THURSDAY, FEBRUARY 14, 1907.

THE SCIENTIFIC WORK OF WILLARD GIBBS.

The Scientific Papers of J. Willard Gibbs. In two volumes. Vol. i., Thermodynamics. Vol. ii., Dynamics, Vector Analysis, Light, &c. Vol. i., pp. xxviii+434, price 24*s.* net; vol. ii., pp. viii+284, price 18*s.* net. (London: Longmans, Green and Co., 1906.)

THESE two handsome volumes are a fitting memorial to one who carved out for himself a very remarkable niche in the temple of scientific fame. With the exception of his one published book on statistical dynamics, we have in these collected papers practically all that Willard Gibbs put into form suitable for publication. Compared with the literary output of the leaders of science of the passing generation, this is a very limited contribution if judged only in regard to quantity. But the quality and far-reaching importance of Willard Gibbs's work place it on an eminence of excellence comparatively rarely reached. This remark specially applies to his great papers on the equilibrium of heterogeneous substances, which with his other papers on thermodynamics constitute the first volume of 434 pages. All are agreed as to the supreme importance of the thermodynamic memoirs, which give to their author a unique place among those who have done most to establish and develop the principles of this fundamental part of the doctrine of energy. It is not quite the same with the papers which form the second volume, of 284 pages, although in these also the author's characteristic qualities of mind show themselves. There is always an originality of view and a logical severity of treatment which indicate that the author has well digested his material before putting it in printed form before the eye of the public. Nevertheless, even if we do not consider the contents of vol. ii. as attaining the same high average of excellence as the contents of vol. i., their comparative brevity makes good the claim that in Willard Gibbs we had a writer and thinker of very exceptional merit.

Unlike most young scientific men, Willard Gibbs was in no hurry to publish, his earliest papers dating from 1873, when he was thirty-four years of age. The second of these papers, that on thermodynamic surfaces, became speedily known to the scientific world through the pages of Maxwell's "Theory of Heat"; and Maxwell was himself the first to construct a model of the volume-entropy-energy surface. Copies of this model were distributed by Maxwell evidently with a certain amount of playful mystery, for each recipient thought that he was the happy possessor of one of (at most) three. The writer knows of six at least, and possibly there are more. We also owe to Maxwell a very clear, brief statement of the essential feature of the great papers on the equilibrium of heterogeneous substances. In spite of this, however, the immense value of these memoirs came to be fully recognised only very gradually, in many instances after important results had been obtained independently by later investigators. In 1892 Ostwald brought out a German translation which was reviewed at the time in these columns (vol. xlvi., p. 245). A French translation followed in 1899, and now at length we have these epoch-making papers reproduced so as to be accessible to everyone. In their new dress they cover about a third more pages than in their original form in the Transactions of the Connecticut Academy of Arts and Science, and the larger type and broader page impart a dignity worthy of their high position in the literature of thermodynamics.

The first volume closes with some unpublished fragments which were intended to form a supplement to the "Equilibrium of Heterogeneous Substances." Only two of a list of nine subjects are touched upon, and one cannot but have a feeling of deep regret that the distinguished author was unable to carry out his project.

The second volume contains twenty-one distinct papers and articles arranged under four headings. In a paper on the fundamental formulæ of dynamics, Gibbs suggests using $\delta\dot{x}$, $\delta\dot{y}$, $\delta\dot{z}$ instead of the usual δx, δy, δz, and shows that for certain problems the modification is of advantage. The second paper is a single-page abstract from the Proceedings of the American Association for the Advancement of Science on the fundamental formula of statistical mechanics, and is of interest as showing the trend of his thinking sixteen years before the publication of his great work on the subject. Eight papers then follow on vector analysis and multiple algebra. The first of these is the reprint of the famous "not published" pamphlet which was printed for private circulation in 1881–4, and it is in reply to certain criticisms of this pamphlet that some of the succeeding papers were written, chiefly as letters to NATURE. Willard Gibbs received his first impulse towards the study of vector methods from Maxwell, who used the quaternion notation in his "Electricity and Magnetism." Not caring for the quaternion approach, for reasons which are explained fully in his controversial articles, he elaborated a notation of his own for the frequently recurring functions familiar to students of Hamilton and Tait. What gives Gibbs's method its character is, however, his "dyadic" notation for the linear vector function. Unlike Hamilton's ϕ, which has, so to speak, only one hand to grip the operand which follows, Gibbs's dyadic has two hands, with one of which it may grip forward and with the other backward, as occasion may offer. It cannot, however, grip with both at once, so that the double-handedness is only apparent. Moreover, it is only in its expanded form that the dyadic is able thus to cleek on to an operand on either side. When, as is frequently the case, the Hamiltonian function ϕ is used, the method becomes identical with that of quaternions.

