THURSDAY, FEBRUARY 7, 1907.

ANATOMY OF THE HORSE.

(1) *Surgical Anatomy of the Horse.* Part I. By John T. Share-Jones. Pp. xii+159; with 33 plates. (London: Williams and Norgate, 1906.)

(2) *Le Cheval.* By H.-J. Gobert. Pp. viii+412; with 80 figures. (Paris: Baillière et Fils, 1907.) Price 7 francs.

(1) SINCE 1832, when William Percival produced the first work exclusively devoted to the anatomy of the horse, considerable advances have been made in the methods of teaching veterinary anatomy; but it cannot be said that the production of anatomical literature has been correspondingly abundant in this country. The veterinarian has not had his time too heavily taxed by the examination of frequent new publications. Consequently, he will welcome with all the more interest the first part of a "Surgical Anatomy of the Horse," from the pen of Mr. J. T. Share-Jones, of the Liverpool Veterinary School. The present volume deals with the anatomy of the head and neck, as applied to the surgery of these regions; and it is to be followed by further parts devoted, in like manner, to the rest of the body.

The author, while admitting the psychological value of anatomy as a means of developing the faculty of observation, "is impelled to the conclusion that the subject is primarily and fundamentally utilitarian, and that the teaching of it should always be in association with the subject of surgery." Such an expression of opinion leads to the conclusion that the author is a surgeon at heart, and not an anatomist, as the term is generally understood nowadays. The modern anatomist has become much more a student of the scientific and comparative side of his subject than of its surgical or—to quote the author—utilitarian aspect. Surgery occupying the first place in his affections, and anatomy coming second, Mr. Share-Jones is clearly the proper person to write a "Surgical Anatomy." But even a surgeon, in producing such a work, should bear in mind that "anatomy" is the substantive, and "surgical" not more than an adjective. The work before us is rather more surgical and much less anatomical than are most standard publications bearing the same title. The various operations performed on the regions discussed are described at some length, with the consequent curtailment of the space allotted to topography. The result is not satisfactory from an anatomical point of view, for it means that the descriptions, as given, are of only moderate value to the student or practitioner to whom the structures have been made familiar by dissection, and of less value to the student entering upon a course of practical anatomy.

Certain statements, moreover, are of doubtful clarity and accuracy. For example, in speaking of the rudimentary first premolar teeth of the horse (referred to as "wolf's teeth"), it is said that "each is developed in the same dental groove as the corresponding row of molars, and is probably due to the displacement of a supernumerary dental germ in the groove." This scarcely squares with phylogeny. Again, the short section on the development of the teeth might have been omitted with profit, for from it the reader will gather little accurate knowledge of the process. To justify this assertion we may quote the first part of the section. "The first stage in the development of a tooth is the appearance in a groove in one of the maxillary bones of a little closed sac, which is called the dental follicle. The membranous wall of the follicle encloses a papilla, which is at a later stage termed the dental pulp, and from which the dentine is secreted. The enamel is developed from a special layer of epithelium which covers the upper aspect of the pulp, and which is called the enamel organ. As the dentine is formed from the superficial cells of the pulp, it becomes deposited between the latter and the follicular wall. From the superficial cells the tubular processes of the dentine are thrown out, but the intertubular substance is secreted by the deeper layer of cells. This latter substance contains the earthy salts."

The prefatory statement that "an endeavour has been made to illustrate graphically wherever possible, and to reduce the written matter to a minimum," leads to a close examination of the illustrations. Of these it may be said that they are of unequal merit, and few of them will compare favourably with illustrations in Continental works on topographical anatomy. In Plate xii. we notice a rather glaring inaccuracy in regard to the teeth, which leads us to suspect that the drawing was not made from an actual section. It is not stated at what level the section was supposed to have been made, and it is, therefore, not easy to form a correct judgment of its truth to nature; but surely there is something wrong with the mylo-hyoid and digastricus muscles?

That, in spite of the blemishes to which we have referred, the work will fill a gap in veterinary literature is undoubted, inasmuch as there is no other book in the English language which claims to be a surgical anatomy of the horse. That it will be of service to the student and practitioner may also be taken for granted. The publisher and printer deserve praise for the manner in which they have turned out the book.

(2) M. Gobert has endeavoured, with a considerable measure of success, to provide a short, popular treatise on the organisation, maintenance in health, and utilisation of the horse, for the use of those who desire to possess a greater knowledge of the animal than can be acquired through the more customary channels. From the nature and scope of the book, it is not expected that the section which deals with the anatomy of the horse will be other than extremely elementary. For the same reason it is unnecessary to submit it to elaborate criticism. The section has many merits. Its facts are set forth in clear terms, shorn, as far as possible, of technicalities. At the same time the author has fallen into the error, so frequently made by writers of similar popular works,

of including details which cannot possibly be thoroughly understood by the ordinary lay reader. For example, a certain amount of description of microscopic structure is included, which is either too much or too little. It would probably have been better omitted entirely. Again, a short list of muscles, such as is given on p. 14, cannot be of any value whatever to the reader for whom the book is intended. Most of the illustrations are good, but some of them—notably Fig. 2—are far from clear.

The compilation has much to commend it, and at the same time has many of the defects which appear to be inseparable from books of its kind.

HIGHER EDUCATION IN GERMANY.

The German Universities and University Study. By Friedrich Paulsen. Authorised translation by Frank Thilly and William Elwang. Pp. xvi+451. (London: Longmans, Green and Co., 1906.) Price 15*s.* net.

THIS excellent translation of Prof. Paulsen's celebrated book on the German universities will be welcomed by many readers interested in the question of university education who have not the time or opportunity to read it in the original; the book is not merely an account of German universities, but treats the general subject of higher education in its relation to the advancement of knowledge and to the life of the community on a broad and philosophic basis.

The peculiar value which seems to us to attach to this work is due to this very breadth of view; the author is concerned, not with pressing the importance of some particular aspect of university life or of the claims of a particular branch of learning, an attitude which reduces so much of the writing on English education to mere sectional pamphleteering, but with the presentation of the historical development of university life, and especially with the function of the university under modern conditions, and with the problems which these conditions bring in their train. It is probably true that it is easier to be dispassionate when one is contented, and Prof. Paulsen is, on the whole, contented with the German universities and what they have done and are doing for the culture of the German people; but his contentment goes deeper; he is satisfied that the universities in Germany owe their hold over the intellectual life of the people to their unreserved acceptation of the scientific spirit, that is to say, the spirit of inquiry and free investigation into all the departments of learning. The university is defended and vindicated by the author primarily as an institution for research and the advancement of knowledge, and secondarily as a place of education; secondarily, not from the mistaken notion that education is considered less important than the expansion of the limits of knowledge, for we may remember that the only way of entering the learned professions, including schoolmastering and the Civil Service, in Germany is through the university, but because the most important part of a university education is considered to be the actual contact with the fountains of knowledge and the acquisition of a capacity to grapple with original sources and to form an independent opinion. The system undoubtedly has its dangers, especially the danger of over-specialisation and the fault of encouraging students to undertake scientific investigation who would be more fittingly employed in practical affairs; but the author considers that the universities have gained and retained their influence by standing in the van of new ideas as the home for investigation, instead of handing on traditional learning, tardily and painfully modified from without by the changes of the times.

It is interesting to note the parting of the ways between the French and German universities at the beginning of the nineteenth century; the Napoleonic era converted the French universities into technical schools for the professions, and banished the pursuit of learning to the academies, while at that very time Humboldt founded the modern University of Berlin in direct opposition as an institution of free learning and broad education, and to that ideal all the German universities conformed.

There can hardly be any doubt as to which ideal has proved most fruitful, but the plan is apparently now advocated in some quarters in Germany of attempting to combine the technical schools in a closer alliance with the universities, and Prof. Paulsen has sufficient faith in the innate Teutonic love of learning to believe that science would not thereby be strangled in the grasp of a short-sighted utilitarianism. This, of course, especially applies to the natural sciences; but in all the faculties there have grown up, side by side with the universities, technical academies of art, military science, commerce, jurisprudence, and the like, which train an increasing number of students.

"All public institutions of learning," remarks Prof. Paulsen, "are called into existence by social needs," and it is interesting to follow the historical evolution of the university from this point of view as it is skilfully delineated by the author. The mediæval universities seem really to have satisfied our modern ideals to an extent which is perhaps not commonly suspected, and will probably never be re-attained; they were, in the first place, cosmopolitan, and not under the restrictions of a particular country or Government, and they were the true repositories of the learning of their times. With the coming of the Renaissance, and later of the Reformation, a change of the greatest importance occurred; from being cosmopolitan they became strictly territorial, from being free they became the *instrumenta dominationis* of the particular Government under which they happened to be.

In consequence, the faculty of law was chiefly fostered to the detriment of all others, and towards the end of the seventeenth century in Germany university life was at a very low ebb. With the foundations of Halle and Göttingen in the eighteenth

century a revival began, which Prof. Paulsen traces largely to the rise of the philosophical faculty from servitude as *ancilla theologiae* to the leadership, though it doubtless corresponded with the awakening of the general intellectual life of the country inaugurated by Klopstock and Lessing.

But the old freedom of the universities in Germany was necessarily never revived in its completion, and the position of the university as a State institution dependent to a large degree in its internal administration on the Government of the country in which it is situated leads to anomalies even now which Englishmen will not readily understand, though the real interference with freedom may be less than it seems. Thus the government of the university, even extending to the syllabus of studies in a particular faculty, is potentially, and sometimes actually, under the control of a Minister of Education, while the ordinary professors are appointed by the Sovereign of their country and the extraordinary by the Minister of Education, and it appears from the statistics quoted by Prof. Paulsen that in a fair proportion of cases the appointment runs counter to the recommendation of the faculties; but our author, ever determined to see both sides of a question, remarks that political and Court intrigues tend to efface the back-stairs politics of the faculties, so that in the end the right man is usually chosen.

It follows also from the dependency of the universities on the State that the teachers must hold cautious political views, and even Prof. Paulsen has nothing at all to say in favour of the Prussian Ministry which dismissed a privatdocent of physics from his post on the sole ground that he was a social democrat.

To choose one more point from a book absorbing throughout in interest, it is instructive to note that the absence of all social life such as is enjoyed at the old English universities does not cause that complete satisfaction which opponents of the system are so keen to insist on, but in several instances boarding-houses are being instituted where students can live in common. In the Middle Ages the residential collegiate system was, of course, universal, and a few colleges were retained long after the system had died out on the Continent for the benefit of the poorer students. It can hardly be held that the collegiate system persisted in England for the same purpose.

We may sketch the plan of Prof. Paulsen's work as follows:—in the first book we are given an outline of the historical development of the universities from the Middle Ages down to modern times, and probably nowhere else can so much be learnt on this subject within the compass of about seventy pages; the succeeding books are concerned with present-day conditions, the second treating of the relation of the university to the State, to society, and to the Church, the third dealing with university teachers and the methods of instruction, the fourth with university life from the student's point of view. In the fifth book some special problems connected with the several faculties of theology, law, medicine, and philosophy are discussed. G. S.

GEODESY IN THE SCHOOLS.

Text-Book on Geodesy and Least Squares Prepared for the Use of Civil Engineering Students. By Prof. Charles L. Crandall. Pp. x+329. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1907.) Price 12*s.* 6*d.* net.

SUCH a treatise offers little scope for originality of treatment or of design. The problems connected with triangulation, or with measurement, or with levelling have been considered too frequently and too minutely by experts to permit the introduction of novelty. Similarly in the application of the results of measurement to the discussion of the figure of the earth, the author must follow beaten paths and occupy ground that has been thoroughly surveyed. His opportunity for exhibiting independence lies rather in the judicious selection of materials, and particularly in determining what should be omitted, that is to say, in considering the requirements of those for whom he is writing. Prof. Crandall is addressing himself primarily to students of Cornell University, and presumably to those who are beginning the study of the subject and not to professional men engaged in actual work.

For a text-book to be used by beginners it might be objected that the author has a little overlaid his treatise with a superfluity of detail. The increased attention given in university training to the study of geodesical problems and the determination of the coordinates of a station on the earth's surface is a feature that should be welcomed and encouraged. On many grounds it may be urged that the use of instruments in the field is an admirable training, more especially as it affords opportunities for the application of those formulæ which have been acquired from bookwork. For this reason one could defend the somewhat lengthy description of instruments here given, their adjustment and method of use, the determination of corrections, &c., though at times the author is tempted to indulge in too great detail. This error, if it be an error, arises from following too closely the reports and data furnished from the offices of the Coast Survey. The danger to be feared is that the minute care and attention to detail necessary in operations extending over a large area, may tend to make the subject repellent to a student whose main object is to gain an intelligent insight into the processes involved. But a greater fault appears to be one of omission. There is too little, almost nothing, concerning the methods of deriving the latitude and longitude of a station. And surely such matters are of quite equal importance with the measurement of a base line, and fall as decidedly within the compass of such a work. To be able to determine one's position on the earth involves something more practical than a mere college exercise. It is information that is frequently needed and may become a matter of great importance.

The first few chapters of the book are mainly occupied with the description of the use and adjustment of instruments in the field. The next three are devoted to consideration of problems connected with

the figure of the Earth. The mathematical ingenuity exhibited may be interesting, but is familiar. In the form and to the extent in which the several problems are discussed, these chapters scarcely belong to a practical treatise, and do not afford the means of applying the facts that the student has himself derived from the use of instruments.

In the second part, which consists of three chapters, the author serves up the standing dish of least squares. So far as theory is concerned he has followed Chauvenet, and for the practical application to triangulation and conditioned problems the admirable treatise of Wright and Hayford on "The Adjustment of Observations" (see NATURE, vol. lxxiv., p. 148). The book is well illustrated, and there are some useful tables and information given in an appendix, though we scarcely understand the principles upon which the formulæ have been selected. The information throughout is conveyed in a clear and lucid manner, but a little unevenness is sometimes noticeable, as though the author were uncertain of the degree of thoroughness with which the several topics should be treated.

AN AMERICAN TEXT-BOOK OF ENTOMOLOGY.

Entomology, with Special Reference to its Biological and Economic Aspects. By Dr. J. W. Folsom. Pp. vi+485; illustrated. (London: Rebman, Ltd., 1906.) Price 14*s.* net.

A WORK treating of entomology purely from the bionomic and economic standpoints is a distinct and long-felt want, but it cannot be said that the book under review supplies that want adequately, in spite of its title and a statement in the preface that it "was written in an effort to meet a growing demand for a biological treatment of entomology."

With such admirable and detailed manuals of insect anatomy as Packard's "Text-book of Entomology" and Henneguy's "Les Insectes" already in the field, Dr. Folsom could have safely avoided a treatment of this subject; as it is, his second chapter, entitled "Anatomy and Physiology," occupies nearly one-third of the book, and yet fails to attain the comprehensiveness of the afore-mentioned manuals. Chapter vii., on the origin of adaptations and of species, might well have been omitted, for it contains nothing that is new and little that is not almost common knowledge; curiously enough, though de Vries's work is discussed, there is no mention of Mendel or his followers.

The inevitable result of these two unnecessary chapters is an unfortunate brevity of treatment in the more useful and interesting sections of the book, and many important phenomena and facts are crowded out altogether. The author may claim (as he does) that his work is "concise," but hardly that it is "comprehensive," since there is no mention of the life-history of Mantidæ, of the eggs of Phasmidæ, of fig-insects, of the cuckoo-spit, of the formation of stick-lac, of the remarkable symbiosis of Acari and bees of the genus Koptorthosoma, of the extraordinary beetles Mormolyce and Hypocephalus. The accounts of parthenogenesis, of phosphorescent insects, and of aquatic insects are lamentably brief, and nothing at all is said of the insects found in caves.

Chapter ix., on insects in relation to other animals, is one of the best in the book; Dr. S. A. Forbes's admirable reports on the insect food of birds and fishes have been largely drawn upon, and deserve the attention directed to them. We have not noticed many errors, but the following need correction in a later edition:—Paraponyx is not the only lepidopterous genus with truly aquatic larvæ (p. 184); *parakleta* should be *paralekta* (p. 216); it is at least doubtful if the mimicry of bees and wasps by species of the genus Volucella can be classed under the heading of aggressive mimicry; it is far more probable that the flies secure immunity from the attacks of vertebrate foes by their resemblance to stinging insects than that this resemblance enables them to enter unobserved the nests of hosts who are quick enough to resist the intrusion of strangers of their own species (p. 235); the blood-parasite conveyed by *Glossina morsitans* is not similar to the malarial parasite (p. 306). The tsetse-fly is cited as the carrier of the blood-parasite in nagana disease, but not of the organism causing sleeping sickness. In the anatomical chapter some reference should be made to the fact that the stomodæal and proctodæal sections of the alimentary canal are lined with chitin, whilst the mesenteron, being of endodermal origin, is not.

The numerous text figures are for the most part excellent, and a goodly proportion are original; special attention may be directed to Figs. 242 and 260; the latter, if a genuine record of an actual occurrence, is a triumph of nature-photography; Fig. 244, illustrating protective mimicry, is unfortunate, for it represents *Eristalis tenax* mimicking a stingless drone-bee. The coloured frontispiece is not only a poor example of what can be done in these days of improved methods of chromolithography and three-colour photography, but also abounds in errors, *e.g.* Fig. 1, labelled *Heliconius eucrate*, is *Lycorea halia*; Fig. 4 is not *Mechanitis lysimnia*, but *Melinaea ethra*; Fig. 5 is not *Papilio merope* ♂ from South Africa, but *Papilio antinorii* ♀ from Abyssinia; Fig. 8 is *Amauris echeria* from West Africa, not from South Africa; Fig. 10 is not really like any butterfly known to science, but it apparently represents *Papilio merope*, ♀ form *cenea*, though it is labelled *Amauris echeria*, the "model" of the Papilio mimic; Fig. 11, labelled *Papilio merope* ♀, is apparently *P. echerioides* ♀. This gives a total of six errors in eleven figures! It is evident that the author has reproduced the errors occurring in the plates illustrating Weismann's "Evolution Theory," and it is a pity that, in the case of the African butterflies at any rate, he did not consult Trimen's classical paper or the frontispiece to Poulton's "Colours of Animals."

A useful bibliography and a trustworthy and comprehensive index conclude the work. R. S.

