of thioindigo: M. **Béchamp**.—Elateric acid: A. **Berg**.—Pseudomorphine: Gabriel **Bertrand** and V. I. **Meyer**. Cryoscopic methods indicate that pseudomorphine is derived from two molecules of morphine with the loss of two atoms of hydrogen, and its formula would thus be $C_{34}H_{36}N_2O_6$.—The crystalline schists of the Ural: L. **Duparc**.—The elaboration of the nitrogenised material in the leaves of living plants: G. **André**.—The influence of time on the anti-virulent activity of the secretions of vaccinated animals and the relative immunity of the tissues: L. **Camus**.—The influence of a prolonged stay at a very high altitude on the animal temperature and the viscosity of the blood: Raoul **Bayeux**. The body temperature and the viscosity of the blood, under the influence of high altitudes, undergo modifications which are proportional to the stay at the high altitude.—Hay fever: Pierre **Bonnier**.—The tectonic relations of the earthquake in Provence: Paul **Lemoine**.—A geological sketch of the regions situated to the east and north-east of Tchad: G. **Garde**.—The geology of the Peloponnesus: Ph. **Négris**.—The position of the localities which appear to

have been most troubled in the earthquake of June 11, 1909: M. **Jullien.**—The oxydases of the waters of Chaldette (Lozère): F. **Garrigou.**

NEW SOUTH WALES.

Linnean Society, April 28.—Mr. C. Hedley, president, in the chair.—The geology and petrology of the Canoblas, N.S.W.: C. A. **Süssmilch** and Dr. H. I. **Jensen.** The Canoblas are a group of extinct volcanoes in the vicinity of Orange, N.S.W. The western tableland here has an elevation of about 3000 feet. The surface of the tableland is a peneplain, above which rise residuals of a still older plain. This peneplain was cut out of a series of folded Devonian and Silurian rocks, and has since been elevated to its present altitude (3000 feet). The Canoblas Mountains proper consist of lavas and tuffs, deposited upon the peneplain.—Observations on the development of the marsupial skull: Prof. R. **Broom.** A fairly complete series of the diprotodont *Trichosurus vulpecula*, and an interesting early stage of the polyprotodont *Dasyurus viverrinus*, have been studied.—Notes on the synonymy and distribution of certain species of Australian Coleoptera, with descriptions of new species of Tenebrionidæ: H. J. **Carter.** The paper comprises notes upon the synonymy and distribution of a number of species referable to the three families Buprestidæ, Tenebrionidæ, and Cerambycidæ, accumulated during a recent visit to Europe, and especially to the museums in Brussels, Paris, London, and Oxford, together with the descriptions of twenty-one species of Tenebrionidæ proposed as new.

CALCUTTA.

Asiatic Society of Bengal, May 5.—A Goniomya from the Cretaceous rocks of southern India: H. C. **Das-Gupta.**—Coptis: I. H. **Burkill.** The author endeavours to determine the source of the roots of Coptis sold in India. Three kinds are sold, one, as is well known, coming from the Mishmi hills, and being derived from *Coptis Teeta*, Wall, the other two imported over-seas, and possibly being, respectively, roots of *Coptis Teeta*, var. *chinensis*, Fine and Gagnep, and of *Coptis anemonaefolia*, Sieb. and Zucc. Plants of *Coptis Teeta* in cultivation at the Lloyd Botanic Garden, Darjeeling, have been studied, and figures drawn from them.—Morphological and physiological differences between Marsilea left on dry land and that growing in water: Nibaran Chandra **Bhattacharjee.** *Marsilea quadrifolia* does not fruit when growing in water, but only on dried earth.—Notes on the history of the district of Hughli before the Mohammedan period: Nundo Lal **Dey.**—The drug astukhudus, nowadays *Lavandula dentata*, and not *Lavandula Stoechas*: I. H. **Burkill.** It is probable that the importation of *Lavendula dentata* into India began with the Portuguese trade. Before that, *Lavendula Stoechas* from Asia Minor served as the drug astukhudus from the time when the Mohammedans introduced it.—The Manikvala tope: H. **Beveridge.**—First notes on *Cymbopogon Martini*, Stapf: I. H. **Burkill.** The two varieties, Motia and Sofia, are to be distinguished from one another by the absence or presence of the chemical body carvon, by the angle at which the leaves arise, and by different preferences in the matter of climate.

CAPE TOWN.

Royal Society of South Africa, May 19.—Dr. L. Crawford in the chair.—The possible existence at Kimberley of oscillations of level having a lunar period: Dr. J. R. **Sutton.** The outstanding seismic feature of Kimberley is the diurnal variation of level whereby the crust of the earth rises and falls once a day under the influence of some solar action as yet uninterpreted. This matter was discussed in a paper read before the Royal Society of South Africa last July. The present discussion is concerned more with variations of level depending upon the gravitational influence of the moon. The observations do not cover a sufficiently extended period to admit of an exhaustive analysis, but, so far as they go, they imply perhaps that when the moon is south of the equator its attractive force causes the whole of the enormous protuberant mass of the earth's crust forming South Africa to oscillate periodically east and west during the course of the lunar day. This oscillation tends to mask whatever true lunar tide there may be in the solid earth. Only when the moon is nearest to the earth does the pendulum move in such a manner as to suggest that there is such a tide.—The rainfall of South Africa. The possibility of prediction over the south-west: A. G. **Howard.** For this investigation, which extended over five complete years, three stations were selected, so as to secure a triangle of observations, and at each the rise or fall of the barometer in twenty-four hours was noted, together with the direction of the wind at L'Agulhas. From a consideration of the various conditions, which fell under twenty-six heads, and were worked out daily during five complete years, it was found possible to construct a table for prediction purposes. This was applied to the rainfall for the year 1908, and the element of error under each condition of barometer was:—(1) when the pressure was decreasing generally, 5·23 per cent., and (2) when the pressure was increasing generally, about 11 per cent., proving the argument that it is possible to predict rainfall over the district from the date suggested.

DIARY OF SOCIETIES.

MONDAY, JULY 5.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Captain Tilho's Explorations in the Lake Chad Region: Lieut. Mercadier.

WEDNESDAY, JULY 7.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.

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