A very readable paper is that on multiple algebra, which Gibbs originally delivered as his presidential address before the mathematical section of the

American Association for the Advancement of Science. Here we find expounded with rare clearness and happy illustration the essential principles of multiple algebra. We can imagine many aspiring mathematicians getting from this article a strong impulse towards the study of a subject the fundamental principles of which are at times almost intuitive, but the working out of which in detail is full of difficulties and pitfalls to trap the unwary.

Under the heading of "The Electromagnetic Theory of Light" there are five papers, all important contributions. They show the sufficiency of the electromagnetic theory to explain dispersion and double refraction, whereas the elastic solid theory of Green could not be reconciled with experimental facts. The elastic theory was, mathematically speaking, rescued from its distressed condition by Kelvin when he imagined the contractile ether; and in regard to this Gibbs points out that, although it explains many phenomena as simply as the electromagnetic theory, it fails to give a satisfactory explanation of dispersion.

Finally, there are six miscellaneous papers, partly reviews and biographical notices. The closing sentence of his notice of Clausius, in which reference is made to the great number of papers published by the eminent German, might by a slight modification be applied to himself.

"Such work as that of [Gibbs] is not measured by counting titles or pages. His true monument lies not on the shelves of libraries, but in the thoughts of men, and in the history of more than one science."

The papers have been edited with great care by Henry Andrews Bumstead and Ralph Gibbs van Name, and the former, in the biographical notice prefixed, discusses with knowledge the scientific work done by Willard Gibbs, and gives a clear-cut picture of the man himself. A portrait forms the frontispiece to vol. i. C. G. K.

TECHNOLOGY OF SOAPS AND CANDLES.

Modern Soaps, Candles, and Glycerin. By L. L. Lamborn. Pp. xx+688. (New York: D. Van Nostrand Company; London: Crosby Lockwood and Son, 1906.) Price 30*s.* net.

THIS is a work intended primarily for the soap manufacturer, and more especially for the American beginner in the art and craft of soap-making. The author finds, he tells us, that the industry has hitherto been indebted for its technical literature to those who can write, but have little worth telling. To remedy this state of things he, a practical man, to practical men sends forth the present volume.

On the whole the effort is a successful one, though the book has defects. Let us summarise these at the outset. Heavy both in style and in avoirdupois, and printed on glazed paper that is very trying to the eyesight, the work is by no means an attractive one to read. There is much tedious repetition, and an unnecessary amount of technical slang is employed. For example, on p. 340 we are directed to "kill the rosin as already described, but leave the soap open on salt alone, with entire absence of strength." The book is quite "practical" enough to dispense with kettle-room jargon. Generally, it suffers from excessive verbiage; the author has a tendency to write round his subject as well as upon it.

Now let us see what there is of value in the book. The various operations of soap manufacture are fully described, about two-thirds of the available space being devoted to this branch of the subject. Two introductory chapters outline the history and principles of soap-making; then come three others, dealing respectively with the raw materials, their purification, and their chemical characters; these are followed by one describing the mechanical equipment of a soap factory, and next by the sections which discourse of the various kinds of soap and the processes involved in their production. The treatment is eminently practical, and, so far as the reviewer can judge, entirely trustworthy. Many useful tables, formulæ, and recipes are embodied in the text; a good section on essential oils and soap perfumery is interpolated; and a large number of illustrations of apparatus are included. These last are, naturally, figures of American machinery almost exclusively; they constitute quite a feature of the work.

In connection with "medicated" soaps, the author is sceptical about any appreciable curative effect being rightly attributable to the medicament or disinfectant incorporated with the soap. The proportion of active ingredient is often very small, and under ordinary conditions of use the time of contact with the skin is but short, so that the scepticism is probably justified. Such curative property as the soaps may possess is, the author thinks, inherent in the detergent itself; the remedial value lies in the mechanical action of cleansing rather than in any specific bactericidal or antiseptic effect of the incorporated substance.