OUR BOOK SHELF.

Minerals and Metals: a Reference-book [of] Useful Data and Tables of Information. A condensed compilation from various sources by J. G. Goesel. Pp. xiii+287. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1906.) Price 12*s.* 6*d.* net.

THE scope of this pocket-book of reference may be best indicated by quoting from the title-page:—"Legal, customary, and scientific measurements; geological classification; rock composition; chemistry, dry and wet assay; mineralogy; metallurgy; metal founding and plating; hydraulics; water purification; mineral oils; gases; explosives; strength of materials, including woods, their properties, adaptability, and preservation; pigments, gums, and solvents for paints and varnishes; miscellaneous data and receipts." It will thus be seen that the variety of subjects treated is much more extensive than is indicated by the main title, "Minerals and Metals"; in fact, there is, in a handy form, a vast amount of information which may be of use to mining engineers and others.

Books of this kind should, of course, be free from ambiguities and errors, but in the portions which we have specially tested, namely, those dealing with minerals and precious stones, numerous errors have been detected; quite extraordinary chemical formulæ are given for even common minerals, whilst in the spelling of names there are many misprints.

The book is clearly printed, though not on thin paper, and is well bound in limp leather, with rounded corners and gilt edges.

Practical Exercises in Chemistry. By G. C. Donington, Senior Science Master in the Leeds Grammar School. Pp. x+251. (London: Macmillan and Co., Ltd., 1906.) Price 2*s.* 6*d.*

MR. DONINGTON'S little book derives special interest from the fact that whilst he is a pupil, and a very grateful one, of Prof. Armstrong, he has found himself compelled by experience as a science master in a school (and one in which no specially unfavourable conditions prevail) to depart from the practice of leaving the pupils without a text-book during their practical lessons. This experience is, we believe, by no means uncommon, and it is an advantage that the "felt want" should be supplied by one who naturally strives to conserve as much as he can of the merits of the no text-book system. In this object the author has, we think, had good success, and his book is likely to take high rank among those which of late years have been written to set forth an elementary course of chemistry for those secondary schools where there is a desire to teach scientific method through the medium of this science.

Paradoxes of Nature and Science. By Dr. W. Hampson. Pp. xv+304. (London: Cassell and Co., Ltd., 1906.) Price 6*s.*

DR. HAMPSON proposes to explain to the uninitiated certain scientific "paradoxes." The only possible "explanation" of such paradoxes is attained by showing that the abnormal phenomena are determined by precisely the same laws as the normal phenomena; to "explain" why a balloon rises it is necessary to propound the general principles of gravitational mechanics and to show that it rises for the same reason as a stone falls. But Dr. Hampson eschews general principles. His "explanations" are appeals to prejudices as unscientific as those which gave rise to the appearance of a paradox. Even when his arguments are sound they must convey to a reader a wholly untrue idea of scientific method.

But they are not always sound. Sometimes he wanders far out of his depth, as, for instance, when he seeks to solve the old logical contradiction of Achilles and the tortoise by a reference to the atomic structure of matter. He would have done well to restrain his jeers at mathematicians until he had gained some acquaintance with the elements of their science.

Seasonal Botany, a Supplementary Text-book. By M. O'Brien Harris. Pp. 56. (London: Blackie and Son, Ltd., 1906.) Price 8*d.*

PROBABLY most teaching botanists looking back upon their early experiences when they first found it necessary to draft a syllabus of instruction can recall an attempt to prepare a course adapted to the round of the seasons. In the case of pure observational study such a course is profitable, but it is the general experience that a seasonal adjustment does not accord with the best morphological or physiological sequence, and this opinion is not modified by the arguments or scheme put forward in the present instance.

The seasonal syllabus given in the form of a tabulated scheme, and a number of physiological experiments on very usual lines, form the chief contents of the book.

French Readings in Science. Selections from Scientific and Technical Writers, arranged and edited for the Use of Students. By de V. Payen-Payne. Pp. vii+230. (London: Blackie and Son, Ltd., 1906.) Price 3*s.* 6*d.*

IGNORANCE of either French or German is a serious handicap to the scientific worker. University examining bodies are recognising this need, and some, such as the University of London, demand from candidates for science degrees a knowledge of these languages sufficient to enable them to translate with fair ease and accuracy. In making his selection of passages from scientific treatises, Mr. de Payen-Payne has included some extracts for their modernity, and others because of their association with great names in science. The compiler is catholic in his tastes, and his work should provide students with just the practice they require.

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.*]

Radium and Geology.

THOSE interested in this subject should refer to the paper which appears in the last issue of the *Philosophical Magazine*, by Mr. A. S. Eve, on the ionisation of the atmosphere over the ocean. Mr. Eve cites observations, and adds others of his own, showing that the ionisation over the ocean is much the same as over the land, and points out the difficulty of explaining this in view of the small content of radium in sea-water compared with that in ordinary rocks. Possessed as I am with the view that extra-terrestrial radio-active dust reaching the earth may account for much of the radium of soils, sediments, and rocks, I cannot but think that Mr. Eve's difficulty may find explanation in an extra-terrestrial source of supply.

Mr. Eve also gives some new determinations of the radium in sea-water, and arrives at results which considerably accentuate the discrepancy which I referred to

in my letter written on January 6 (NATURE, January 24, p. 294). On his results, a normal river supply of the supposed uranium would in 90,000 years suffice to give the ocean its present radio-activity. In short, practically the whole of the uranium has to be accounted for in the sediments. Mr. Eve perceived the difficulty, and suggests that the sediments are, indeed, its destination. I have already referred to the difficulties attending this view.

Prof. Sollas's contention (p. 319) as to the probable original character of the uranium in zircon is, I think, unanswerable. I had this fully in view when referring to uranium-bearing minerals in certain rocks. In certain rock masses the zircon might be the chief or entire source of radium, but it would appear that this cannot possibly be the case with ordinary granites. The analysis made by Mr. Strutt of a Cornish granite showed that less than one-ninth only could in this case be so accounted for. Mr. Strutt directs attention to this. Again, Prof. Sollas shows by the analysis he cites that this granite was probably unusually rich in zircon. In Mr. Clarke's last report of analytical work done in the laboratory of the United States Geological Survey (Bulletin No. 228) I have found nine granites in which the zirconia is determined. The highest percentage was 0·08, and the others ranged from 0·04 downwards to a trace. Mr. Clarke in Bulletin No. 148, speaking of zircon, says of igneous rocks generally:—"It may rarely be present up to a few tenths of 1 per cent. of the rock." He also gives, as roughly approximate, that the average content of zirconia in igneous rocks is 0·03. This would imply a quantity of zircon adequate to account for barely 4 per cent. of the mean radium content of igneous rocks.

There are, probably, other radio-active minerals possessing an original store of uranium, but I think Mr. Strutt has shown good reason for believing that the chief radium carrier is the mica, at least in granites. This is a mineral which from its properties would be very likely to absorb and retain substances in solution. J. JOLY.

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The Green Tints of Sunset.

THE appearance of a green light at sunset, like many other phenomena supposed to have only recently attracted attention, was noticed and commented upon by the ancient Egyptians, and more particularly so because in the clear air of Egypt the tints of sunset are peculiarly distinct.

As the sun there descends nearer and nearer to the horizon, apparently hastening to disappear behind one of the Libyan hills, as if burying itself in the sand at their base, the immensely enlarged flaming disc suddenly becomes, for an instant, of a brilliant green colour, and immediately a series of green rays suffuses the sky in many directions, well-nigh to the zenith.

The same phenomenon appears sometimes at sunrise, but to a smaller extent.

According to ancient Egyptian notions of cosmogony, the sun, after passing through the western gate into the world of night, travelled northward parallel to the Nile until the sixth hour, when it commenced to journey southward, having passed to the eastern side of Egypt, and, finally, at sunrise came forth by the "Gate of the East."

Now, during the nocturnal voyage, the solar orb was said to be a disc of Mafkait, which was the title of a green-coloured mineral, and so the sun was considered from sunset to sunrise to be coloured green. Sometimes, just as the last part of the sun's disc vanishes, its colour changes from green to blue, and so also after it has disappeared the sky near the horizon is often green, whilst toward the zenith it is blue. This was alluded to in ancient Egyptian writings, where sometimes it is said that at sunrise or sunset the sun's rays were of Tahen, a blue metal, the title of which is often used in reference to the blue of the sky.

In Egyptian thought day was the emblem of life and night that of death, and the nocturnal sun being identified with Osiris thus rendered Osiris the god of the dead. The setting sun being green, therefore Osiris, as the nocturnal deity of the dead, was on the monuments and representations of him when referred to as god of the dead painted green, as were other funerary divinities, such as Sekar, the form of the dead Ptah, which was that of a mummy with face and hands coloured green or dark blue. The splendid coffins of the high priests of Ammon, all the decorative tableaus of which are painted, frequently depict the green sun, and deities such as Anubis, god of the funerary journey, Isis, Nephtys, and Osiris are coloured green.

It may be interesting, if possible, to decide whether the Egyptians recorded their observation of the green colour at sunset in very early times. The late M. Groff, who has treated upon this point in the *Bulletin de l'Institut Egyptien*, proved that they did so as early as the fifth dynasty, by showing that a monument of that date delineates the half disc of the setting sun by a figure painted in three successive bands, the two lower, that is to say, those abutting on the horizon—of green, and the upper one of blue.

This is not the proper place to discuss the innumerable instances upon Egyptian relics of representations relative to death being coloured green. It is undoubtedly the case that the practice arose from the green tints of sunset and sunrise, but it may justifiably be said that in the green-coloured sun disc referred to, which dates 5000 years back, we have the, at present, earliest known human record of an astronomical phenomenon. JOSEPH OFFORD.

2 Fairfax Road, Bedford Park, W., January 29.

February and March Meteors.

FEBRUARY and March meteoric showers have never been sufficiently investigated. No very special displays have invited abundant observation, and, moreover, cold and cloudy weather often prevails at this season. Meteors, too, are generally rare, and from these several causes few observers have made persevering efforts to determine the strengths and positions of the radiants visible.

In 1877 and 1887, February–March, the writer at Bristol obtained some observations, but they were altogether insufficient to reveal more than a small minority of the meteoric streams of this period. Giuseppe Zezioli at Bergamo, and Lieut.-Colonel G. L. Tupman in the Mediterranean in 1867–71, effected many valuable observations in Febraury and March, and perhaps their results are the best secured up to the present time.

With the earth approaching aphelion, meteors are usually scarce, though there are a number of interesting showers visible, and fire-balls are invitingly plentiful. But the firmament not having been thoroughly watched during the latter part of the winter season, an earnest, persevering, and accurate observer has a very promising field before him, and may expect to discover more new showers than are likely to reward his vigils under summer and autumnal skies.

A number of streams presented during February and March have been already detected, but there is a large majority of very feeble systems still awaiting recognition. The visible strengths of many showers vary from year to year, and there are periodical displays which only occur at long intervals, so that fresh observations are very desirable if our knowledge is to keep pace with the developments frequently occurring.

Fireballs are often numerous on about February 10 and March 1–4. Some of the radiant points of ordinary shooting-stars recorded at Bristol are:—

February		March	
75+41	7–23rd	161+58	end
134+67	and in March	166+4	beginning
147+6		177+48	end
158+28		190+58	middle
175+10		196+44	
181+34	20th	229+32	end
204−10	13–21st	254+55	14th
236+11	13–20th	263+62	end
263+36	20th	270+47	middle
332+71		316+76	

Bristol, February 4. W. F. DENNING.

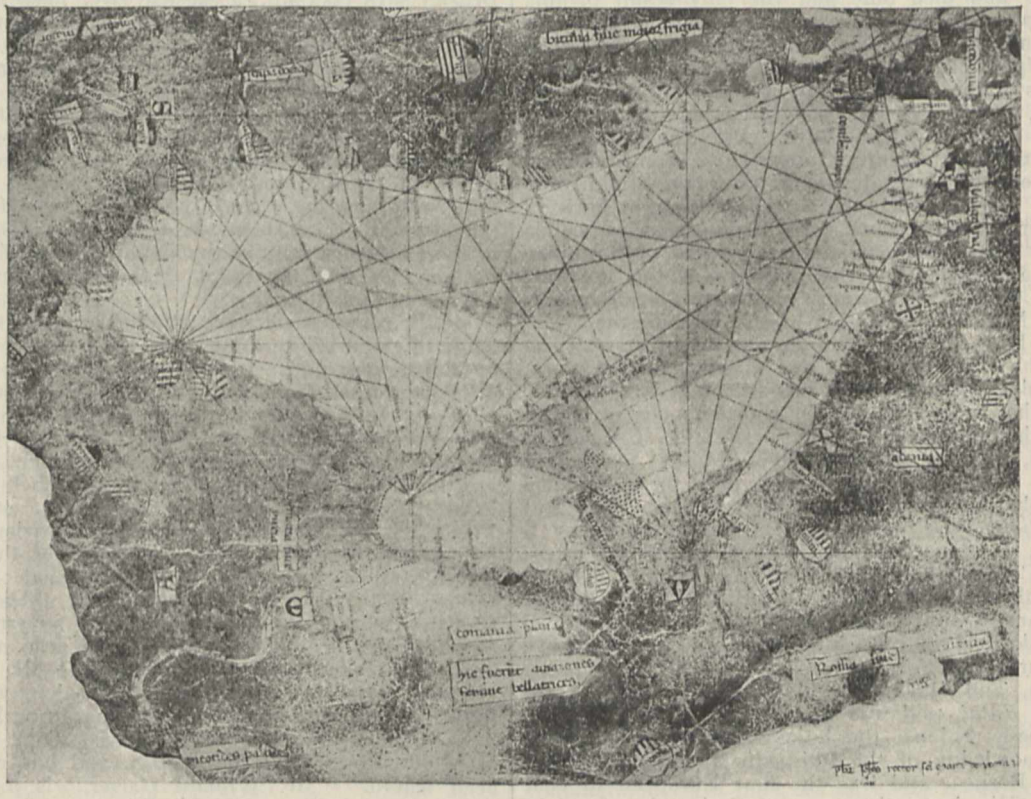
THE DAWN OF MODERN GEOGRAPHY.[1]

MR. C. R. BEAZLEY has now published the third and concluding volume of his important work, "The Dawn of Modern Geography." The third volume is "A History of Exploration and Geographical Science from the Middle of the Thirteenth to the Early Years of the Fifteenth Century (*c.* A.D. 1260–1420)." A summary of the further progress of geographical knowledge through the time of Prince Henry the Navigator until the rounding of the Cape of Good Hope by Bartholomeu Dias and the voyage of Vasco da Gama at the end of the fifteenth century is appended.

Mr. Beazley's work stops short, therefore, with the voyages of Prince Henry's seamen, with which the dawn of modern geography may well be said to have ripened into full morning. He begins this volume with the Polos, and they and Friar Odoric are the central figures of the book. Naturally the narrative tends to group itself around persons, and to become a mere summarised account of their doings; there is little scope for hypothesis or argument except in respect to disputed names and sites. The central facts of the period described are the sea voyages of the Italian sailors, Venetians and Genoese, and the land-journeys of the merchants of the two great republics. Mr. Beazley shows how the sea-enterprise of the Spaniards and Portuguese was started and at first directed by Genoese shipmen, and how knowledge of the Further East was increased by the competition of the *mercatori* of the Ligurian Commonwealth and the City of the Lagoons (which, by the way, he insists on spelling "Lagunes").

Next in importance is the contribution of the Roman Church. Mr. Beazley well emphasises the great importance of the Roman attempt to proselytise the East during the period of Moslem eclipse by the pagan Tartar power. Already, in the preceding period, of which Mr. Beazley's second volume treated, the tendency towards an alliance of Christendom with Heathenesse against the Saracens had come into prominence. The idea of crushing the followers of the False Prophet between the hammer of the Hun and the Frankish anvil had seemed by no means an impossible one. Nor had it seemed unlikely that, with the help of the hordes of Gog and Magog which God had sent forth to do His will, the defeat of the Horns of Hattin might be avenged and the Holy Places restored to Christendom; and why should not the Tartars themselves enter the Christian fold? So Rome sent forth missionaries to the lands of the Ilkhan, and Western bishoprics arose where hitherto only the heretical Armenians, Jacobites, and Nestorians had maintained a faith of doubtful authenticity amid Moslems and Heathen, and the Greek had not been seen for centuries.

Yet of all this endeavour only one tangible result remained: the increased knowledge of the East which the missionaries transmitted to the West. Mutual doubt born of ignorance, mutual incompatibility, prevented Hun and Frank from understanding one another; the precariousness of the way from West to East made communication difficult, and the divisions of the Papacy led the Tartars to place little faith in the power of Christendom to strike anew from the West. Also, a new spirit had arisen in the world; the merchant had come to power side by side with king, knight, and priest. The ideals of the twelfth



Genoese Map of the Black Sea: A.D. 1300–5. From "The Dawn of Modern Geography."

[1] "The Dawn of Modern Geography." Vol. iii. By C. Raymond Beazley, M.A., F.R.G.S. Pp. xvi+638. (Oxford: Clarendon Press, 1906.) Price 20*s.* net.

century were out of date to the men of the thirteenth, especially in the Mediterranean lands, where a republic of merchants had deposed an Emperor and parcelled out his lands, using the cry of the Faith as a cloak for their own ambition. And now neither the merchants of Venice nor those of Genoa would give up their *fondaci* of Alexandria or Cairo, and their lucrative trade with the land of the Soldan, the head-centre of Islâm, at the bidding of a Sanuto in order to restore Jerusalem to the temporal dominion of their faith. The days of the Crusaders were over; the Viking spirit from the North that had impelled the warriors of the Cross to set out to battle with the Paynim followers of Mahound was exhausted, and the men of the later day seemed to love the bezant as much as they venerated the Rood. So the Western Tartars turned to Mohammedanism; the light of the Roman missions in the lands of the Ilkhanate flickered and died out, and the only result of this second phase in the intercourse between the Frankish West and the East was the increased geographical knowledge which, in conjunction with the commercial ventures of the time, it brought about. Many ran to and fro, and knowledge was increased.

Many ran far in those days. A journey to Cathay in the thirteenth century must have seemed almost as tremendous as a voyage to the moon would now, and the stories which the travellers brought back of the Chinese must have seemed almost as incredible to their stay-at-home friends as stories of Selenites. Mr. Beazley describes the journeys of the Polos at length, and gives a most interesting epitome of Messer Marco's description of the land of the Great Cham, Kublai. The civilised power, in comparison with which Europe was a den of savages, the posts, the banknotes, the great seaport of Zayton (Arabic *Zêtûn*, the modern Amoy); the enormous city of Hang-chau; the mighty Khanbalik or Peking, Coleridge's *Xanadu*, the city of Kubla Khan himself; the distant isles of Zipangu or Japan; all must have sounded incredibly wonderful to the Western ear. Yet that the *Milioni* were not liars was proved by many a witness, contemporary and following shortly after; Monte Corvino the first Roman Archbishop of Peking, Odoric the Friar, Marignolli the Bishop of Bisignano, and many a simple Genoese trader besides. Of all these Odoric is the most interesting, and seems to have gone furthest. For if Marco Polo visited Szechuen, Yunnan, and Burma in his official capacity as a Chinese *Futai*, and was the first to acquaint Europe with these regions, the humble missionary brought back knowledge of the Philippines and of the isles beyond Borneo, and was the first European to visit Lhasa. His description, too, of Cathay is second in interest to that of Polo only. And few things in this description are more interesting than his account of how he, with the Bishop and other missionaries, met the Great Khan (a successor of Kublai) upon the high road and went forth to meet him, the Bishop in cope and mitre, with cross upraised on high, all singing the *Veni Creator*; and how the Emperor raised himself in his palanquin reverently to kiss the sign of salvation; and how Brother Odoric, mindful of the injunction *Non apparebis in conspectu meo vacuus*, tendered to Majesty his humble trencher of apples, whereof the Emperor took one and deigned to eat it.

The Tartar Emperors of the Yuen always treated the Frank Christians with courtesy and showed interest in their religion; it was not until the national Chinese uprising and their replacement by the Ming that Christianity was oppressed, and, very shortly, China was shut to them as completely as two hundred years later Japan was shut to Christian endeavour by the policy of the Tokugawa Shoguns. Just as the Nearer East was barred by the conversion of the Persian Tartars to Islâm, so was the Further East barred by the accession of a national dynasty to the throne of China. No more Franks visited China until the coming of the ships of Portugal and Holland in the sixteenth century. Here also the progress of geographical knowledge was brought to a halt and the promise of the dawn, temporarily at least, belied.

In the opposite field of operations, however, progress, though slower, was never stayed. As was natural, on account of the then superior state of their civilisation to that of the Franks, the Maghrabi Mohammedans were the first to explore the coasts beyond the Pillars of Hercules, and even discovered Madeira and the Canaries. This we know from the voyage of the Eight *Maghrûrîn*, or "Deceived Ones," of Lisbon, then (before 1147 A.D.; on p. 411 Mr. Beazley says 1154 A.D.) a Moslem city. These worthies set forth in a manner strongly reminiscent of the Wise Men of Gotham, who went to Sea in a Bowl, and found Madeira, which they called, not "Al Ghanam" (as Mr. Beazley has it in his note on p. 532: this would mean "the Sheep"), but *Gezîret al-Ghanam*, "The Isle of Sheep." Afterwards they found the Canaries and eventually got back to Lisbon, where the stay-at-home Gothamites mocked at them for "Maghrûrîn," and probably for *Majnûnîn*, "lunatics," also. However, their isles existed, and in the thirteenth century the Canaries were discovered by the Genoese Lancelot Malocello, from whom Lanzarote took its name.

Mr. Beazley describes the gradual progress of knowledge of these Western isles, the discovery of Madeira by Portuguese under Genoese admiralty, the voyages of Portuguese, Catalans, and French beyond Cape Nun to Bojador, and the French expeditions of Béthencourt and Gadifer de la Salle to the Canaries at the end of the fourteenth century, which, perhaps, are the origin of the unsubstantiated French claim to have discovered Guinea long before the sailors of Prince Henry the Navigator. Mr. Beazley is not indistinctly of opinion that the claim of the seventeenth-century writer de Bellefond that Dieppois sailors (we object to Mr. Beazley's "Dieppese") traded with the Guinea coast as early as 1364 is unfounded, to say the least of it. He does not enter much into the question of the MS. of "Mr. William Carter," describing these voyages, which, according to M. Margry, in his "Navigations françaises . . . d'après les documents inédits" (Paris, 1867), was lent to M. de Rosny in 1852 or 1853, and has not since been traced. "Mr. William Carter" is a Frenchman's name for a typical Englishman; it savours of "Miss Mary Smith," or the British "M. Jules Dupont" for a Frenchman. But it should not be difficult to ascertain whether there existed sixty years ago a gentleman bearing this name who would have been likely to have possessed such a manuscript. In any case, however, even if found, it would probably turn out to be of seventeenth-century date, and as worthless for history as de Bellefond's own testimony or the ridiculous rubbish of the Zeni (pp. 456–60) about their "voyages" to the North, in which these heroes confuse Friesland with Iceland, and bestow upon "Frisland" a king called "Zichmni," and so on.

Mr. Beazley gives an interesting sketch of Genoese maritime activity, and shows that the Genoese were the founders of map-making with their wonderfully accurate *portolani*, of which he gives several illustrations, all of them extremely good with the one exception of that of the "Veschonte" map of 1311 (p. 513), which is marred by an ugly band stretched

across it; one would have thought that this could have been avoided.

Of English contributors to earth-knowledge at this time there were very few. The wonderful Oxford philosopher, Roger Bacon (to whom Alma Mater ought to put up a statue) certainly knew more about the world than most of us are accustomed to think was known in his time, and was remarkably up to date in his information (pp. 500–507), but there were no others like him, nor were any of our sailors or chapmen discoverers like the men of Genoa or Venice. They were pirates who could gain victories over "Espagnols-sur-mer," but no more. Maundeville, alas, is now well known to be a fraud. He never existed but in the perverse brain of a Liégois clerk, John à-Beard, who concocted his tales of "Anthropophagi, and men with heads beneath their shoulders," from the true stories of contemporary travellers and many an antick tale drest up anew. The supposed English "discovery" of Madeira about 1370 by Machin is probably a myth (p. 441). Edward I.'s embassy to the Ilkhan Arghun of Persia in 1291–3 under Geoffrey of Langley (Galfridus de Langele) is interesting, but the ambassador went under Genoese guidance, and the English were out of their element in those parts. A century later an English constable of Guisnes and his secretary took a jaunt to Egypt and the Holy Places, and were no doubt grievously fleeced by the "magnus" and the "alius drugemannus," and the usual crowd of guides, donkey-boys, and camel-drivers and other demanders of *bakhshîsh*, much as their descendants might now be. But they saw a giraffe, and no doubt that was worth the money. The trip cost each pilgrim about 250*l.* in modern value. Such tours were not uncommon at the time: Mr. Beazley mentions some Germans; an active knight who ran out to Jerusalem and back in less than the space of one year, and another, William of Boldensel, who travelled in great state, and was so mighty and great that none dared trouble him for impost or dues of any kind wherever he went. There was also that amusing pedant the Rector of Sudheim, who consorted with none but kings and nobles the whole time he was away, and when he got back no doubt bored the good folk of his Westphalian village to death with them for the rest of his life.

Another German, Schiltberger, was no Boldensel or Ludolf; he consorted with kings, it is true, but as their slave. Captured at Nicopolis, he was the bondman of Bajazet the Turk, and was by the fortune of battle transferred to the servitude of Timur the Tartar. Only after many years of slavery did he escape to his native Germany again. His account of the lands in which he lived so many years, from Egypt to Siberia, is naturally of the greatest value; we wish only that he had told us more. He was but an unlettered warrior.

Of the rule of the second Tartar Empire we have further knowledge from an unexpected source. Of Catalan mercantile activity we have already spoken. The Castillian rivals of Aragon were no traders, and their first contribution to geographical knowledge was due to an embassy to the East like that of the Englishman Langley, but more than a century after his time. In 1403 King Henry of Castille dispatched the noble hidalgo Don Ruy Gonzalez de Clavijo as his envoy to Timur the Tartar, Tamerlane the Great himself, and Mr. Beazley tells us of the terrible journey of the Spanish envoys, across the uninhabited wastes which the terrible tyrant had made, to his court at Samarkand, of what they saw when at last they got there, and how they left on their return shortly before the conqueror set out on his endeavour to rival Genghis and conquer China, only to die a few stages out of his capital (1405).

In Spain at this time the Moslem kingdom of Granada still existed, shorn of its ancient glory both in war and in science. But Moslems still contributed to the increase of geographical knowledge, and one, from the neighbouring Morocco, was second to none as a traveller and recorder of his travels. This was the wonderful Shêkh Ibn Batûta of Fez, who in the fourteenth century traversed the greater part of the known world, from Peking to Timbuktu, and wrote an account of his travels which, as might indeed have been expected, shows far greater intelligence than most Frankish records of his time. We wish that Mr. Beazley had written more about the Moslem geographers. Yakut is dismissed in three lines (p. 534); Edrisi, in spite of his relations with the Franks of Sicily, has but two pages. It is not enough.

Space forbids further account of the interesting things in Mr. Beazley's last volume. In it there are singularly few misprints, and the author has evidently submitted his Oriental names to the scrutiny of someone familiar with Arabic and Syriac. We have no more "Jesus Jabuses" or "Mar Jabalabas" in this volume, though "Nujmuddin" for the name of an Egyptian sultan is hardly pretty; let us give this "Star of the Faith" his hard Egyptian *gîm*, and call him Nigm-ud-din.

The long-needed index has appeared in the last volume, and with its completion let us cordially congratulate Mr. Beazley on the achievement of his work, which is a credit both to him and to his University.

SIR MICHAEL FOSTER, K.C.B., F.R.S.

FIFTY years ago the science of physiology, as now understood, was scarcely recognised. It began in England when the early anatomists added an account of the uses or actions of the several muscles, glands, and viscera to the account of their form and structure. So in the sixteenth and seventeenth centuries each anatomical description was followed by the word *Usus*. True, experiments were practised from the time of Vesalius downward, by Harvey himself, by Redi, and by the Rev. Stephen Hales, and often with brilliant success. The problems of the circulation, of spontaneous generation, and of blood-pressure in the arteries were solved by these admirable experimenters; but their efforts were isolated. Fifty years ago we had in England excellent observers with the microscope, particularly Sharpey and Bowman; but there was no systematic study of the working of the human machine by masters like Johannes Müller, Ludwig and Claude Bernard, and "practical physiology" consisted in little more than examining the tissues under the microscope and exhibiting a few chemical reactions of animal fluids.

The first attempt to teach the new physiology in England is due to Dr. Gamgee, who translated the fifth edition of Hermann's famous text-book. About the same time a scientific physician in London gave up practice for the sake of investigating healthy and morbid functions of plants and animals, as well as man; and a few years later a young country surgeon who had already given hostages to fortune by a wife and two children persuaded his father to let him leave Huntingdon and adopt the fortunes of a teacher of physiology. Dr Burdon-Sanderson from Edinburgh, and Dr. Michael Foster from Huntingdon, taught, the one pathology (human, animal and vegetable), the other histology and "the use of the microscope." Both were tall in stature and striking

in appearance; both made their mark in the practical application of biology to the health of men and animals; both migrated from University College, London, Sanderson to Oxford, and Foster to Cambridge, in order to introduce the modern science of biology into the curriculum of the older universities. Sanderson died somewhat earlier; Foster has only just been removed.

It is still too early to decide on the extent and permanent value of Foster's work, but some estimate of it may be attempted.

His strongest point was force of character, energy, perseverance, thoroughness. He expected his pupils to work as hard as he did, and to regard scientific investigation as the most honourable and delightful pursuit. He had the rare faculty of discovering talent in pupils and giving it concentration and method. He set them problems to solve, and as soon as they had shown their capacity to work alone, he left them to plant the seed in another virgin soil. Foster's success at Cambridge was remarkable, both in the number of those who took up serious study in the laboratory and in the great eminence achieved by very many. His greatest merit is that, like Ludwig, he created in his disciples the noble ambition to increase knowledge, and was content to see the result and to applaud. Some of his pupils have made themselves a European reputation, others have carried Foster's methods and enthusiasm into botany, pathology, public health, and medicine.

Foster early acquired an excellent style for scientific writing. Probably Huxley's lectures and writings pleased him first, but however Foster's style was acquired, he at last attained the state which Hazlitt asserted (not without reason) he had reached when it was less trouble to write well than to write ill.

The child's "lessons" in physiology were as well composed and expressed as the famous "text-book" (1876) and the "History of Physiology" (1900).[1]

He soon gathered together his first band of disciples, among them Francis Balfour, whose brilliant career was sadly ended by an accident on the Alps; Langley, who succeeded him at Cambridge; Gaskell, Sherrington, Adami, Sedgwick, L. E. Shore, F. G. Hopkins—these are only some of the names of men who owed their first step in scientific investigation to Foster's inspiration, and remained his cordial friends to the last.

As soon as he had taught the elements of practical research in physiology, he encouraged his pupils to work out their own vein, whether the task first set them was completely finished or not. Whatever other academical differences he encountered, Foster never failed in the support of his old pupils.

Apart from his lectures and his books, Foster threw himself heartily into the duties which his position as secretary of the Royal Society entailed. He held the office from 1881 to 1903 under the presidency of Spottiswoode, Huxley, Stokes, Kelvin, Lister, and Huggins. He did much to stimulate interest in the biological side of the society.

Foster was a well-known official of the British Association, and was president at Dover in 1897, when he was made a K.C.B. He spoke only to begin or reinforce the discussion. On the council his influence was powerful, and was never used for private ends. At the annual dinner of the society Foster only spoke at intervals, and the task was always well performed. But his oratory at its best was to be heard at less formal meetings where ready wit and good-natured sallies were appropriate.

After his connection with Cambridge was severed, Foster found fresh occasion for serving science by his election as representative of the University of London in Parliament in succession to Sir John Lubbock, now Lord Avebury. His speeches in the House were few, and chiefly confined to subjects on which he could speak with authority—education, public health, fisheries, scientific experiments on animals, and similar cases of applied knowledge. He spoke slowly and distinctly, with a quiet emphasis which secured attention from both sides of the House. He entered Parliament as a Unionist and a supporter of the Boer War; but he found himself out of sympathy with Mr. Balfour's Government on financial policy and on popular education; he therefore sought first to resign, and afterwards to transfer his seat from the Unionist to the Liberal side. At the General Election he was defeated by a very small majority, and his seat is occupied by Sir Philip Magnus. In connection with his political career must be mentioned the important commissions on which Foster served—that on vaccination, of which the late Lord Herschell was chairman; that on the disposal of sewage; another on fisheries; and, perhaps the most important, one on tuberculosis in animals and man. The final report of this committee was signed by Foster only a few days before his death.

On the day before he was taken ill, at the meeting of the British Science Guild at the Mansion House, he spoke as follows:—"This meeting shows how widely science is entering into our lives; it has interwoven itself with our works, and is more and more guiding our ways. If we could imagine a world without science, we might address to that world the words which Dante addressed to Italy in the Middle Ages: 'Nave senza nocchiero in gran tempesta.' Nothing is more clear than that science is not for men of science alone. We, with our slight efforts, can lift great weights. We are a feeble folk, and if we can effect anything it is by pulling the long end of the lever, and it is because of the length of the lever that we are able to effect anything. Thus, with our slight efforts, we can lift great weights at present, and we shall lift heavier and heavier weights in the future if we have the support of the people, and the support of the Government bidden by the people. It is for the people to bid the Government, and the present Government perhaps above all other Governments, to help science; for they can give us the opportunities we are asking for to-day."

To Foster's personal charm no description can do justice. To old friends like Prof. Carey Foster or Mr. Coots Trotter he was always the same. On a dredging expedition where he and his mate managed the tackle in the intervals of sea-sickness, in a crowded Italian railway carriage, or receiving polyglot professors, Foster's voice always announced good humour, good temper, and good nature.

He delighted in his garden, and was said to cultivate physiology when not too busy with a new iris. Next to his own species he delighted in cats and dogs and flying birds. His early life between Huntingdon and Cambridge was one of struggle, and his later days, when he had lost his laboratory, were clouded by occasional ill-health; but, on the whole, his strenuous and active life was a happy one, for it exercised his great and varied abilities for worthy objects. He was a man greatly beloved, and he has left a deep memorial in the hearts of all who knew him best.

The funeral of Sir Michael Foster took place at Huntingdon on Saturday, among those present at the graveside being Lady Foster, Dr. Michael G. Foster, Dr. R. Bradford, Sir Thomas Barlow, Dr. Pye Smith, Mr. Horace Darwin, Dr. Gaskell, Prof. Langley, and Prof. Sherrington. A memorial service was held on Saturday afternoon at St. James's Church, Piccadilly, and was attended

[1] Even Foster's writings were not always free from oversights. In one passage he advises the reader to "get a firm hold of the most prominent feature of the subject"; in another he corrects a woodcut by explaining that the granules "have been rendered too bold by the artist."

by many leading men of science. The Royal Society, of which Sir Michael Foster was a secretary for twenty-two years, was represented by Lord Rayleigh, O.M., president; Prof. D. Ferrier, vice-president; Sir Archibald Geikie, secretary; Mr. R. Harrison, assistant secretary; and a large number of fellows of the society. Among those present were Lord Reay (president of the British Academy), Lord Monkswell, Sir William Crookes, Sir Philip Magnus, M.P., Sir Arthur Rücker (principal of the University of London) and Lady Rücker, Sir Norman and Lady Lockyer (British Science Guild), Major MacMahon (British Association), Sir William Ramsay, Sir Joseph Swan, Sir J. Crichton-Browne, Sir James Blyth, Prof. R. Meldola (president of the Chemical Society), Dr. Russell Wells, Prof. S. P. Thompson, Dr. E. Divers, Dr. J. Kingston Fowler (dean of the faculty of medicine at the University of London), Prof. Wyndham Dunstan, Prof. Tilden, Prof. Priebsch, Sir Alexander Pedler, Dr. Bashford, Prof. Thane, Prof. Starling, Dr. Hugo Müller, Prof. Emerson Reynolds, Sir Henry Howorth, Prof. McLeod, Sir H. Trueman Wood, Dr. Horace Brown, Prof. Judd, Prof. Hull, and Mr. Frederick Macmillan.