In the section dealing with the manufacture of candles there are two points of special interest. One of these relates to a long-standing problem of chemical technology, namely, how best to utilise the by-product oleic acid as a source of candle material. This acid forms a large proportion of ordinary fats, but, being a liquid, is not suited for the production of candles. It is possible, however, to convert the oleic acid into solid substances (elaidic acid, hydroxystearic acid), which can be so used; but until recently the expense and the smallness of the yield have prevented the satisfactory utilisation of the by-product in this way. The author outlines the latest modification of the process for transforming oleic acid into hydroxystearic acid; it is asserted that from 85 per cent. to 95 per cent. of the former can now be obtained as the solid product, instead of only 30 per cent. as previously produced. Sulphostearic acid and stearolactone are obtained by dissolving the oleic acid in petroleum and treating the solution with strong sulphuric acid; the first gives hydroxystearic acid on hydrolysis with steam; the stearolactone is re-con-

verted into oleic acid and again subjected to the action of sulphuric acid. The author, unfortunately, says nothing definite about the vital matter of expense, but as far as the complete recovery of the by-product is concerned the process now leaves little to be desired.

The other matter of interest is the Twitchell method of decomposing fats into their constituent fatty acids and glycerin. This is effected by boiling the fat with water and a small quantity—about 1 per cent.—of sulphobenzenestearic acid. On standing, the products of the reaction separate into layers of fatty acids and glycerin of a relatively high degree of purity. Not only in candle-making, where it is now largely used, but in soap-making, the process is claimed to be economically superior in several respects to the time-honoured method of saponification with alkali hitherto universally adopted. It gives a greater yield of glycerin; the cost of recovering the glycerin is smaller owing to the much greater purity of the menstruum; there is economy in the cost of material, since soda-ash can be used instead of the more expensive caustic soda for converting the fatty acids into soap; and, finally, the necessary mechanical equipment is simpler. Whether or not with these advantages the Twitchell process will eventually supersede the historic alkali method of soap-making remains to be seen; the indications are that it may well do so. Meanwhile, the remarkable steatolytic action of the sulpho-aromatic fatty acids, on which the process depends, is worthy of note from the scientific point of view. One explanation of the ease with which fats are resolved into their constituents by these compounds assumes it to be due to the emulsifying power of the sulpho-acids, but the matter requires further investigation.

The most approved methods for the recovery of glycerin are fully described, and the work closes with a chapter on the chemical examination of raw materials and factory products.

In view of recent events in this country, it is interesting to read that in the United States, where other kinds of "trusts" seem to flourish, there is but little "cooperative control of production" in the soap industry. On the contrary, there is a marked tendency towards self-sufficient independence among the individual producers. The author's reason for this is that, whilst control of the raw material and of the facilities for transport are two essential factors in organising a successful "combine," these conditions are largely absent in the production and distribution of soap.

"The chief raw material is obtainable wherever meat is eaten, and the market exists wherever cleanliness is appreciated."

Possibly more than anything else it was the difficulty of monopolising the supplies of raw material that recently enabled the individual producers in this country to maintain the "tendency towards self-sufficient independence" which the author notes in the case of soap-makers in the United States.

C. SIMMONDS.

SOME PROLEGOMENA TO THEOLOGY.

Völkerpsychologie: eine Untersuchung der Entwicklungsgesetze von Sprache, Mythus und Sitte. By Wilhelm Wundt. Zweiter Band. Mythus und Religion. Erster Teil. Pp. xi+617. (Leipzig: Wilhelm Engelmann, 1905.) Price 14*s.* net.

THIS is the first part of the second volume of Wundt's important work, and it deals in three long chapters with imagination, imagination in art, and imagination in the formation of myths.

The first chapter defines imagination, and points out its chief characteristics, *e.g.* that it is intuitive in its working, and does not deal with the products of the understanding, that it is creative, and that it is spontaneous or involuntary. The author claims that experimental analysis reveals its mode of operation as a subjective condition of all our perceptions in space and time. More especially the illusions in space-perceptions are discussed by which, *e.g.*, a tetrahedron as represented on paper may appear to face the spectator in two quite different ways, according to the position of the point fixated; and again, in regard to time, it is pointed out how the imagination of itself supplies the measure into which a succession of musical notes of precisely the same emphasis and length is fitted; so, too, with speech-rhythm. Sensations of light, colour, movement, and the like are next discussed, and the author reaches the conclusion that there are two main principles at work in imagination, the one *vivifying apperception*—the spectator so projecting himself into the object that he feels himself at one with it—and the other *the power of illusion or imagination to heighten feeling*. The writer now passes to child-psychology, and analyses imagination in children as it may be observed in their play, their fairy tales, and their attempts at drawing; and in comparing the products of the artistic faculty in children and in savages he emphasises the two points that neither savages nor children, as a rule, copy objects before them, but recall what they have seen, and that both prefer objects in which they have an immediate interest, generally men and beasts.