A large and representative congregation also attended the memorial service held in Trinity College Chapel, Cambridge, of which college Sir Michael was a fellow. The congregation included the Vice-Chancellor (the Rev. E. S. Roberts, Master of Caius), Profs. Sir R. S. Ball, E. C. Clark, T. Clifford Allbutt, A. Macalister, A. R. Forsyth, Carey Foster, F. Howard Marsh, G. Sims Woodhead, H. Jackson, and A. C. Seward, Dr. W. N. Shaw, and the following representatives of learned societies:—University of Oxford, Prof. Poulton, Dr. Collier, Prof. Gotch; the Royal Society, Mr. A. B. Kempe (treasurer), Mr. F. Darwin (foreign secretary), and other councillors; University College, London, Prof. H. S. Foxwell; British Association, Sir George Darwin and Mr. A. E. Shipley; Cambridge Philosophical Society, Dr. Hobson (president) and Mr. H. F. Newall (treasurer); the Epidemiological Society of London, Dr. H. Timbrell Bulstrode; Manchester University, Prof. Lamb and Prof. Conway.

NOTES.

AT the forthcoming meeting of the British Association in Leicester, the evening lectures will be by Mr. W. Duddell, on "The Arc and the Spark in Radio-telegraphy," and by Dr. F. A. Dixey, on "Recent Developments in the Theory of Mimicry." The lecture to the operative classes will be given by Prof. H. A. Miers, F.R.S., on "The Growth of a Crystal."

WE notice with deep regret that Prof. D. I. Mendeléeff, the eminent Russian chemist, who was born seventy-three years ago to-day, died on February 2. Prof. Mendeléeff was the subject of a "Scientific Worthy" article in NATURE of June 27, 1889 (vol. xl., p. 193), and we hope to supplement this next week with a short account of work accomplished by him since that date.

WE learn from the *British Medical Journal* that the seventh International Congress of Physiology will be held this year at Heidelberg on August 13–16, under the presidency of Prof. August Kossel. In connection with the congress there will be an exhibition of scientific apparatus. Announcements of communications should be sent to the Physiological Institute, Heidelberg, before June 15.

A REUTER message from Melbourne on January 31 reports that slight shocks of earthquake have occurred at Eden, New South Wales, and at Gabo Island, off the coast of Victoria. Severe shocks were felt in north-eastern Tasmania on January 30. News has reached Melbourne that two severe and prolonged shocks were felt in the Tonga Islands on January 2.

Science announces that Dr. Otto Lummer, professor of experimental physics at Breslau, will begin a course of ten lectures at Columbia University on February 15. Prof. J. Larmor, Sec.R.S., will begin a course of six lectures on March 27. Mr. W. Bateson, F.R.S., will give the Silliman memorial lectures at Yale University next year. The preceding lecturers on this foundation have been Prof. J. J. Thomson, F.R.S., Prof. C. S. Sherrington, F.R.S., Prof. Ernest Rutherford, F.R.S., and Prof. W. Nernst.

ON Tuesday next, February 12, Prof. W. Stirling will begin a course of six lectures at the Royal Institution on "The Visual Apparatus of Man and Animals"; on Thursday, February 14, Mr. A. Harker will give the first of two lectures on "The Minute Structures of Igneous Rocks and their Significance"; and on Saturday, February 16, Prof. J. J. Thomson will commence a course of six lectures on "Röntgen, Kathode, and Positive Rays." The Friday evening discourse on February 15 will be by Mr. J. J. Lister, on "Foraminifera."

A COMMITTEE has been appointed by the Board of Treasury to inquire generally into the work now performed at the National Physical Laboratory, with special reference to the character of the tests undertaken there and the lines on which any further development of the work of the laboratory should proceed. The committee consists of Mr. G. W. Balfour, chairman, Sir Andrew Noble, Bart., K.C.B., F.R.S., Sir J. Wolfe Barry, K.C.B., F.R.S., Mr. W. J. Crossley, M.P., and Mr. R. Chalmers, C.B. Mr. G. C. Upcott, of the Treasury, will act as secretary to the committee.

UPON the authority of the *Figaro*, the Paris correspondant of the *Times* reports that M. Daniel Osiris has left by his will a sum of one million sterling to the Pasteur Institute. The bequest by which the Pasteur Institute thus benefits will provide it with an annual income of from 30,000*l.* to 40,000*l.* It is already one of the best endowed scientific institutions in the world, and this princely gift will enable it to organise on a practical basis a large number of new branch establishments for scientific research all over France and in the French colonies.

COLONEL JOHN MERCER BROOKE, whose death in his eightieth year was recently announced, was best known as the inventor of a deep-sea sounding apparatus which was subsequently superseded by that of Lord Kelvin. During the American Civil War, Colonel Brooke, along with Maury, the distinguished hydrographer, associated himself with the seceding States, and was successful in effecting many improvements in the cannon of the time. At the close of the war he was appointed a professor in the Virginia Military Institute at Lexington, and held the chair of physics and astronomy until 1899. In the years preceding the Civil War, he was engaged in making hydrographic surveys in the Pacific Ocean, particularly in the archipelago and along the coasts of China and Japan.

A RECENT Reuter message from Entebbe shows that the new Commissioner of Uganda is making vigorous efforts to combat the scourge of sleeping sickness. Acting upon the discoveries made by the Royal Society's commission with regard to the transmission of the disease by the local species of tsetse-fly, it is sought to render the fly innocuous by preventing it from becoming infected with the micro-organism (Trypanosoma) which causes the disease. With this end in view the natives are being removed from the

lake shore, the region which is the special haunt of the tsetse-fly in question, while at the lake ports, such as Entebbe and Jinja, every effort is being made to oust the fly by destroying the vegetation which harbours it, and Entebbe is already reported to be clear of fly. It is only to be hoped that the process of deforestation will be carried out with discretion as well as with zeal, and only those tracts denuded of forest which have been definitely proved to harbour the tsetse; a forest tree may be destroyed in half an hour which a hundred years will not replace. The experience of other diseases transmitted by biting insects, such as yellow fever, indicates that the most efficient method of preventing the spread of the disease is to isolate the patients in such a way as to prevent them from infecting the insects which are the carriers. If it is possible to carry this out on so large a scale as the Protectorate Government is trying to do it, we may hope to see in a few years the disease stamped out completely in the territory of Uganda. The Commissioner is to be congratulated on the promptness and energy with which he is turning the conclusions of scientific investigation to practical use.

An interesting innovation in coal-mining practice is reported from the United States, where at a colliery at Shamokin, Pennsylvania, concrete has been substituted for mine timbering. A plant for the manufacture of these cement props is in course of erection at Trevorton.

On January 28 coal was struck at Lord Dudley's sinkings at Baggeridge Woods at a depth of 556 yards. The seam is 20 feet thick, and beds of excellent ironstone have also been encountered. The discovery has verified the prediction of geologists regarding the existence of Coal-measures under the sandstone to the west of the South Staffordshire coalfield. This is the first place where coal has been found on the eastern side of the great Western Boundary fault, and the discovery is one of national importance. The work of sinking was commenced nine years ago, and great difficulties had to be contended with in consequence of the large quantities of water encountered.

The Transvaal Geological Survey has issued a monograph (Memoir No. 3, Pretoria, 1906, price 7*s.* 6*d.*), by Mr. E. T. Mellor, on the geology of the Transvaal Coal-measures, with special reference to the Witbank coalfield. It contains a detailed account of the coal resources of the Witbank district, at the present time the most important coalfield in the Transvaal. In addition, the available information regarding the geology of the Coal-measures of the Transvaal in general is ably summarised. Notes on the correlation of the Transvaal Coal-measures, a list of the fossils of the Transvaal Coal-measures, analyses of the coals, statistics of production from 1893 to 1906, and a useful bibliography are appended. The memoir covers sixty pages, and is accompanied by a map, six sections, and fourteen plates reproduced from photographs.

In the *Engineer* of February 1 there is a copiously illustrated description of the Tehuantepec railway and of the terminal harbours at Salina Cruz, on the Pacific, and Coatzacoalcos, on the Gulf of Mexico, which were formally opened by the President of the Republic of Mexico on January 23. The length of the line is 189 miles, and the opening up of a trade route across the isthmus will be of special benefit to the middle west of the United States. The average saving in distance by the Tehuantepec route over a Panama canal for traffic between Europe or the Atlantic ports of the United States is about 1250 miles. Proposals to construct a railway across the isthmus were made as long ago as 1842, and a railway was completed by 1894, the Mexican Government having spent on the undertaking 3,500,000*l.* The railway, however, was not adapted for heavy traffic, and had no terminal facilities or harbour works. In 1898 the Government entered into a contract with the London firm of S. Pearson and Son, Ltd., to reconstruct the line and to provide harbour accommodation. This has now been done at a cost of 9,500,000*l.*, and the railway will undoubtedly prove a formidable competitor to the Panama Canal when that difficult enterprise is completed. For the Panama Canal the Americans have decided on a lock-canal system; but this system cannot, Mr. P. Bunau-Varilla points out in a very important paper contributed to the Society of Arts (Journal, vol. lv., p. 239), be looked forward to with complacency in a volcanic neighbourhood subject to earthquakes. Mr. Bunau-Varilla, who had been connected with the Panama Canal since 1884, proposes a well-considered alternative scheme in which water is used as the carrying power for the machinery to do the excavating and for the transport of the dredged material. In short, the heavy rainfall is not treated as an enemy, but converted into a friend and ally. In this way Mr. Bunau-Varilla claims to have solved the problem set by Charles V. in 1523 to Cortes: Discover the secret of the straits (*el Secreto del Estrecho*). The secret lies in the topography and hydraulics of the isthmus. Everything has been prepared by nature, in the high valley of the Chagres, to lift the earth that obstructs the site of the straits. Harness this power, and the straits will be made by its spontaneous action.

In a document issued by the Public Works Department, the director of the Zoological Gardens at Giza announces that he has returned from a trip to the Sudan, bringing with him a number of animals, inclusive of a giraffe, three young elephants, and five ril gazelles (*Gazella ruficollis*).

Having in earlier issues of the same journal discussed the filtering apparatus attached to the gill-rakers of various groups of surface fishes, especially those which feed on plankton, Dr. Enoch Zander in part ii. of vol. lxxxv. of the *Zeitschrift für wissenschaftliche Zoologie* records the results of his investigations in connection with corresponding structures in deep-sea fishes. The general results arrived at in the case of surface-dwelling species hold good in the main for deep-sea fishes, forms living in open water usually having the filtering apparatus much more strongly developed than in the bottom-dwelling types. The large-headed open-water genus Stomias is, however, an exception in this respect.

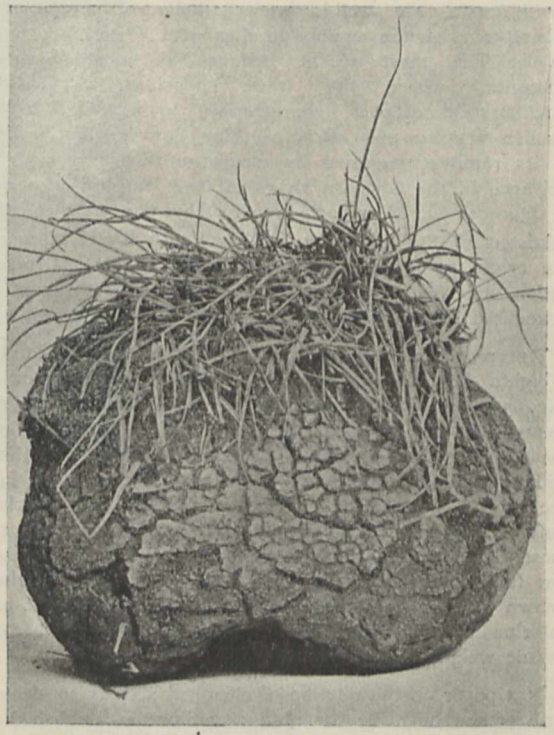
In the *American Naturalist* for January Mr. E. Linton describes the manner in which the parasitic fish *Fierasfer affinis* effects an entrance into the body of the sea-cucumber, which serves as its host. Although the observations are not entirely new, they are of considerable interest. When the small pellucid fish comes alongside of the holothurian, it gradually feels its way down the body of the latter by means of its head until it reaches the vent, when it immediately curls itself into a loop and thrusts the tip of its whip-like tail into the aperture of the latter. When this is accomplished, the fish straightens its body, and proceeds leisurely to insinuate itself, tail-first, into the body of its host, the action being apparently assisted by the spines of the dorsal and ventral fins. The whole process occupies only about half a minute.

MUCH interest attaches to an account, by Mr. James Murray, in the January number of the *Zoologist*, of a remarkable "encystment" undergone by a British species of so-called "water-bear" (Macrobiotus). Certain peculiar little yellow elliptical or sausage-shaped packages, from which, when squeezed, water-bears in a quiescent condition spurted out, were, it appears, first observed. Subsequent investigation proved these to be an early stage of the encystment of these creatures. In the species fully examined there is an outer cyst with six rudimentary legs; inside this is an inner, limbless cyst containing at first a fully developed water-bear. Later on the Macrobiotus shrinks to an almost amorphous condition, so that it looks more like a worm. What happens afterwards, and likewise the object of these strange changes, have yet to be ascertained. A similar encystment was detected almost synchronously by Prof. Lauterborn in the case of a Continental species. In the same issue Mr. A. Campbell describes certain naked house-mice similar to a type described in 1856 as *Mus musculus nudoplicatus*. Since, however, this phase is a pathological development, it has obviously no right to a racial name.

THE U.S. Bureau of Entomology has re-issued (Bulletin No. 26) a report, published in 1895, on the San José or Chinese scale-insect (*Aspidiotus perniciosus*) in a revised and expanded form, so as to include an account of the investigations and remedial measures which have been undertaken and suggested since that date. The author of the new publication is Mr. C. L. Marlatt, acting chief of the Bureau. The insect, it seems, first made its appearance in America in the early 'seventies at San José, California, on the estate of the late Mr. James Lick, who was in the habit of importing plants from abroad. It was not, however, until 1901, as the result of a special expedition, that its native home was definitely located in north-eastern China. The isolated condition of this habitat is considered to be the reason that prevented the pest from overrunning a large portion of the world centuries ago. Despite the destruction caused to orchards when it once obtains a footing, the pest is now to a great extent under control, mainly owing to a lime-sulphur wash. In some degree the invasion has, indeed, been a blessing in disguise, since the greater care rendered necessary in selection, planting, and culture has largely benefited fruit-growing in general. At one time great hopes were entertained that a Chinese ladybird would form the most efficient restraining agent, but the use of washes and the presence of a parasite were inimical to the beetle.

WE have to acknowledge the receipt of the first three parts of a new publication from the Museum für Natur- und Heimatkunde zu Magdeburg, edited by Prof. A. Mertens, the director of the museum. By far the most important item in these *Abhandlungen und Berichte* is a paper by the editor on the urus, or aurochs (*Bos primigenius*), which occupies the whole of part ii. The author gives a review and digest of the whole of the early literature and documents relating to the ancient wild ox of Europe, as well as of the comments upon them by previous writers. In his opinion, there is no doubt that the name aurochs properly belongs to this animal, although it has often been misapplied to the bison. It is likewise certain that in the time of Herberstain (the middle of the sixteenth century) both aurochs and bison were living in Poland, and that they were seen alive by him. According to other testimony, there was living in the Jaktorowka (or Wiskitki) forest, of the Masovia district of Poland, in the year 1564, a herd of thirty aurochs. By 1599 the number was reduced to twenty-four, while in 1602 only four remained, these being reduced in 1620 to a single cow, which appears to have been alive seven years later. It seems, however, that a few half-domesticated individuals were living in captivity in 1627. Herberstain's testimony that the aurochs was typically a black (or at all events a very dark-coloured) animal with a light dorsal streak is accepted. Other evidence tends, however, to show that there was a grey variety or phase in Poland, and a red one in central Germany, while the partially domesticated individuals kept in confinement during the early part of the seventeenth century may have developed other colour phases, with partial albinism. Several particulars with regard to the breeding and general habits of the aurochs are also given.

IN a fifth instalment of his "Studies of Mexican and Central American Plants," published as vol. x., part iii.,



Calibanus caespitosus (Scheidw.) Rose.

of the Contributions from the United States National Herbarium, Dr. J. N. Rose describes a large number of new species. The author being greatly interested in cacti, made them the subject of special investigation during his trip in 1905, and has identified several new and interesting specimens that are described and illustrated. In some cases numerous individuals cluster together to form a large cushion, as *Echinocactus robustus*; others develop into strange arboreal structures producing hundreds of nearly erect branches, notably *Cereus Webberi*, while *Echinocactus ingens* produces a large circular body that is cut up into sections resembling Dutch cheeses and boiled with sugar to make candy. Even more curious is the liliaceous plant shown in the illustration here reproduced, that is characterised by its thick corky exterior, and lives upon the food absorbed through a few fibrous roots; it forms the type of a new genus, named after Shakespeare's Caliban, *Calibanus caespitosus*.

In the Journal of the Royal Microscopical Society for December, 1906, Dr. Alfred C. Stokes contributes a note on a certain form of butterfly scale the structure of which well illustrates certain points in connection with the much-studied "Podura" scale. He says:—"These special wing-scales are formed of three distinct membranes, of which the upper and the lower bear longitudinal ribs, between which both membranes are distinctly, even conspicuously perforated by minute apertures arranged in rows more or less horizontal." It appears not to be generally known that the "clouded yellow" (*Colias edusa*) possesses pear-shaped wing-scales mixed with the ordinary scales, corresponding more or less closely to Dr. Stokes's description. These special scales seem to take the place of the "plumules" of many Pieridæ and Satyridæ, and of the "battledore" scales of Lycænidæ.

The growth of the sudd on the Upper Nile, and the blocking of American rivers with plants of the water-fern, Azolla, are well-known examples of the danger arising out of the undue development of certain water weeds. The most recent instance is recorded from Australia, where the water hyacinth, *Pontederia* (*Eichhornia*) *crassipes*, characterised by its bladder-like swollen petioles and attractive blue flowers, has, owing to its rapid propagation by means of offsets, become a nuisance in the northern rivers of New South Wales and in Queensland. A report prepared by the order of the Minister for Public Works in New South Wales discusses the origin of the plant, the methods and cost of eradication, and proposes that a Noxious Weeds Bill should be introduced into Parliament.

The report of the International Committee on Atomic Weights for 1907 is published in the current number (No. 319) of the Proceedings of the Chemical Society. New values are suggested, on the basis of determinations made during the past year, for bismuth, nitrogen, tantalum, and terbium, and the opinion is expressed that alterations are needed in the atomic weights of silver and chlorine. Before, however, recommending any change as regards these elements, the committee deems it advisable to wait for fuller information of the results of determinations known to be in progress, as the new values for silver and chlorine will have an influence on a large number of atomic weights.

In a paper on the relation of chemical activity to electrolytic conductivity, by Mr. John L. Sammis, published in the *Journal of Physical Chemistry* (vol. x., No. 8), a large number of experimental observations are cited as disproving the views of Arrhenius and Ostwald that chemical activity in solution is proportional to the electrolytic conduction. The activity of acids in inverting sugar, catalysing esters, and dissolving magnesium is changed by the addition of benzene to the aqueous solution employed at a rate disproportionate to the conductivity. The replacement of one metal by another is said to take place in molten salts or solutions which are the best of insulators as well as in liquids which are good electrolytes. It was found that in sixty-nine non-conducting solutions of copper oleate prepared with different solvents, copper was easily precipitated by lead, whilst in fourteen other non-conducting solutions lead did not replace copper. The general purpose of the paper is to emphasise the view that the solvent is not indifferent to the solute. It is contended that the facts brought forward are explainable only on the hypothesis that "chemical" union occurs between the solvent and the dissolved substance.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN FEBRUARY:—

Feb. 8. 16h. Venus at greatest elongation, 46° 53′ W.
,, 19h. Venus in conjunction with the Moon. Venus 0° 51′ N.
9. 10h. Minimum of Algol (β Persei).
12. 6h. 49m. Minimum of Algol (β Persei).
15. 20h. Vesta in conjunction with the Moon. Vesta 0° 42′ S.
19. 6h. 31m. to 9h. 33m. Transit of Jupiter's Sat. III. (Ganymede).
20. 23h. Conjunction of Mercury and Saturn. Mercury 1° 40′ N.
22. 6h. Conjunction of Jupiter with the Moon. Jupiter 2° 45′ N.
,, 16h. 8m. to 16h. 58m. Moon occults ν Geminorum (mag. 4·1).
23. 7h. 11m. to 8h. 29m. Moon occults ζ Geminorum (variable).
25. 5h. 30m. to 6h. 31m. Moon occults δ Cancri (mag. 4·2).
26. 10h. 12m. to 13h. 14m. Transit of Jupiter's Sat. III. (Ganymede).

MICROMETER MEASURES DURING THE SOLAR ECLIPSE OF AUGUST, 1905.—At the meeting of the Paris Academy of Sciences held on January 7, M. J. Merlin submitted a paper discussing the micrometer measures made at Roquetas (Spain) by MM. André and Guillaume during the total solar eclipse of August, 1905. From this discussion he arrives at the conclusion that the lunar-parallax constant determined by Prof. Newcomb is not affected by any error sufficiently large to be detected by the measurements carried out. There is, however, room to correct the relative positions of the sun and moon as given in the *Connaissance des Temps*, although the correction does not modify the apparent trajectory of the moon in regard to the sun; it serves only to advance the position of the former in that trajectory by an amount corresponding to an advance of 11·1 seconds in the calculated times of the contacts (*Comptes rendus*, January 7).

HEIGHTS OF METEORS OBSERVED IN 1906.—In No. 4152 of the *Astronomische Nachrichten* Mr. Denning gives the heights, lengths of paths, and velocities of ten large meteors observed in England during 1906. The heights at the commencement of visibility varied from fifty-nine to eighty-nine miles, whilst those at disappearance varied from twenty-two to fifty-six miles. Seventy-two miles was the length of the longest path recorded, and twenty-four miles that of the shortest. The velocities determined lie between fifteen and thirty miles per second, the latter value having been determined for a Perseid observed on August 5, 1906.

A QUICKLY CHANGING VARIABLE STAR.—In Bulletin No. 9 of the Laws Observatory, University of Missouri, Mr. F. H. Seares discusses the observations of the quickly changing variable star R.R. Draconis (188.1904) which were made at that observatory during 1905–6. The variable is of the Algol type, with a period of about 2·8 days, and its light-curve is peculiar in being extraordinarily steep about the time of minimum. The latter could not be determined exactly, because the star becomes invisible for about two hours in the 7½-inch refractor employed, but the observations plainly showed that the range is greater than three magnitudes, and that the rate of change at the time of disappearance is one magnitude in half an hour. The normal magnitude of this object is 9·98, and the elements of its period, as determined from these observations, are:—

Min. = J.D. 2417026·682 + 2·831079d. E. G.M.T.

Some of the residuals suggest the possibility of a variation in the period, but for the present this possibility remains very uncertain.

METCALF'S COMET 1906*h*.—Another set of elliptic elements for comet 1906*h* has been calculated by Mr. Crawford from observations made at the Lick Observatory. This gives October 5·66, 1906, as the time of perihelion passage, and 8·23752 years as the period of the comet (Lick Observatory Bulletin, No. 108).

THE ERUPTION OF MATAVANU IN SAVAII, 1905–6.

THE last-issued number of the *Zeitschrift der gesellschaft für Erdkunde zu Berlin* contains an account of a very remarkable volcanic eruption which had been in progress for more than twelve months in September last in the island of Savaii. The volcanoes of this island had been quiet for more than a century when, in 1902, two minor outbreaks occurred, and in 1905 a greater eruption commenced, causing so much anxiety and alarm that the German Colonial Administration sent to Prof. K. Sapper, of Tübingen, a collection of specimens, photographs, and newspaper and other reports, from which he has compiled an account which is interesting in spite of its inevitable incompleteness.

The eruption was ushered in by a series of earthquakes lasting from July 25 to August 1, 1905; at half past nine on the night of the last-mentioned date a loud detonation was heard, and shortly after "pillars of fire" were seen issuing from a valley known as Matavanu, some 12 kilometres from the coast on the north-eastern side of the island. At first the eruption was of an explosive character, and does not seem to have been very violent, as the estimates of the height to which matter was thrown do not exceed 200 metres, and the hill formed was never more than 150 metres in height. On August 9 lava began to flow, at first in small quantities, afterwards more abundantly, until it reached the coast on December 6, and flowed down to the sea at intervals up to the end of September, 1906, the date of the latest reports received by Prof. Sapper. During this period the outflow of lava seems to have been continuous, though varying in amount, and unaccompanied by any considerable degree of explosive activity.

Lava flowing under its consolidated upper crust into the sea near Salago, September, 1906.

Many people visited the volcano during the eruption, and an interesting account by Dr. Grevel is reprinted from the local newspaper; his party made the ascent on April 23 last, over the crust of the lava stream, which was smooth and easily traversed, and cool enough for the Samoans who accompanied him to walk over it. The solid surface of the lava stream was broken at intervals by vent holes, the one nearest the crater being at first mistaken for a parasitic cone, as the crust of the lava rose in a gentle convexity to the orifice, which was much smaller in diameter than the cavity underneath. Thick, sulphurous vapours prevented any sight into the cavity, and large stones thrown in gave no clue to its depth, as their fall was unheard. Four of these vent holes were examined, which repeated the features of the first on a smaller scale, and the party then climbed to the crater by an easy ascent over the lava flow on the northern side. Owing to the drift of the south-east trade wind, no view of the crater could be obtained, so Dr. Grevel and his party worked round by the east, where the surface was covered with countless bodies of moths, attracted by the glow of the crater and killed by the vapours rising from cracks in the surface of the lava flow; the same vapours had proved fatal to a flying-fox, a dove, and a sea-gull. From the southern edge a good view of the crater was obtained; it was about 300 metres in diameter, filled with a lake of molten lava in gentle ebullition, caused by the rise of steam bubbles, and from the centre a gentle streaming to the north commenced, which increased in rapidity until the lava disappeared in a cataract into a cloud of steam, and presumably joined the stream over the surface of which the party had ascended.

On reaching the sea, the lava flowed out to the reef, where its end, being cooled by the surf, formed a wall between which and the coast the lava flowed quietly along the lagoon. At its end the sea was in violent ebullition, dense clouds of steam were formed, and for 100 metres from the end of the flow the sea was boiling hot, and fishes, killed and cooked by this boiling sea-water, were collected and eaten by the natives. In a few places the lava flowed over the reef into the deep water outside, and where this occurred its progress was marked by violent geyser-like explosions, which were mistaken by some people for fresh volcanic eruptions, but were in reality due to steam formed under the still liquid lava. We reproduce a very striking photograph of one of these geyser-like explosions at the front of a lava stream flowing into the deep sea. The lava was remarkable for its fluidity, and issued in great quantity; according to a map attached to Prof. Sapper's paper, the area covered by the lava extends about 6 kilometres to the west and 12 kilometres to the north-east of the volcano, and has a width of from 2 kilometres to 5 kilometres; it has filled the lagoon for about 8 kilometres along the coast, destroying several villages and rendering others uninhabitable by cutting off their water supply, while several small promontories of lava were thrust forward beyond the reef.

RESEARCH IN TROPICAL MEDICINE AND HYGIENE.[1]

(1) THE greater part of the first report is occupied with an elaborate memoir by Drs. Thomas and Breinl on trypanosomes, trypanosomiasis, and sleeping sickness. It comprises a description of cases of sleeping sickness, a full account of inoculation experiments with the *Trypanosoma gambiense*, from which the conclusion is formulated that the trypanosomes of sleeping sickness of Uganda and of the Congo Free State and of trypanosomiasis are identical, together with an account of the pathological anatomy and histology of trypanosomiasis, the action of various drugs on trypanosomes, and experiments with the trypanosomes of surra, mal de caderas, dourine, &c.

The late Mr. Dutton and Dr. Todd contribute an important memoir on human tick fever in the Congo Free State, with an appendix by Mr. Newstead on the anatomy of the tick (*Ornithodoros moubata*) which conveys the disease.

1 (1) "The Thompson-Yates and Johnston Laboratories Report." Edited by Rubert Boyce and Charles Sherrington, with H. E. Annett, Benjamin Moore, Ronald Ross and E. W. Hope. Pp. 141. Vol. vi. (New Series), Part ii., December, 1905.

(2) *Ibid.* Vol. vii., Part i., February, 1906. Pp. 88+plates.

(3) "Rapport sur l'Expédition au Congo, 1903–5." Par J. Everett Dutton and John L. Todd. (École de Médicine Tropicale de Liverpool, Mém. xx.) Pp. 70. (All published for the University Press of Liverpool, by Williams and Norgate, London, 1906.) Price 5s.

(4) "Second Report of the Wellcome Research Laboratories at the Gordon Memorial College, Khartoum." By Andrew Balfour.

Lastly, Surgeon Ross, R.N., contributes a short paper on the habits of the marine mosquito (*Acartomyia zammitii*).

(2) The second report contains papers on a new species of louse (*Haematopinus stephensi*) which acts as the intermediary host of a new hæmogregarine parasite in the blood of the Indian field rat, by Mr. Christophers and Mr. Newstead; a note on the anatomy of *Gastrodiscus hominis*, a human fluke, by Dr. Stephens; a revision of the Sarcopsyllidæ, by Dr. Karl Jordan and the Hon. N. C. Rothschild, a family of fleas which includes the jigger, and the rat flea supposed to transmit plague to man; and a description of the maiotic process in Mammalia, by Messrs. Moore and Walker. The last-named paper is illustrated with a number of beautiful plates, and is well worthy of study.

(3) In this report the late Mr. Dutton and Dr. Todd, after some general remarks on the conditions favouring the spread of malaria, describe the conditions existing at some of the towns and posts of the Congo Free State, and formulate recommendations for remedying these. Dr. Breinl and Mr. Kinghorn describe experiments showing that the Spirochæta of African tick fever is infective for the horse, dog, rabbit, guinea-pig, rat, and mouse in addition to monkeys, whereas the *Spirochaeta obermeieri* of relapsing fever is infective for monkeys only. Dr. Breinl has also compared the immunity produced by these two Spirochætes, and finds that each strain produces considerable active immunity against re-infection, but does not produce immunity against infection with the other strain. The course of the disease also varies with the two strains, and the conclusion, therefore, is that tick fever and relapsing fever are produced by different species of Spirochætes.

(4) The second report of the Wellcome Research Laboratories of the Gordon College, Khartoum, by Dr. Andrew Balfour, the director, maintains the high standard of the first one (see NATURE, vol. lxxi., p. 605), both as regards the nature of the work recorded and the manner in which it is presented to the reader. Nearly half the volume comprises records of mosquito work in Khartoum, of biting and noxious insects, mosquitoes, and other human, animal, and vegetable pests of the Sudan. Dr. Balfour describes a hæmogregarine parasite of the jerboa and a leucocytozoon of mammals, and contributes a report on cattle and equine trypanosomiasis in the Anglo-Egyptian Sudan. Fortunately, human trypanosomiasis and sleeping sickness do not yet seem to be endemic in this part of Africa, nor has the tsetse-fly which conveys it (*G. palpalis*) been described here. In the chemical laboratory a considerable amount of work has been done by Dr. W. Beam, the chemist, on water analysis, Sudan grains and gums, &c. The travelling naturalist, Mr. Sheffield Neave, records many interesting observations on blood, blood parasites, &c., of birds, fish, and other animals.

R. T. HEWLETT.

PRESIDENTIAL ADDRESSES AT THE NEW YORK MEETING OF THE AMERICAN ASSOCIATION.

A GENERAL article upon the proceedings of the American Association for the Advancement of Science at the meeting held at New York during the Christmas vacation appeared in NATURE of January 24 (p. 304). Through the kindness of the general secretary of the association, Dr. L. O. Howard, we have received copies of several of the addresses delivered by the president and by the chairmen of sections, but limitations of space will not permit us to publish any of them in full. The subjoined extracts from these addresses will, however, afford an indication of the subjects considered and the views expressed.

EDUCATIONAL THEORIES, ANCIENT AND MODERN.[1]

The Greek idea of education and culture was based upon the existence of a privileged class, fed, clothed, and sheltered by the labour of slaves—a real aristocracy devoted to war, art, literature, and luxurious living. The sway of the so-called classic idea of education has been, and still is, one of the marvels of history. The splendour of Greek art, the brilliancy of Greek literature, and the keenness of Greek logic, have held the world as in a trance, unable to break away from its charms—though it has been unsuited to other peoples and other social conditions.

Francis Bacon more than any other man showed the inadequacy of the classic method, fine as it was along certain lines, and the comparative worthlessness of scholasticism, and he opened the eyes of the educated people of his time to the wealth of opportunity for interesting and profitable study in the great laboratory of nature, and, better than all else, he set forth the dignity and intellectual value of science study, and vigorously scouted the idea that the usefulness of scientific truth in any degree detracted from its educational value.

But none of the writers touching on education, with the possible exception of Froebel and Pestalozzi, not even Locke, Milton, or Dr. Samuel Johnson, looked at the matter from the scientific standpoint, which takes into account, first, the physiological laws which govern the growth and development of the brain; secondly, the exterior stimuli for promoting that growth most successfully; and, thirdly, the kind and quantity of knowledge and skill one must have in order to meet most completely the demands of a carefully selected occupation.

Every good teacher aims to make his subject as interesting as possible to his pupils. If they fail to take a lively interest in it, something is wrong; either it is not properly presented, or it is over their heads, or it is clearly of no earthly use. Natural lack of capacity on the part of the child is rarely a valid reason for failure if the child be healthy and normal. I have learned to discredit the truth of the oft-told tale that "John has no capacity for" such a subject—mathematics, for example. "He never could learn mathematics—he takes no interest in algebra, and he hates geometry," &c. Our higher schools and colleges are full of young people who protest vigorously that they never could, and never can, understand or take any pleasure in or gain any profit from certain studies. I firmly believe that every normal person, at least nine out of ten of the children and youth at school and college, can fairly master and actually enjoy and profit by, not only mathematics, but by every subject in the curriculum if it be properly taught, and under proper conditions as to age and preparation.

Attention is as necessary to the growth and development of the brain as exercise is to the development of a muscle, and interest is the condition of a lively attention. When in a school or lecture-room the limit of close attention is reached, the lesson or lecture should close, for the educational process has already stopped. It is not only useless, but it is worse than useless, to go on when the class or audience refuses for any reason to attend. I therefore doubt the educational value of subjects which are not, and perhaps cannot be, made interesting.

Of course I do not claim that all selected studies can be made equally interesting, or that any one study can be made equally interesting to all pupils, even when the pupils are properly graded, but I do claim that a lively interest is necessary, and that educational progress is very nearly proportional to the strength of that interest.

Perhaps the most valuable contribution to the science of education has come through a study of the laws which obtain in the growth and development of the brain, and the conditions under which that growth and development is most healthy and complete. There are times and seasons for the development of the mental and moral faculties as there are of the physical faculties. While such times and seasons are not precisely the same for all children, we find that all attempts at premature development are not only worthless, but are permanently injurious. Precocity is now regarded as a species of brain deformity. Plants and animals may be forced, and unusual and interesting results may be produced by forcing, but no one of us wishes a son or a daughter to be a prodigy in one direction at the cost of normal development in other directions.

The psychologists tell us that the brain cells develop as do other physical organs, not only through thought,

[1] From an address delivered by Prof. C. M. Woodward, president of the American Association.

but through muscular activity and the exercise of our senses. Accordingly, a healthy and timely growth and development of the brain is to be promoted by an education involving a great variety of activities, skilfully adjusted as to quality and quantity to the mental and physical status of the child.

Closely related with this of brain culture is the subject of manual training, which has recently gained a foothold in our scheme of rational education. Its nature and educational value are still under discussion.