The second chapter deals with imagination in art. Wundt believes that it is utterly idle to inquire what form of art arose first, that in the most primitive races we find the beginnings, not only of the musical arts (including both dance and song), but of the graphic arts as well. Into the details of the chapter, which discusses the whole range and development of the graphic and musical arts, we cannot now enter. The author inquires, among other things, why in early art beasts are drawn more truthfully than men, and notes that as early art is generally based on recollection it exhibits a face view of human beings, but a profile view of beasts. The discussion of *Stilisierung* on pp. 186–8 is interesting, and the gradual progress exhibited of the alligator-motive, though perhaps not convincing to the ordinary man, is as possible as many other things in anthropology.

A suggestive treatment, too, may be found of the different effects produced by portrait and statue (p. 274), and of the reasons that may be given for the differing shapes of Egyptian and Greek temples. In dealing with song, the author contests the view of Preuss that all work-songs were originally charm-songs. He strongly opposes the theory of Jacob Grimm that the fairy-tale is a degenerate nature-myth; his own view with regard to the relative position of the fairy-tale, the nature-myth, and the epic appears to be that the epic has two sources, traditions of actual heroes on the one hand, and the despised fairy-tales on the other, and that it has not as its immediate preparation any such high-flown theogony and cosmogony as the supporters of the Grimm theory allege. He discusses, too, the views of Usener, the foremost representative of the nature-myth hypothesis, who regards Thersites, for example, as being originally a god, and who sees in the struggle between Thersites and Achilles a variation of the old story of the struggle between summer and winter.

The third and last chapter opens with a contrast between the historical and the psychological treatment of mythology, and the author claims that psychology is of more importance in dealing with myth than in dealing with speech, which after all is, in the narrower sense, a psychophysical function. His discussion of the various types of theory, the naturalistic, the animistic, the theory of analogy and the like, if full and adequate, is a little hard to follow. The author is strongly opposed to the hypothesis that myths have all arisen in one period and one country.

"If Anthropology has established anything," he writes, "it is this, that the qualities of human imagination and the feelings and emotions that influence the working of the imagination agree in their essential features in the men of all zones and countries, and that therefore no migration-hypothesis, going far beyond the bounds of possible proof, is needed to explain the similarity of certain fundamental ideas in mythology, while on the other hand the perpetual differences of these products of the imagination, depending as they do on natural surroundings, race and degree of civilisation, in many ways point directly to an autochthonous origin."

The cream of Wundt's own psychological theory on the matter seems contained in p. 579; mythological personification he regards as only a heightened form of what writers on æsthetics call *Einfühlung*, "a form in which the whole personality in its momentary condition of consciousness, together with the after effects of earlier experiences which enter into this, passes over to the object." So we have only to do with a modification of that general function without which the object could not exist for us at all, namely, apperception.

Space fails us to discuss the topics of the closing pages, the distinction drawn between myth and poetry, the mutual influence of myth and poetry, their relations to speech, and so on. The second part of this volume will be concerned with the problems that surround the connection between myth and religion. The full significance of Wundt's contribution to his present subject can hardly be realised until that part has appeared, and for this and many other reasons its speedy publication will be welcome to the numerous readers whom this instalment has doubtless interested and attracted.

COAL MINING.

The Principles and Practice of Coal Mining. By James Tonge. Pp. viii+363. Illustrated. (London: Macmillan and Co., Ltd., 1906.) Price 5*s*. net.

UNTIL the year 1866, when Sir Warington Smyth wrote, for Weale's excellent series of rudimentary handbooks, his little book on coal-mining, the art of mining was in the trammels of empiricism; but since that date progress has been rapid. Indeed, the tendency of the times is now towards a higher standard in mining as in all branches of technical education. Greater efficiency is consequently now demanded of candidates for the Board of Education examination in the principles of mining, and for the examinations for certificates as colliery managers and under-managers. In order to meet these conditions there has been of recent years a steady output of new elementary mining text-books. Many of these are excellent, but not one of them is presented in so attractive a form as the latest addition to the list by Mr. James Tonge. Well printed, tastefully bound, and copiously illustrated, it gives in concise form an accurate view of the subject of coal-mining, together with such information regarding collateral science as is essential for the elementary student.