The manual-training movement stands inevitably as a criticism upon the system of education which came down the ages through the fathers to us, and naturally the latter stands on the defensive. It also is a standing reproof to the old wasteful, unscientific method of teaching apprentices the theory and uses of tools. It is for educational science to justify the ways of progress, which lays aside the idols of the past and erects new temples and opens new kingdoms. Of all the temples, none is finer, none is more glorious, and none should be more scientifically planned and reared than education.

The evolution of the fully fledged technical school, or the technical department of the university, has taken place during the last half-century, and yet its broad, stimulating, attractive features have a following which bids fair to double the attendance of college and university students. This does not mean that letters and polite learning are being neglected, but that a new constituency is eager for the new education. This new education, though it recognises at all points a high order of usefulness, and contains little that is conventional, is only remotely professional. If ever its curriculum becomes narrow, it is quickly condemned by the best representatives of an education which combines utility with culture. No longer can the "Levites of culture," as Huxley calls them, claim to monopolise liberal education. The new education can be as liberal as the old, and both can be narrow. Fortunately, they flourish side by side, and the future shall choose the excellences of each. An adequate science of twentieth-century education will evaluate the characteristics of each, and bring the wisdom of the past, not its foolishness, to nourish the wisdom of the future.

Accuracy of Astronomical Clocks.[1]

The accuracy with which our astronomical clocks perform their function is a subject of interest. The earliest star catalogue of precision is that of Bradley. In discussing the performance of his clock, I have used the adopted rates as given by Auwers in his re-reduction of Bradley. The monthly means of the rates from July, 1758, to July, 1759, were taken, and the difference of each rate from its monthly mean. Then the mean of these differences, without regard to sign, was taken for each month.

The rates of two other clocks of the Greenwich Observatory were likewise discussed, the standard clock for the year 1850 and that for 1900, the adopted daily rates as published in the annual volumes being used. The first of these was kept in the observing room, and thereby subjected to large variations of temperature, while the second, made in 1871 by E. Dent and Co., was fixed to the north wall of the magnetic basement, as in this apartment the temperature is kept nearly uniform. The pendulum of this latter clock is provided with barometric as well as thermometric compensation.

There are two well-known clocks which should be mentioned, and in conclusion I will give some hitherto unpublished data concerning the clock with which I have been working during the past three years.

Probably no clock has had its rate more thoroughly discussed than Hohwü No. 17, the standard clock of the observatory at Leyden. It was set up in the transit room in 1861, and in December, 1898, was removed to the large hall of the observatory, where, enclosed in two wooden cases, it was placed in a niche cut in the pier of the 10-inch refractor. Further, to guard against sudden changes of temperature, the niche is closed by a glass door. At the meeting of the Royal Academy of Sciences at Amsterdam, held September 27, 1902, Dr. E. F. van de Sande Bakhuyzen submitted a formula as the best representation of the daily rate of the clock, and gave the result of a comparison of the observed daily rates 1899–1902, the average interval of time for each rate being six days, with those computed by means of the formula. I find that during the year 1900 the mean of these differences is 0·028s., and the largest difference is 0·071s.

About 1867, F. Tiede installed at the Berlin Observatory a weight-driven clock enclosed in an air-tight case. The original escapement was replaced in 1876 by a gravity escapement, and the clock continued to give satisfaction certainly up to 1902, when it was dismounted for cleaning. The only published rates that I have been able to secure are those during twelve weeks in 1877–8. During this period the average deviation of the observed daily rates, the average interval for each rate being six days, from the mean daily rate for the entire period is 0·030s.

In 1903 there was installed at the U.S. Naval Observatory one of Riefler's clocks, No. 70, with a nickel-steel pendulum, the impulse being communicated to the pendulum through the suspension spring. This clock was enclosed in an air-tight glass case, and was mounted in a vault where the temperature was artificially controlled. The definitive rates have been determined from September, 1903, to May, 1904, but, unfortunately, during this entire period we were unable to prevent the glass case leaking, and there was a variation of temperature in the vault of about 5° C.

Collecting together the results obtained, we have:—

Mean Deviation of Daily Clock Rate.

Clock	Date	Mean Deviation
Bradley	1759	... 0·102
Greenwich Observatory ...	1850	... 0·149
Greenwich Observatory ...	1900	... 0·051
Berlin Observatory	1877	... 0·02–0·03
Leyden Observatory	1900	... 0·028
U.S. Naval Observatory ...	1904	... 0·015

[1] From an address delivered by Prof. W. S. Eichelberger chairman of the Section of Mathematics and Astronomy.

Fact and Theory in Spectroscopy.[1]

Any treatment of the production of radiation falls more or less naturally into three parts, namely:—(1) the radiation of solid and liquid bodies which is almost, but not quite, independent of atomic structure; (2) the radiation which takes its rise in radio-active substances, and which is apparently dependent upon atomic collapse; and (3) the radiation of gaseous substances, dependent almost entirely upon normal atomic structure, and possibly also upon the mode of excitation.

The subject to which consideration is now invited has to deal only with radiation of this third class. Radiation which in terms of the electron theory is said to be due, not to abrupt or discontinuous acceleration, but to periodic acceleration.

Briefly defined, spectroscopy is that science which has for its object the general description of radiation, including the production of radiation, the analysis of radiation, the registration of radiation, and the measurement of radiation.

The theory of separating, recording, and comparing radiation is by no means simple or complete. That these last three operations demand in practice the highest degree of skill is exemplified by the work of Rayleigh, Rowland, Michelson, Perot and Fabry, and Hale.

There is, however, a certain very true sense in which these last three processes are merely preparatory to a more profound study of the first, namely, the production of radiation. From this point of view, spectroscopy hinges upon the radiant atom—if there be an atom—and may be defined, imperfectly and narrowly perhaps, as *the science of the radiant atom.*

More than one brilliant and partially successful attempt has been made within the last quarter-century to establish an adequate foundation for this science by devising what may be called a satisfactory atom. But before considering any of these attempts, it may be well to state briefly what seems to be the criteria by which any such foundation is to be judged.

Perhaps it may be fair to consider that atom as most competent which will explain satisfactorily the largest number of the following nine facts:—

[1] From an address delivered by Prof. H. Crew, chairman of the Section of Physics.

(1) The fact that spectral lines are in general approximately sharp.

(2) The fact that spectral lines are never perfectly sharp, but always have a finite physical width.

(3) The fact that certain spectral lines are arranged in series and bands after the manner described so perfectly by Balmer's equation and its generalised forms.

(4) The fact that increase of pressure causes a shift of spectral lines toward the red, as discovered by Humphreys and Mohler.

(5) The fact that a magnetic field will transform single lines into multiple polarised lines, as discovered by Zeeman.

(6) We come now to a group of phenomena which are not easily described under a single caption. I refer to phenomena such as those observed by Plücker and Hittorf, when they found one and the same gas in one and the same tube yielding very different spectra according to the mode in which the electric discharge was applied to make the gas luminous. In the same category doubtless belongs the extinction of air lines by the insertion of self-induction into the discharge circuit. Here may belong also the fact studied by Lenard and others, that the region near the electrode of an arc gives a spectrum different from the region near the centre of the arc; the fact also that the so-called "spark lines" are introduced into an arc by reducing the current to small values, a fact first studied by Hartmann.

Certainly in this same category belongs the fact that the spectrum of an arc is modified when the arc is surrounded by an atmosphere different from ordinary air.

Here also lie the profound differences between arc and spark spectra of the same element.

Notwithstanding the fact that "multiple spectra" is a term which has hitherto been employed to describe the Plücker tube variations, I propose that we generalise it and use it to describe this entire group of facts. Since the name is so appropriate, let us call the sixth fundamental phenomenon that of "multiple spectra."

(7) Any competent atom must allow us to infer the relations which have been proved to exist between spectral phenomena and atomic weights.

(8) The phenomena of line reversals and absorption bands.

(9) The fact that heat alone, at least within the range of our highest artificial temperatures, produces characteristic spectra in only a few rare instances.

These, briefly, are the parts of the spectroscopic superstructure for which a foundation is sought. These are the various parts which it is hoped will, some day, be cemented together, by a simple and general theory, into a harmonious structure.

But there is a final criterion, even more fundamental than any of those which have been mentioned, that such a theory must satisfy, namely, this hypothetical radiant atom must not in its behaviour, except as a very last resort, contradict any of the established principles of physical science, be they mechanical, electrical, or chemical.

The principle of the conservation of energy must be satisfied, even if it is necessary to assign an undreamed of amount of energy to each atom; in like manner Newton's third law is to be satisfied, even if the electromagnetic ether is called upon to furnish the reaction.

But even with this added criterion, the preceding list of nine phenomena is confessedly incomplete; the only object of such a catalogue is to include those typical fundamental facts which ought, apparently, to follow as immediate consequences from the structure of the radiating body, so soon as that structure is correctly guessed. Thus Doppler's principle is omitted on the ground of its being rather a kinematic law, governing periodic disturbances in any medium than a dynamical fact to be explained in terms of atomic structure and forces.

Having established a set of criteria by which we may estimate the fitness of a radiant atom, it would be interesting, if I were competent, and if time permitted, to pass in review some of the various atoms which have been proposed in recent times, such as that of Kelvin, 1884, or those suggested by the Hertzian oscillator.

But neither of these two conditions are fulfilled, and I propose, therefore, to consider only one atom, namely, the one which by common consent, I think I may safely say, more nearly satisfies the demands of experimental fact than any other ever devised. I refer to the atom first proposed in a general way by Lord Kelvin in his paper entitled "Epinus Atomised" (Baltimore Lectures, p. 541, Cambridge, 1904), and afterwards profoundly modified by Lorentz, Thomson, and Larmor.

So much work along this line has been done in the Cavendish Laboratory that one feels impelled to call this "the Cambridge atom"; in view, however, of its structure, perhaps "the Saturnian atom" is a more appropriate designation.

The Contributions of America to Geology.[1]

In speaking of the contributions of America to geology, I do not propose to give an inventory of the geological facts which have been made known as the result of work in this country. I propose rather to ask the question, "What has our country contributed to the stock of geological ideas?" In that classical history of geological science which Lyell has given us in his "Principles of Geology," he directs attention to the fact that the share which different nations bore in the early development of geological science was dependent, not alone upon the genius of individual workers, but in large measure upon the peculiar geological conditions of the various countries in which they worked.

Of course, it must be admitted that there is to-day no department of geological science which is as characteristically American as mineralogy was German, as dynamical geology was Scotch, as stratigraphical geology was English, and as palæontology was French, a century ago. I believe, nevertheless, that there have been certain contributions to the stock of geological ideas which are characteristically American.

The doctrine of the permanence of continent and ocean—the gradual emergence of continental lands and the withdrawal of the waters into the deepening ocean basins—was first enunciated by Dana in 1846. It was, apparently, the thought of the subsiding ocean bottom rather than the thought of the emerging land by which Dana was first led to the doctrine of the permanence of continent and ocean, but in his presidential address before the American Association for the Advancement of Science in 1855, Dana refers to the stratigraphy of New York as illustrating the idea of continental emergence. The doctrine of the permanence of continents when announced by Dana was essentially a new one. Geologists and pseudo-geologists of all classes had felt at liberty to re-distribute continents and oceans according to their own sweet will.

There is now little doubt that Dana was right in his general conception. The greater density of the suboceanic masses in comparison with the subcontinental masses, as shown by pendulum observations, indicates that the distinction between continent and ocean has its basis in the heterogeneity of the material in the interior of the earth, and the determining conditions must therefore have had their origin in the initial aggregation of that part of the primitive nebula which formed the earth.

Certain it is, however, that Dana made the evolution of the continents too simple an affair. He recognised, indeed, that the progressive emergence of the continental lands was attended by continual oscillation, yet, even in the last edition of his "Manual," it appears that he did not duly appreciate the magnitude of those oscillations. The doctrine of the progressive evolution of continents, as taught by Dana, gave new clearness and emphasis to the general conception of geology as a history of the globe.

The Geological Survey of Pennsylvania made known the folded structure—the alternate anticlines and synclines—of the Appalachians. The beautiful sections of these folded strata, in the atlas of that survey, reveal the thoroughness with which the structure of the mountains was investigated by Henry D. Rogers.

While the stratigraphy was worked out so beautifully in the first geological survey of Pennsylvania, the dynamic conception derived from it was crude indeed. But, however completely the Pennsylvania geologists failed to con-

[1] From an address delivered by Prof. Wm. North Rice, chairman of the Section of Geology and Geography.

struct a satisfactory theory of mountain-making, their observations of Appalachian structure were of immense value in their destructive effect upon some of the notions of mountain-making prevalent at the time.

The true interpretation of the Appalachian waves is probably to be found in the contractional theory of mountain elevation, of which Dana was the leading expounder. That the main cause of mountain elevation is tangential pressure in the crust resulting from internal contraction is now generally acknowledged, though there may be doubt whether the main cause of contraction is the cooling of the earth from an incandescent condition.

It is a curious fact that the first published suggestion of the agency of ice in connection with the drift came from a cotton manufacturer in Connecticut, Peter Dobson by name. The credit of the introduction and championship of the glacier theory of the drift belongs, not to a native, but to an adopted citizen of this country. In the early papers of Agassiz, the conception of the Glacial period took a form which he himself later recognised as an exaggeration. He conceived at first a fall of temperature so widespread that a polar ice-cap extended southward over the whole breadth of Europe and across the Mediterranean, reaching the Atlas Mountains. Later he recognised the ice-sheet that covered the Alps as entirely separate from the ice-sheet of northern Europe. The tendency to an exaggerated view of the Glacial period overcame him again in later years, when he maintained that, at the climax of the Glacial period, there was "floating ice under the equator, such as now exists on the coasts of Greenland." As Agassiz travelled in various parts of his adopted country, he recognised everywhere in the northern States the traces of glaciation, already familiar to him in Switzerland and in Scotland.

Within the last few decades the labours of earnest and able investigators have developed the glacier theory more in detail, and have added vastly to our knowledge of Quaternary history. The imaginary polar ice-cap has given place to ice-sheets of more limited dimensions, though still vast. The series of terminal moraines, marking stages of re-advance or halts in the retreat of the ice-sheet, have been carefully mapped.

In early years the study of geology in this country was substantially confined to the region east of the Mississippi, but, in due season, the weird and fascinating region of the Cordillera revealed itself to explorers and geologists. It is now more than half a century since American geologists began the study of that western wonderland. The first lesson that geologists learned in that land was the efficiency of subaërial denudation to remove vast quantities of material and shape the topography of wide areas. That western land has taught us, not only to recognise the fact of subaërial denudation, but also to formulate its methods. In Powell's "Exploration of the Colorado River," he distinguished rivers as consequent, antecedent, and superimposed. Davis has carried the analysis somewhat further, giving us subsequent and obsequent rivers. Powell formulated the doctrine of base-levels; Davis has given the conception greater accuracy and consistency by distinguishing base-level from profile of equilibrium. To Davis also we owe the full development of the conceptions of youth and age in river valleys and in drainage systems, and of cycles of erosion ending in the formation of peneplains.

Half a century ago the exploring expeditions connected with the Smithsonian Institution began to collect fossils from the Tertiary deposits of the western plains. Over those western plains were found to stretch vast continental deposits, certainly not all of lacustrine origin. These continental deposits of the western plains yielded in unparalleled richness mammalian fossils, which have been studied by Leidy, Marsh, Cope, Osborn, Scott, Wortman, and others. No other single series of discoveries has been so potent in changing the bearings of palæontology upon the doctrine of evolution.

In the half-century since the publication of Darwin's first edition, the attitude of palæontologists has completely changed. Not only is it true at present that palæontologists are substantially unanimous in accepting the doctrine of evolution, but it has come to be generally believed that the very science which afforded a half-century ago the strongest objection to evolution now affords its strongest support.

When the first edition of the "Origin of Species" was published, the classes of birds and reptiles seemed to stand widely asunder. But in the very next year (1860) an odd feather of Archæopteryx was discovered, and a year later the skeleton now preserved in the British Museum; but Archæopteryx was a solitary representative of the birds of markedly reptilian character until the discovery of Ichthyornis and Hesperornis in the Cretaceous of Kansas, of which preliminary descriptions were published by Marsh in 1872.

But the discoveries of most evolutionary significance, as already intimated, have been among the Tertiary mammals. A number of series has been traced, leading from generalised types in the Eocene, through forms of gradually increasing specialisation, to genera which still survive.

Some Phases of Prehistoric Archæology.[1]

Are eoliths artifacts? This is the fateful question. Their geological age is of no consequence if they are only natural forms, and have never been used by man or his precursor. The first flakes to be utilised were in all probability natural forms. It is not likely that Eolithic man knew how to obtain the raw material from the chalk. He depended on picking up from the drift flakes of approximately the shape and size needed. A sharp edge was utilised once, twice, or until it became dulled, and was then cast aside. If an angular piece did not admit of being comfortably grasped in the hand, the troublesome corners were removed. Such conclusions as these are forced upon one after careful examination of a series of the specimens in question. Would the same conclusions be so irresistible if these objects were merely nature's playthings? Many may even be grouped according to more or less definite patterns. Two of these deserve special mention, viz. the small crescent-shaped scrapers comparable to the spoke-shave, and the double scrapers with an intervening point between the two scraping edges. Sometimes two margins are worked, but on opposite sides. That is to say, after chipping one of the margins, instead of rotating the specimen until the adjacent margin comes into play, it was reversed.

The wide differences of opinion as to the origin of eoliths can hardly be due to prejudice alone. Faulty or insufficient observation and incorrect interpretation doubtless play their part. Luckily, there is no disposition to drop the matter until the truth appears. At the International Congress of Anthropology and Prehistoric Archæology held at Monaco April 15–22, 1906, the chief subject of the second session was the pedigree of the eolith. According to NATURE (June 28, 1906, p. 211), "a series of mill-modelled flint nodules was exhibited, among which there was certainly a number closely resembling many Prestwichian types, but conspicuous by their absence were the decidedly purposeful and rationally usable Kentian forms." On the other hand, Prof. E. Ray Lankester "submitted that he had recently placed on exhibition in the British Museum a considerable series (*Amer. Anthropol.* (N.S.), 1905, vii., 432, 433) of specimens selected from Prestwich's collection, all borer-like in form, too identical in shape and so rationally of obvious utility for any possibility of their being the result of fortuitous natural collisions."

As a further indication of the importance attaching to a correct solution of the problem, and indirectly in recognition of the value of Rutot's contribution toward such a solution, the meeting of the German Anthropological Association for 1907 will be held in Cologne in order that the members may visit the eolithic stations of Belgium and see the collections of the Brussels Museum.

Of caverns with Palæolithic mural decorations outside France, thus far reported, one is in Italy and four in Spain. The most important cavern in the Spanish group is that of Altamira, in the north coast province of Santander, this being the one in which the discovery of mural figures first took place. The genuineness of these figures would have continued to remain in doubt

[1] From an address delivered by Prof. MacCurdy, chairman of the Section of Anthropology.

had it not been for similar subsequent discoveries elsewhere.

M. Émile Cartailhac and the Abbé H. Breuil have recently studied with great care the wall paintings and engravings at Altamira. The cavern is a series of large chambers connected by passage ways. There is no evidence of its having been occupied by either man or beast since the close of the Quaternary, at which time the entrance was completely closed by a fall of earth and stones.

A second recent fall has afforded a new opening to the cavern, reached by clambering over the débris that closed the original entrance. The first chamber is divided by means of a mass of fallen stones. The one on the left is 40 metres long by 20 metres wide. The one on the right is a sort of corridor connecting with other chambers. Industrial remains of the floor deposits are confined to the entry and the chamber on the left. There is evidence that the cave bear had occupied the cavern before man took possession. Figures, engraved or painted, are found on the walls of every part of the cavern, especially on the ceiling of the chamber on the left, near the entrance, where the frescoes are remarkable for their beauty, size, and good preservation—a sort of Sistine chapel representing the *chef d'oeuvre* of perhaps more than one Michael Angelo of that far-off time.

These works of art represent a variety of technique. Some are simple line engravings. Others are more deeply incised. But the engravings are not so numerous as the figures represented in colour. Many are done in a single colour, either red or black. The most remarkable are the polychrome frescoes similar to those of Font-de-Gaume already described.

The figures are not all animal representations. Many are signs, the significance of which is not known. They do not belong to a single epoch. The superposition of figures, each in a different technique, studied in connection with the relative state of preservation of the various figures, has furnished a key to the order of succession. The same succession is traceable in the caverns of France, so that the Abbé Breuil and his colleagues, MM. Cartailhac, Capitan, Peyrony, and Bourrinet, have been able to distinguish four distinct phases[1] in the evolution of mural painting and engraving, all of them being represented in the cavern of Altamira.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The following Graces passed the Senate at Congregations held on February 1 and 2:—(1) That, in accordance with recommendation i. contained in the third report, dated November 13, 1906, of the special board for mathematics on the mathematical tripos, the regulations for the mathematical tripos, part i., contained in the report, be approved (placet, 776; non-placet, 644). (2) That, in accordance with recommendation ii. of the same report, the regulations for the mathematical tripos, part ii., contained in the report, be approved (placet, 780; non-placet, 638). (3) That, in accordance with recommendation iii. of the same report, the temporary provisions for the mathematical tripos, alike under the old regulations and the new regulations, contained in the report, be approved (placet, 777; non-placet, 637).

The Adams prize for 1907 has been awarded to Dr. E. W. Brown for his essay on "The Inequalities in the Moon's Motion due to the Direct Action of the Planets."

Mr. Douglas W. Freshfield will deliver a public lecture on Ruwenzori, at the Sedgwick Museum, on Thursday, February 14. The lecture will be illustrated by lantern pictures, including many taken during the Duke of the Abruzzi's expedition.

The special board for biology and geology has nominated Mr. C. Shearer, Trinity College, to use the University table at Naples for three months from March 1.

MR. FRANCIS GALTON, F.R.S., has given a further sum of 1000*l.* to the University of London in aid of the study of national eugenics founded under his previous benefaction. Mr. David Heron has been appointed Galton research fellow in national eugenics, in succession to Mr. Edgar Schuster, resigned.

SIR COWASJEE JEHANGHIR READYMONEY has, says the *Times*, offered to the Bombay Government the sum of 2½ lakhs of rupees (16,666*l.*) for the erection of a university examination hall in Bombay, thus following the munificent example of his father in giving to the city the Elphinstone College buildings and the Senate hall of the University.

THE annual general meetings of the Association of Technical Institutions will be held at the Clothworkers' Hall, Mincing Lane, E.C., on Friday and Saturday, February 8 and 9, as follows:—on Friday afternoon the presidential address will be delivered by Sir Horace Plunkett, K.C.V.O. On Saturday morning the following papers will be read and discussed:—the cooperation of adjacent authorities in the supply of higher technical education, Principal A. F. Hogg; monotechnic institutions, Mr. Charles Harrap.

SIR A. B. W. KENNEDY, president of the Institution of Civil Engineers, speaking at a dinner given by the Carpenters' Company on Monday to a number of eminent members of the engineering profession, remarked that the idea of thirty or forty years ago that the training of an engineer should be specialised has passed away. It is now recognised by all engineers that their profession is one at bottom, and that therefore an engineer should have a thorough general training in scientific work which should be the basis of all his future work, and that he should only specialise when it is necessary to do so to earn his daily bread.

THE inaugural lecture to the courses on Japanese education, to be delivered under the Martin White benefaction in the University of London by Baron Dairoku Kikuchi during the spring and summer terms, will be given at the University, South Kensington, on Thursday, February 14, at 5 p.m. Sir Edward Busk, Vice-Chancellor of the University, will preside. Admission to the inaugural lecture will be free by ticket, obtainable on application to the academic registrar at the University, South Kensington. Arrangements have been made for a course on Japanese educational administration to be delivered at the London School of Economics, and for courses on Japanese educational methods, to be delivered at University College, Gower Street, and King's College, Strand.

THE annual court dinner of the Leeds University was held on Thursday, January 31, and was attended by His Excellency Baron Komura, the Japanese Ambassador to this country, as the chief guest. Among those present were the High Sheriff of Yorkshire, the mayors of many neighbouring boroughs, representatives of various education authorities, technical institutions, grammar schools, and other bodies. Baron Komura, in proposing the toast of the University, referred to the debt of gratitude which Japan owed to the educational institutions of England, and among them to the University of Leeds, which has numbered a good many young Japanese among its students. Since the granting in 1904 of the Charter establishing the University, a new capital fund has been raised by private donations which now amounts to 82,300*l.* New buildings are in progress to accommodate the department of mining and metallurgy, and other important extensions rendered necessary by the growth of numbers in the University are under consideration.

THE council of the University of Manchester has decided to institute two new lectureships, one in economic zoology and one in economic botany. The lectureship in economic zoology will provide further instruction in special subjects for the senior and honours classes in zoology, and the lecturer will devote a portion of his time to the preparation of reports on animal parasites and pests. An important part of the duty of the new lecturer will be to conduct research on such subjects as the fauna of reservoirs and sewage conduits, the life-history of animal parasites, and on other matters of economic importance. The lecturer in economic botany will give instruction to

[1] A fifth and closing phase is discernible at Marsoulas, resembling somewhat the work on the painted pebbles of Mas d'Azil.

special classes, and will assist in arranging and making accessible to students and to the public the collections of plants and plant products possessed by the University. It will also be his duty to examine and report upon such specimens of plant diseases, of timbers, and of other vegetable products, as may be sent to the University and to the Manchester Museum for identification, and to conduct special researches in economic botany.

THE annual distribution of prizes and certificates to the successful students attending the colleges and schools conducted in London by the City and Guilds of London Institute, was held at the Mansion House on January 31. The Lord Mayor presided. Sir Edward Busk, Vice-Chancellor of the University of London, in the course of an address referred to the suggestions of the departmental committee of the Board of Education for the amalgamation of the Royal College of Science, the Royal School of Mines, and the Central Technical College at South Kensington in one great technical college. He sees no reason why such a scheme cannot be carried out. The Royal College of Science would be the nucleus of the scientific side of such a technical college, and the Central Technical College would be the nucleus of the engineering side. He earnestly hopes that the governing body of the new institution will take measures to ascertain that candidates for admission already possess a sound general secondary education. At present the students who come up have not sufficient general knowledge and culture. Sir J. Wolfe Barry, in proposing a vote of thanks to Sir E. Busk, expressed the hope that a start would soon be made with the development at South Kensington of a great college for technical education.

AMONG the most recently announced gifts to American seats of higher education may be mentioned the following, recorded in *Science*. As already announced by cable (p. 237), Mr. J. D. Rockefeller has given the University of Chicago 540,000*l*. for its permanent endowment, and 43,400*l*. for current expenses and special purposes. Among the special provisions of this latter gift is one to provide permanent increases in the salaries of instructors, 8000*l*. Mr. Rockefeller's gifts to the University of Chicago are said to amount to more than 4,000,000*l*. It is announced that 65,000*l*. have been subscribed toward the 100,000*l*. endowment which is being raised to mark the seventy-fifth anniversary of Lafayette College. Of this sum, Mr. Andrew Carnegie has given 10,000*l*. for a mechanical engineering course. He will give an additional 10,000*l*. provided the 100,000*l*. is obtained. A further gift of 10,000*l*. from Mr. Andrew Carnegie to Bates College is announced. Mr. Carnegie's offer of this amount stipulates that friends of the institution shall subscribe 20,000*l*., and this amount has been secured. Mr. Carnegie has also given 150,000*l*. for the construction of a building to be used by the Bureau of American Republics. Provision for the site already has been made by the United States and the South American Republics.

A LONG communication to the *Times* by Mr. A. Mosely again directs attention to American methods of education. Mr. Mosely recently returned from the United States and Canada, where he went to prepare for the arrival of British teachers who are now at work visiting American schools and studying Western systems of education. He tells a gratifying story of the kindness of the welcome accorded to the visitors. The interchange of views between two great English-speaking peoples must be of enormous benefit to those who are trying to work out practical systems for the education of future generations. Already the British teachers have been impressed with the great belief in the value of education shown by Americans. Mr. Mosely points out that this belief in education finds a ready echo amongst all classes of society, who are prepared to pour out money, both through taxation and by princely gifts, for education. The material advantage of the American system of education is manifesting itself by the prosperity of the country and by the flow of inquiries at the doors of every university and place of higher education for the services of the students as they graduate. In fact, there are many applications for every pupil available. One of the most noticeable features in the United States is, the letter continues, the desire of the pupil, ably backed by the parent, to take full advantage of the magnificent system afforded by the country of practically free education from the kindergarten to the university.

THE final report of the Royal Commission on Trinity College, Dublin, and the University of Dublin has been published. The recommendations of the commissioners and the decision of the Government, as announced by Mr. Bryce in reply to a deputation on January 25, have given rise to much discussion. The difficulty in connection with the establishment of a satisfactory system of university education in Ireland is a religious one. As the first conclusion of the commissioners states, Trinity College has been, and is, a satisfactory organ for the higher education of the Protestant Episcopalian population of Ireland, but it has never been, and is not now, to an extent adequate to the reasonable requirements of the country, an organ for the higher education of the Roman Catholic population. The important matter is somehow to secure for all Irishmen who desire it the benefit of university education, and, in view of this paramount necessity, we welcome the scheme outlined by Mr. Bryce as being likely to consolidate educational effort and to free institutions of higher instruction from impediments arising from sectarian animosities. The Government appears to have decided that the University of Dublin shall be enlarged so as to become a national university for Ireland, which will include as constituent colleges:—Trinity College, a new college in Dublin, and the Queen's Colleges in Cork and Belfast. In regard to the new college, it is to be furnished with adequate buildings and laboratories, and it is hoped that on the science side use may be made of the Royal College of Science, and that its laboratories and apparatus will be the means of effecting the change economically. The funds at present used by the Royal University—which is purely an examining body—are to be employed for the purposes of the new college and the proposed University of Ireland generally. It is intended that the new university shall be absolutely unsectarian, and that there shall be no tests for governors, fellows, teachers, students, or examiners. Though there are signs already that the proposals of the Government will in some quarters meet with great opposition, we are hopeful that it will prove possible to establish in Ireland a comprehensive university which will include eventually every Irish seat of learning reaching a proper university standard.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 22, 1906.—"The Relation of the Kidneys to Metabolism." By F. A. **Bainbridge** and A. P. **Beddard.** Communicated by Prof. E. H. Starling, F.R.S.

The effects of removing the greater part of the total kidney weight of cats were studied; a portion of one kidney was removed at one operation, and some weeks later the opposite kidney was removed. After the second operation the animals refused food and lost weight, though not more rapidly than normal cats kept for twenty-four hours without food. The increased output of urinary nitrogen described by Bradford was not invariably observed, but in some cats, which refused food after the second operation, the output of nitrogen was increased, though not to the amount found before the second operation. Moreover, the output of urinary nitrogen did not rise until the animals had lost about 25 per cent. of their body weight. A similar rise of nitrogen has been found by many observers in normal animals, when the body fat has been largely used up, and energy has to be supplied by increased proteid katabolism. It may be concluded, therefore, that the increased output of nitrogen observed in cats deprived of three-quarters or more of their kidneys is the result of inanition; no evidence was obtained that the kidneys directly influence nitrogenous metabolism.

Bradford found that dogs, after excision of part of one kidney, were apparently unable to pass a concentrated urine. The authors find, however, that under the same

conditions cats can still pass a concentrated urine, and that its amount is not greater than normal. Even after the second operation the urine is not excessive in amount or notably dilute. Retention of nitrogen always occurred after the first operation, and in one animal after the second operation also. Analysis, by Schryver's method, of the blood, liver, and muscles showed, by comparison with normal animals, a marked increase, not only in the actual amount of residual nitrogen in these organs, especially the liver, but also in its percentage relatively to the total nitrogen.

December 6, 1906.—"On the Transpiration Current in Plants." By Prof. H. H. **Dixon**. Communicated by Prof. J. Joly, F.R.S.

The adequacy of the theory which attributes the rise of water in trees during transpiration to the traction transmitted downwards in the water columns has been questioned by several different investigators. These objections, which have been based on an erroneous view as to the effect of the presence of undissolved gas in the water-ways or of dissolved air in the water itself, have already been disposed of. A more recent criticism maintains that the resistance offered to the transpiration current by the conducting tracts of trees is so great that the forces generated in the leaves are inadequate to raise the water, and that even if these sufficed, air-containing water could not transmit the tensions involved, and hence it is imperative to assume lifting mechanisms located in the water-ways in order to account for the upward movement of water in trees.

In the present paper it is pointed out that the advocates of this view have taken up their position, partly owing to an overestimate of the velocity of the transpiration current, but principally owing to an excessive evaluation of the resistance of wood to the flow of water.

With regard to the methods employed by the critics of the cohesion theory to determine the velocity of the transpiration current, the author points out that cut branches supplied with colour-solutions draw up these solutions, not only unretarded by the resistance of the lower parts of the stem, but actually with the assistance of the atmospheric pressure. There is also reason to believe that the velocity in the lower parts of the branches, which is the velocity observed in these experiments, is greater than that in the more distal parts. Hence the observation of the rate of the rise of the colour-solution, according to this method, tends to give an exaggerated idea of the velocity of the water current in intact trees. As to the second method employed for estimating the velocity of the current, it is shown experimentally that the transpiration of isolated branches enclosed in desiccated chambers does not give a fair indication of the total amount transpired by all the branches of a tree, but again tends to give excessive results. This is evident immediately when we consider that the desiccated branch is able to draw on the water store of the whole tree.

The paper also contains the record of numerous experiments carried out with the view of determining the resistance offered by the water-conduits of plants to the flow of water under various heads, and it is shown that the velocity, which is directly proportional to the head, is in the case of the yew between 7 cm. and 9 cm. per hour when the head is equal to the length of the transmitting piece of wood. According to the recent criticism of the cohesion theory, to produce such a velocity would require a head equal to almost six times the length of the water conduits. Hence the objection that to raise the sap in trees 150 metres high would require tensions approximating to 100 atmospheres, based as it is on this estimate, is without foundation. In reality the cohesion theory would demand, if, indeed, the excessive velocities before alluded to are assumed throughout the water-ways of high trees, that osmotic pressures approaching 30 atmospheres should be available in the cells of the leaves. Pressures of this magnitude have been observed in the leaves of less lofty plants.

The discrepancy between the results of the observers quoted and those recorded in the paper are possibly partially due to the use of higher pressures by the former, which tend to exaggerate the errors due to the inevitable clogging at the cut surfaces. In this connection, a method is described by which this error may be eliminated when determining the amount of water transmitted through a cut branch.

In conclusion, it is pointed out that not only is the cohesion theory in accordance with the most trustworthy observations, but the fact that other theories, both old and new, have to assume properties for the water-ways of plants, which are either in the highest degree improbable according to received scientific views, or are even directly negatived by experiment, seems to support the theory by a process of exclusion.