In his treatment of the subject, the author wisely has followed closely the logical and natural order laid down by the late Sir Clement Le Neve Foster for the Board of Education syllabus. General ideas are first given regarding the occurrence of coal and the methods of search. The sinking of shafts and the working of coal then receive attention. The means of supporting the roof and sides of underground excavations, and the conveyance of the coal to the shaft and thence to the surface, come next. Other chapters are devoted to the important operations of keeping the workings free from water, and of supplying them with fresh air and light. The volume concludes with chapters on the preparation of coal for the market, and on the accidents and diseases incidental to the miner's calling, with some brief notes on the laws regulating mining in this country.

These varied subjects are dealt with in a thoroughly practical manner, and although necessarily brief, the descriptions are well up to date. We note, for example, an interesting account of the Parsons turbo-fan. A screw fan, used in conjunction with a compound steam turbine, at a colliery at Wylam-on-Tyne exhausts air from the pit and discharges it into the atmosphere through a conical outlet. The diameter of the fan is 5 feet, and it passes 120,000 cubic feet per minute at 2-inch water gauge, running at a speed

of 2000 revolutions per minute. The steam pressure at the turbine is 70lb. per square inch, and the exhaust steam is condensed. At the Hulton Colliery Company's Deep Arley Pit, with which the author is connected, a turbine-driven fan has recently been erected. The plant consists of a screw propeller fan 3 feet 6 inches in diameter, driven direct by a steam turbine. The efficiency of the fan varies from 50 to 60 per cent., and although this is low compared with that claimed for other fans, the economy of the plant, or in other words the steam consumed per useful air horse-power output, compares favourably with that usually obtained with centrifugal fans driven by high-class reciprocating steam engines. An illustration of the plant is given. Throughout the book the illustrations are adequate, and in many cases very good, the only exception being Fig. 111, of a coil clip for endless rope haulage, which appears to be incorrectly drawn.

AMPHIPODOUS CRUSTACEA.

Das Tierreich. 21 Lieferung. Crustacea. Amphipoda, I., Gammaridea. By the Rev. T. R. R. Stebbing, F.R.S.. Pp. xxxix+806; 127 figures in text. (Berlin: R. Friedländer und Sohn, 1906.) Price 48 marks.

READERS of Stevenson may possibly remember that when the hero of "Catriona" took leave of Alan Breck on Gillane Sands and turned to meet his pursuers, his attention was caught, in the solitude and silence of that "unchancy" place, by "the sand-lice hopping nimbly about the stranded tangles." One might search far through the fields of literature before finding another mention of the amphipodous Crustacea. Their small size, the aquatic habits of the majority, and the fact that they are neither immediately useful nor directly harmful to man, combine to withdraw them from popular observation, while even to many who claim the title of naturalist they are known only by name. Yet the student who attempts to gain some knowledge of this group of animals is likely to be bewildered at the outset by the almost infinite variety of specific differentiation which they present, no less than by the overwhelming mass of technical literature in which their peculiarities are recorded.

It is true that more or less comprehensive systematic monographs and summaries of what might be called the "minor morphology" of the group are not wanting. In his "Catalogue of the Amphipodous Crustacea in the British Museum," published in 1862, Mr. C. Spence Bate attempted a revision of all the forms then known, and thereby lightened considerably the task of subsequent workers, if sometimes also adding not a little to their perplexities. Later monographs, such as those of Boeck, Bovallius, Sars and Mayer, have dealt only with single subdivisions of the order or with the Amphipoda of restricted geographical areas. In 1888, however, Mr. Stebbing's monumental report on the Amphipoda of the *Challenger* Expedition not only described a larger and more varied material than had been at the disposal of any previous writer, but gave an exhaustive and critical analysis of the earlier literature, the like of which is available for very few other groups of animals.

When, therefore, it was announced that Mr. Stebbing had undertaken to prepare a revision of the Amphipoda for the "Tierreich," every carcinologist anticipated that its publication would mark an epoch in our knowledge of the group. The present volume of more than eight hundred pages contains only the first part of this work, dealing with the Gammaridea, the largest of the three legions (or suborders) into which the order is divided. It is in every way worthy of Mr. Stebbing's high reputation. The whole field of existing literature has been explored with painstaking minuteness (extending to the collection and recording of typographical errors), and an unrivalled experience in dealing with this group of animals has been brought to bear on the task of interpreting and criticising the descriptions of previous authors.