Chemical Society, January 17.—Prof. R. Meldola, F.R.S., president, in the chair.—The relation between absorption spectra and optical rotatory power, part i., the effect of unsaturation and stereoisomerism: A. W. **Stewart**. A close relation is shown to exist between the general absorptive power of compounds and their molecular rotation, the substance having the greater general absorption having also the greater molecular rotation.—Organic derivatives of silicon, part ii., the synthesis of *dl*-benzylethylpropylsilicol, its sulphonation, and the resolution of the sulphonic derivative into optically active components: F. S. **Kipping**. *dl*-Benzylethylpropylsilicol yields with sulphuric acid a mixture of sulphonic acids of which one has been isolated in the form of its ammonium salt. This acid probably has the constitution

$$SO_3H.C_6H_4.CH_2.SiEtPr.O.PrEtSi.CH_2.C_6H_4.SO_3H,$$

and is the externally compensated compound. The *d*-methylhydrindamine salt can be resolved by crystallising fractionally from aqueous methyl alcohol.—The association of phenols in the liquid condition: J. T. **Hewitt** and T. F. **Winmill**. The authors have determined the surface energy of several liquids, and find that the association of phenols is diminished or entirely inhibited by the presence of ortho-substituents. This effect of steric hindrance is also seen with the aromatic alcohols.—A new mercuric oxychloride: J. T. **Hewitt**. On allowing solutions of sodium hydroxide and mercuric chloride in sodium chloride to diffuse into one another, through a layer of sodium chloride solution of intermediate density, dark red crystals having the formula $Hg_6O_5Cl_2$ are deposited.—Preparation of chromyl dichloride: H. D. **Law** and F. M. **Perkin**. Chromic acid is dissolved in concentrated hydrochloric acid, and sulphuric acid added in small quantities. The chromyl dichloride formed is drawn off and purified by aspirating dry air through it and subsequent distillation.—Oxidation of hydrocarbons of the benzene series: H. D. **Law** and F. M. **Perkin**. The hydrocarbons investigated were toluene, the three xylenes, mesitylene, ψ-cumene, and cymene. In all cases varying yields of the monoaldehydes were obtained.—The constitution of silver nitrite; a correction: E. **Divers**.—Aromatic selenonium bases: S. **Smiles** and T. P. **Hilditch**. Trianisyl- and triphenetyl-selenonium chlorides and some of their derivatives are described.—The relation of colour and fluorescence to constitution: A. G. **Green**. A study of the phthaleins of phenol and quinol, which the author has had in progress for some time past, has brought to light several facts strongly confirming the view that the coloured salts of these phthaleins have a quinonoid structure, thus rendering Silberrad's deductions as to the structure of these bodies unnecessary (Journ. Chem. Soc., 1906, lxxxvii., 1787).—Tetraketopiperazine: A. T. **de Mouilpied** and A. **Rule**.—Transformations of highly substituted nitroaminobenzenes, ii., *s*-tribromo-*l*-nitroaminobenzene: Miss A. E. **Smith** and K. J. P. **Orton**.—Resolution of tetrahydro-*p*-toluquinaldine into its optically active components: T. C. **Beck** and W. J. **Pope**. By treating two equivalents of *dl*-tetrahydro-*p*-toluquinaldine hydrochloride with one equivalent of the ammonium salt of Armstrong and Lowry's *d*-αβ-bromocamphorsulphonic acid under appropriate conditions, a nearly quantitative separation of *d*-tetrahydro-*p*-toluquinaldine-*d*-αβ-bromocamphorsulphonate is obtained.—Note on the theory of valency: W. **Barlow** and W. J. **Pope**. A reply to Chapman (Proc. Chem. Soc., 1906, xxii., 320).—The condensation products of triacetic lactone with acetoacetic ester and β-aminocrotonic ester: F. N. A. **Fleischmann**.—Derivatives of multivalent iodine, part ii., action of heat on *p*-iodoacetophenone dichloride,

p-iodoacetanilide dichloride, and on the dichlorides derived from *o*-, *m*-, and *p*-iodotoluene: W. **Caldwell** and E. A. **Werner.**—Disalicylamide: J. **McConnan.**—Benzoyl derivatives of *N*-methylsalicylamide: J. **McConnan** and M. E. **Marples.**—The velocity of reaction of bromine with some unsaturated acids in aqueous solution: E. **Barrett** and A. **Lapworth.** The authors have been engaged in the examination of addition of bromine to some unsaturated acids in aqueous solutions in the hope of throwing some light on the mechanism of such reactions. The results of experiments with cinnamic, benzylidenemalonic acid, and *β*-bromocinnamic acids are described. They appear inconsistent with the view that bromine dissociates into ions before addition at a double linking, and seem to show that the ions of the acids, as well as the acids themselves, unite with bromine directly.—Note on the molecular complexity of liquids: A. E. **Dunstan** and F. B. **Thole.** A criticism of Holmes's results (Journ. Chem. Soc., 1906, lxxxix., 1774).

Zoological Society, January 15.—Dr. J. Rose Bradford, F.R.S., vice-president, in the chair.—A new monkey from the Ituri Forest, obtained during the recent Ruwenzori expedition: Oldfield **Thomas.**—The "bleating" or "drumming" of the snipe (*Gallinago coelestis*): P. H. **Bahr.** The object of the paper was to prove that this phenomenon was produced by the tail-feathers of this species, a point which had been much disputed. It was found that if the feathers were attached to a cork in a special manner, the peculiar bleating sound could be produced, and, furthermore, that only two feathers in this species were the active agents in producing the sound. Observation proved that these two feathers were held in a particular manner in front of the others during the bird's flight in the breeding-season. Feathers of both male and female were found to bleat, a fact which had been borne out by numerous observers in the field. These feathers were found to have a peculiar structure, differing materially from that of the other feathers in the tail. Microscopically they differed, and the number of hamuli was found to be in excess of those found in other feathers. The feathers of various exotic species had been experimented upon, and those of *G. delicata, G. nobilis, G. frenata, G. paraguayae* in the New World, *G. australis* and *G. aucklandica* in the Antipodes, and *G. solitaria* and *G. megala* in Asia, had been found to produce musical sounds. These feathers varied in structure, and consequently the sound produced differed accordingly. The feathers of *G. gallinula, G. major*, and *G. stenura* were not found to be musical.—A collection of mammals from Annam sent home by Dr. Vassal: J. L. **Bonhote.** Twenty-four species were enumerated, of which the following four were described as new:—(1) *Nycticebus pygmaeus*, sp.n.; (2) *Tupaia concolor*, sp.n.; (3) *Sciurus leucopus fumigatus*, subsp.n.; (4) *Funambulus rufigenis fuscus*, subsp.n.—Descriptions of seven new or little-known species of marmoset monkeys from the Amazonian region: Dr. E. A. **Goeldi.**—Contributions to the knowledge of the systematic arrangement and anatomy of certain genera and species of Squamata: F. E. **Beddard.**—A list, with descriptions of the new species, of Pyralidæ collected by Mr. A. E. Pratt in British New Guinea in 1902–3: G. H. **Kenrick.**

Royal Microscopical Society, January 16.—Annual meeting.—Dr. Dukinfield H. Scott, F.R.S., president, in the chair.—The president delivered his annual address, his subject being the flowering plants of the Mesozoic age in the light of recent discoveries.

Geological Society, January 23.—Sir Archibald Geikie, Sec.R.S., president, in the chair.—The geology of the Zambezi basin around the Batoka Gorge (Rhodesia): G. W. **Lamplugh**, with petrographical notes by H. H. **Thomas.** This paper contains an account of the physiographical and geological structure of the hitherto undescribed country bordering the Batoka Gorge, which was investigated by the author in 1905 under the auspices of the British Association. An account of the results obtained by the author appeared in NATURE of November 30, 1905 (vol. lxxiii., p. 111).

DUBLIN.

Royal Dublin Society, December 18, 1906.—Prof. J. A. McClelland in the chair.—The principal lines of the spark spectra of the elements: Dr. J. H. **Pollok.** The paper gave a collected table of the principal lines of all the common and rare elements, arranged in order of their wave-lengths, and described a convenient method of conducting spectrographic analysis with gold electrodes by photographing the electrodes first with a long slit, and then sparking the solution under examination with a short slit, giving long gold lines, with short lines between, of the element or elements under examination. Photographs of a number of spectra were given, with conspicuous gold lines marked upon them at convenient distances, to aid in identification.—The quantitative spectra of iron, aluminium, chromium, silicon, lime, manganese, nickel, and cobalt: Dr. J. H. **Pollok** and A. J. G. **Leonard.** This paper showed the progressive disappearance of the lines of these elements on dilution of their solutions, and gave tables of the residuary lines.

January 15.—Prof. Sydney Young, F.R.S., in the chair.—Radium and geology: Prof. J. **Joly** (see NATURE, January 24, p. 294).—Method of finding the absolute dilatation of mercury: Prof. J. **Joly.** A mercurial barometer is raised in temperature by a steam jacket, and the change of reading observed. The construction is simple, and such as to eliminate errors of increased vapour tension. An accuracy of 0·4 per cent. is attained with ordinary care in observation.

PARIS.

Academy of Sciences, January 28.—M. A, Lacroix in the chair.—The mineralogical constitution of the recent cone of Mont Pelée: A. **Lacroix.** Conclusions drawn from a study of a series of specimens collected by M. Guinoiseau during a recent ascent of the new cone.—The superiority of the expenditure of energy arising from a flesh diet with respect to the expenditure arising from a diet in which foods of ternary composition predominate. Consequences from the point of view of the general theory of food: A. **Chauveau.** A dog was submitted to diets in which meat, fat, and sugar respectively predominated. The respiratory exchanges of the animal were studied both during work and at rest, and the results shown graphically.—The propagation of quasi-waves of shock: P. **Duhem.**—Researches on the orbit of the comet 1819 IV. (Blanpain), and on the possibility of the capture of this comet by Jupiter: I. **Lagarde.** A re-calculation of Encke's results. It would appear to be a case of the transformation of an orbit originally parabolic into an elliptic orbit of slight eccentricity, but, owing to the small number of observations taken and their moderate accuracy, there is still some uncertainty.—The coefficients of development of the perturbation function: Armand **Lambert.**—Spherical functions: Émile **Waelsch.**—The representation by points of the most general equation of nomographical order 3: Maurice **d'Ocagne.**—The curvature of the envelopes in the most general movement of a solid body in space: G. **Koenigs.**—The calculation of the compressibility of gases in the neighbourhood of atmospheric pressure by means of the critical constants: Daniel **Berthelot.** Two methods of reduction are compared, that of Van der Waals and the same modified by the author, and these are compared with the experimental figures. The author also criticises the method of reduction employed by M. Guye, and condemns it.—The solubility of carbon in barium and strontium carbides: H. Morel **Kahn.** With barium, the amount of carbon dissolved varied with the time of heating from 1·25 per cent. to 6·2 per cent., and analogous figures were furnished by strontium carbide.—Copper metaphosphate: V. **Auger.** Cuprous metaphosphate is formed by the action of metaphosphoric acid upon copper at a red heat. On cooling, the cuprous salt is decomposed into copper and the cupric salt.—The causes which modify the estimation of fluorine in mineral waters: P. **Carle.** It is pointed out that negative results for fluorides in mineral waters are commonly due to errors in manipulation, and, in particular, the method used for separating the silica. It is found that a solution of carbonic acid under pressure is capable of dissolving appreciable amounts of finely divided calcium fluoride. Fluorides are nearly always a con-

stituent of mineral waters.—A new method of estimating the halogens in organic compounds by means of the metal-ammoniums: E. **Chablay.** In previous papers the author has given an account of the action of the metal-ammoniums on various organic haloid compounds, and in this work it was noticed that the whole of the halogen remained after the reaction combined with the alkali metal. This fact has been utilised as the basis of a very neat method for determining halogens in organic substances. Full details are given, and numerous analyses establishing the accuracy of the method proposed.—The condensed chromium sulphates: Albert **Colson.**—Some derivatives of hordenine: E. **Léger.** A description of the preparation and properties of the neutral tartrate, compounds with methyl and ethyl chloride, ethyl bromide and iodide, benzoyl and cinnamyl hordenine, and other derivatives.—Acetyl nitrate: Amé **Pictet** and Eugène **Khotinsky.** This substance has been obtained by dissolving nitric anhydride in acetic anhydride, and separating by fractional distillation under reduced pressure. The nitrate detonates violently when suddenly heated, and hence had to be analysed by indirect methods. Towards aromatic substances, acetyl nitrate acts as a nitrating agent of great power, benzene, toluene, anthracene, and thiophene being nitrated at temperatures below 0° C.—Ethyl benzoylglyoxylate: A. **Wahl.** Ethyl benzoylacetate in ether solution is submitted to the action of well-dried nitrous fumes, and the product distilled under reduced pressure. The reactions of the new α-diketone with piperidine, hydroxylamine, *o*-phenylamine-diamine, semicarbazide, aniline, and phenylhydrazine were studied.—The volume variations of the nucleus, of the chromatic mass, and of the cell in the course of the development of the pollen of *Nymphaea alba* and *Nuphar luteum*: W. **Lubimenko** and A. **Maige.**—Two new antelopes from Central Africa, *Cephalophus centralis* and *Cephalophus aequatorialis*: Maurice **de Rothschild** and Henri **Neuville.**—The affinities of the Bradypodidæ (sloths) and, in particular, of *Hemibradypus mareyi* with the Hapalopsidæ of the Santacruzian of South America: R. **Anthony.**—The toxic products of the organism (muscular extracts): MM. **Charrin** and **Goupil.** The properties of an aqueous extract of muscle vary with the pressure under which the juices are expressed.—The interpretation of certain facts of coloured vision: Adrien **Guébhard.** A criticism of a paper on the same subject by E. P. Fortin.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 7.

ROYAL SOCIETY, at 4.30.—The Influence of Increased Barometric Pressure on Man, No. 3, The Possibility of Oxygen Bubbles being set free in the Body: Leonard Hill, F.R.S., and M. Greenwood, jun.—On the Combining Properties of the Opsonin of an Immune Serum: Prof. R. Muir and W. B. M. Martin.—Experiments made to determine the Condition under which "Specific" Bacteria derived from Sewage may be present in the Air of Ventilating Pipes, Drains, Inspection Chambers, and Sewers: Major W. H. Horrocks.—Observations on the Life-History of Leucocytes, Part ii., On the Origin of the Granules: C. E. Walker.

ROYAL INSTITUTION, at 3.—Standards of Weights and Measures: Major P. A. Macmahon, F.R.S.

LINNEAN SOCIETY, at 8.—*Papers:* New Plants from Malaya: Dr. Otto Stapf.—Tertiary Foraminifera of Victoria: the Balcombian Deposits of Port Phillip: F. Chapman.—*Exhibitions:* Specimens of *Chara ornithopoda*: H. and J. Groves.—Some Observations of Climbing Plants (with lantern-slides): Rev. John Gerard.—Herbarium formed by A. Ruperti, 1698–1700: W. Rose Smith.

CHEMICAL SOCIETY, at 8.30.—On the Rapid Electroanalytical Deposition and Separation of Metals, Part i., The Metals of the Silver and Copper Groups and Zinc: H. J. S. Sand.—The Alkaloids of Ergot: G. Barger and F. H. Carr.—Influence of Substitution on the Formation of Diazo-amines and Amino-azo-compounds, Part vi., the Partially Methylated 4:6-Diamino-*m*-xylenes: G. T. Morgan and F. M. G. Micklethwait.—(1) The Reduction of Hydroxylaminodihydroumbellulone Oxime; (2) The Constitution of Umbellulone, Part ii., the Reduction of Umbellulonic Acid: F. Tutin.—Studies on Optically Active Carbimides, Part v., The Aryl Esters and the Amides of 1-Menthylcarbamic Acid: R. H. Pickard and W. Oswald.—Some Constituents of Natural Indigo, Part i.: A. G. Perkin and W. P. Bloxam.—The Occurrence of Isatin in some Samples of Java Indigo: A. G. Perkin.—(1) On the Absorption Spectra of Benzoic Acid, the Benzoates and Benzamide; (2) The Absorption Spectra of Phthalic, *iso*Phthalic and Terephthalic Acids: Phthalic Anhydride and Phthalimide: W. N. Hartley and E. P. Hedley.—αα*γ*-Trimethyl- and αα*γγ*-Tetramethyl-tricarballylic Acids and αΔ-Dimethylbutane αβΔ-Tricarboxylic Acid: H. Henstock and C. H. G. Sprankling.—A Reaction of Certain Colouring Matters of the Oxazine Series: J. F. Thorpe.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Investigations on Light Standards and the Present Condition of the High Voltage Glow Lamp: C. C. Paterson (Conclusion of Discussion).—Comparative Life Tests on Carbon, Nernst, and Tantalum Incandescent Lamps using Alternating Currents: H. F. Haworth, T. H. Matthewman, and D. H. Ogley.

FRIDAY, FEBRUARY 8.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Anniversary Meeting.

PHYSICAL SOCIETY, at 8.—Annual General Meeting.—President's Address.—The Magnetic Fields and Inductive Coefficients of Circular, Cylindrical, and Helical Currents: A. Russell.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Reconstruction of a Swing-Bridge on the Southwold Railway: Claude Pain.

MALACOLOGICAL SOCIETY, at 8.—Annual Meeting.—What Evolutionary Processes do the Mollusca show? B. B. Woodward.

MONDAY, FEBRUARY 11.

SOCIETY OF ARTS, at 8.—Gold Mining and Gold Production: Prof. J. W. Gregory, F.R.S.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Round the North Magnetic Pole and through the North-west Passage: Captain Roald Amundsen.

TUESDAY, FEBRUARY 12.

ROYAL INSTITUTION, at 3.—The Visual Apparatus of Man and Animals: Prof. William Stirling.

ANTHROPOLOGICAL INSTITUTE, at 8.15.—Note on a Dolmen at Presle, France: A. L. Lewis.—The Ethnology of Modern Egypt: Dr. C. S. Myers.

WEDNESDAY, FEBRUARY 13.

SOCIETY OF ARTS, at 8.—Motor Omnibuses: Lord Montague of Beaulieu.

THURSDAY, FEBRUARY 14.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: On the Purification and Testing of Selenion: R. Threlfall, F.R.S.—On the Specific Inductive Capacity of a Sample of Highly Purified Selenium: O. U. Vonwiller and W. H. Mason.—The Thermomagnetic Analysis of Meteoric and Artificial Nickel-Iron Alloys: S. J. W. Smith.—Investigation of the Law of Burning of Modified Cordite: Major J. H. Mansell, R.A.

SOCIETY OF ARTS, at 4.30.—The Practical Side of Famine in India: Sir Frederick S. P. Lely, K.C.I.E.

LONDON INSTITUTION, at 6.—Scientific Method: Prof. H. E. Armstrong, F.R.S.

ROYAL INSTITUTION, at 3.—The Minute Structures of Igneous Rocks and their Significance: Alfred Harker, F.R.S.

MATHEMATICAL SOCIETY, at 5.30.—Groups defined by the Order of the Generators and the Order of their Commutator: Prof. G. A Miller.—On the Reduction of the Factorisation of Binary Septans and Octans to the Solution of a Pellian: Dr. T. Stuart.—On Repeated Integrals: Dr. E. W. Hobson.—The Construction of the Line drawn through a Given Point to meet Two Given Lines: Prof. W. Burnside.

FRIDAY, FEBRUARY 15.

ROYAL INSTITUTION, at 9.—Foraminifera: J. J. Lister, F.R.S.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Annual General Meeting.

SATURDAY, FEBRUARY 16.

ROYAL INSTITUTION, at 3.—Röntgen, Kathode, and Positive Rays: Prof. J. J. Thomson, F.R.S.

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