As Mr. Stebbing explains in the preface, the work as originally planned included all species described up to the end of 1898, but publication was unavoidably delayed. A supplement has, however, been added which enumerates, without describing, the new species and genera established up to the end of 1905. Excluding those dealt with in the supplement, the number of species accepted as valid is 1076, while 257 others are mentioned as doubtful. They are distributed among 304 accepted and nine doubtful genera and forty-one families.

In a work like the present, questions of nomenclature inevitably come to the front, and even those zoologists who deprecate unnecessary interference with established names will admit it to be desirable that in an authoritative revision of a group of animals an effort should be made to settle the nomenclature on a stable basis. Mr. Stebbing has devoted much attention to this point, and his decisions will in most cases be accepted as final by the majority of students. We may regret, however, that he has not seen his way to mitigate the severity of his interpretation of the rule of priority in one or two cases where it seems to introduce, instead of removing, confusion. As Mr. Lydekker pointed out some time ago in a letter to NATURE (vol. lxxi., p. 608), the transference of old and well-known generic names to other genera may often be seriously misleading. With regard to one such change adopted in the present work, Canon Norman recently expressed the opinion that, "considering the inadequate description of the genus Podocerus and its erroneous use for nearly one hundred years, the name ought to be excluded from an altered use." This opinion, coming from one of so wide experience in systematic zoology, will find many supporters, at least among those who think that the animals themselves are more profitable objects of study than their names.

Mr. Stebbing's volume will remain the standard work of reference on the Gammaridea for a very long

time to come, and he has earned the gratitude of all students of the group by its publication. The editors of "Das Tierreich" are to be congratulated on the latest addition to the exceedingly useful series of monographs issued under their direction.

W. T. C.

OUR BOOK SHELF.

Incubation, or the Cure of Disease in Pagan Temples and Christian Churches. By Mary Hamilton. Pp. 223. (London: W. C. Henderson and Son; Simpkin, Marshall, Hamilton, Kent and Co., 1906.) Price 5*s*. net.

"In the ancient science of divination, four working methods were commonly practised. Revelations of the future were deduced from natural portents, from the flight of birds, from the entrails of sacrificial victims, or from dreams. . . . Incubation was the method by which men sought to entice such dreams." These sentences from the introduction indicate the substance of this work. The book is divided into three parts:—(1) incubation in pagan temples, *e.g.* the cult of Asklepios at Epidauros, Rome, Athens, &c., and at the Oracles, Amphiaraos, and others; (2) incubation in Christian churches during the Middle Ages; and (3) the practice of incubation during modern times in Italy, Austria, Greece, and the Greek islands. Translations are given of the various stele which describe the cures wrought and the methods employed in procuring them. The book forms a useful summary of the subject, valuable both to archæologists and to historians of medicine.

Manual of Wireless Telegraphy. By A. F. Collins. Pp. x+232. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1906.) Price 6*s*. 6*d*. net.

The present writer ventured to suggest, in an article in Nature a short time ago, that with the publication of a really standard book on any particular branch of electricity the issue of further literature on the same subject should cease. If this recommendation had been adopted the present volume would never have seen the light. It does not profess to be anything more than a manual specially adapted for those who are, or desire to become, wireless telegraph operators. There are already numerous books covering almost identically the same ground, and we are of opinion that the useful information contained in any of them could be much more effectively learnt in an hour's practical instruction. Compared with other books of its kind, it may be pronounced a favourable specimen. The style, though a trifle too American for our taste, is simple, and the diagrams are numerous and clear. The illustrations are also plentiful and well reproduced. A list of stations and ships equipped on the various systems forms a distinct feature of the book, which will probably remain up to date for a few weeks longer. M. S.

Catalogue of the Lepidoptera Phalaenae in the British Museum. Vol. vi., Noctuidæ. Pp. xiv+532; pls. xcvi–cvii. (London: Printed by order of the Trustees, 1906.) Price 25*s*.

The present volume is the third of those devoted to the great family Noctuidæ, and includes the subfamily Cucullianæ, with 111 genera and 693 species, a considerable number of both genera and species being described as new. In addition to the coloured plates there are 172 plain illustrations in the text, generally representing the body and left wings of a specimen, the right wings being denuded of scales to show the neuration. To the right of this again is the outline of the thoracic crest and head in profile, the latter showing an antenna, eye, palpus, &c. The first text figure, however, represents the larva of *Cucullia verbasci*. Opposite p. 2 is a large table, showing the relationship of the genera regarded as belonging to the Cucullianæ with one another. The general arrangement and character of this volume differ little from those which have preceded it. Full tables are given of genera and species, and the descriptions are quite sufficiently long for most practical purposes. Brief notices of larvæ and food plants are added, when known.

It is very creditable to all concerned that this important work should be carried on so steadily, a volume appearing about every two years. It may be interesting to notice the dates of the prefaces of each of the six volumes already published:—Vol. i. (Syntomidæ), September 30, 1898; vol. ii. (Arctiadæ: Nolinæ, Lithosianæ), January 20, 1900; vol. iii. (Arctiadæ: Arctianæ, and Agaristidæ), June 20, 1901; vol iv. (Noctuidæ: Agrotinæ), June 20, 1903; vol. v. (Noctuidæ: Hadeninæ), February 24, 1905; vol. vi. (Noctuidæ: Cucullianæ), November 1, 1906.

Die meteorologischen Elemente und ihre Beobachtung, mit Ausblicken auf Witterungskunde und Klimalehre. By Otto Meissner. p. vi+94; with 33 illustrations. (Leipzig u. Berln: B. G. Teubner.)

This very useful text-book, intended for higher schools and for self-instruction, forms part vi., vol. ii., of the collection of scientific treatises published by O. Schmeil and W. B. Schmidt. It explains the physical laws necessary for clearly understanding meteorological processes and apparatus, and contains valuable footnotes, together with the derivation of all technical terms employed in the text. Many points, such as the difference between periodical and non-periodical oscillations of meteorological elements, "variability" of temperature, the use of the cloud-mirror, &c., which are frequently puzzling to observers, and are generally only dealt with in treatises of greater pretensions, are made quite clear by means of examples. We recommend the perusal of the work to any meteorological students who are acquainted with the German language.

The Treatment of Diseases of the Digestive System. By Prof. Robert Saundby. Pp. viii+133. (London: Charles Griffin and Co., Ltd., 1906.) Price 3*s*. net.

This unpretentious little book will serve to bring before the practitioner the salient points in the diagnosis and treatment of diseases of the digestive tract. The dose of bismuth in many cases might be larger; useful drugs such as salol, bismuth salicylate, and ipecacuanha are not mentioned; and no precautions are detailed in the use of thymol in ankylostomiasis. Otherwise the teaching throughout seems to be sound and commonsense.

The Plants of New South Wales. By W. A. Dixon. Pp. xxxiv+322. (Sydney.: Angus and Robertson, 1906.) Price 6*s*. net.

This is a handy little book providing a compact guide for naming flowers in the field by means of analytical tables on similar lines to Gremli's well-known flora of Switzerland, but localities are omitted. The author lays stress on the extensive use made of vegetative characters for identification, with which there can only be entire agreement so long as the characters are determinative.

While a condensed guide of this kind is of the greatest service for carrying about, sooner or later the botanist is sure to require a flora giving fuller

descriptions. The author has prepared for this contingency by providing references under each genus to the "Flora Australiensis" and the "Flora of New South Wales," and has arranged his system and nomenclature according to the last named. Ferns and fern allies are included, but of monocotyledons the families of rushes, sedges, and grasses are left out.

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.]*

Magnetic Storm and Aurora on February 9-10.

A MAGNETIC storm was recorded at the Kew Observatory (National Physical Laboratory) on the afternoon of February 9 and early morning of February 10 larger than any that has occurred since October 31, 1903. The curves were slightly disturbed during the whole of February 9, but the storm may be regarded as commencing with a rapid movement of a few minutes of arc in the declination needle at 2.15 p.m., with a synchronous sudden rise of 45 γ (1 γ=0·00001 C.G.S.) in the horizontal force. The storm lasted an unusually short time, being practically over by 3 a.m. on February 10, but several large rapid movements were recorded. The largest declination movement occurred between 8.19 p.m. and 8.45 p.m. on February 9. During these twenty-six minutes the needle moved 57′ to the west and then 73′ to the east, the extreme westerly position being reached at 8.34 p.m. The most easterly position during the storm was reached at about 10.55 p.m., when the trace was off the sheet for a few minutes. The range during the storm actually shown on the sheet was 1° 38′. Between 1.13 a.m. and 1.45 a.m. on February 10 the needle moved steadily, without sensible oscillation, to the west, this movement reaching 1°. The rate of movement was practically uniform from 1.13 a.m. to 1.33 a.m., when it accelerated so suddenly that the curve resembles two straight lines inclined at a finite angle.

In the case of the horizontal force, the force fell more than 355 γ between 8.25 p.m. and 8.33 p.m. on February 9, when it went off the sheet for a few minutes. Between 8.40 p.m. and 8.49 p.m. it increased fully 240 γ. The total range during the storm exceeded 480 γ.

The vertical force, though less disturbed than the other elements, showed a range of 325 γ, the highest and lowest values being attained at 6.25 p.m. on February 9 and 1.48 a.m. on February 10 respectively. The most rapid change took place between 8.25 p.m. and 8.42 p.m. on February 9. The storm was doubtless associated with the aurora, which seems to have been widely observed on the evening of February 9. CHARLES CHREE.

AN unusually beautiful display of aurora borealis was seen here (51° 56′ N. lat., 2° 35′ W. long.) between 6.30 p.m. and 11 p.m. on Saturday evening, February 9. At about 6.30 p.m. I became aware that the north-western sky, instead of darkening after sunset, was becoming lighter, and the quivering upward rays showed that it was the northern lights. The aurora was at its best between 8 p.m. and 9.30 p.m., stretching half across the northern heavens from Cetus to Leo, from the horizon upwards towards the zenith, some of the curved flashes reaching to Jupiter.

This aurora was characterised by the brilliant soft whiteness of its light, occasionally tinged with pale green, which filled the north-western and northern sky from the horizon to a considerable elevation, from which at times long rays shot up; but more generally the lights appeared as curved, wavy bands rushing up to the zenith, and hanging there for a few seconds as white, cloudy patches in the clear sky among the brighter stars. Between 8.45 p.m. and 9.15 p.m. the colour about Ursa Major and Leo was a dull, faint red. The aurora was not watched after 11 o'clock, but by that time it had greatly diminished in brilliancy, and the sky was becoming cloudy.

I may add that for some weeks I have been noting the sun-spots, of which lately there have been a considerable number, and on the morning of February 9 one near the middle of the sun's disc was so large that I afterwards saw it with the naked eye through smoked glass.

E. A.

Dadnor, near Ross, Herefordshire, February 11.

The Flight of an Elongated Shot.

WOULD any reader of NATURE kindly enlighten me on the following points in the theory of projectiles?

(1) Whether one is right in supposing that a bullet or shot of the modern pointed cylindrical form, when fired at any angle of elevation *in vacuo*, would preserve the original direction of its axis of rotation, so that at the end of its flight its long axis would be considerably inclined to its line of flight.

(2) Whether a similar shot fired through the air would be acted upon by a couple tending to produce rotation about an axis perpendicular to the plane of the trajectory, the magnitude and direction of this couple depending upon the form of the projectile and the position of its centre of gravity, a zero value being possible; and whether the effect of this couple would be to produce rotation about an axis in the plane of the trajectory and perpendicular to the long axis of the shot, so that the point of the projectile would be deflected downwards and to the right or left.

(3) Whether, if the above suppositions are correct, any successful attempts have been made to keep the long axis of the shot tangential to its trajectory during the whole course of its flight, by giving it a particular form, and varying the density of its parts in a particular way.

P. D. STRACHAN.

Philippolis, Orange River Colony.

THE answer to proposition (1) is best given for the most general case. A body projected in any manner in a field of gravity *in vacuo* will move so that the centre of gravity (C.G.) describes a parabola, while the body moves about the C.G. so that to an observer seated at the C.G. the body has the motion described by Poinsot, in which the momental ellipsoid rolls on a fixed plane. The normal to this plane is the axis of resultant angular momentum, and this axis preserves a direction fixed in space, while the body moves about it. When this axis coincides with a principal axis, the body appears to be spinning steadily about the axis, but a closer observation reveals always a precessional and nutational motion.

The question in the limited form of proposition (1) presupposes a body of perfect uniaxial symmetry spun accurately about its axis; but such a condition cannot be realised in practice any more than it is possible to balance a pin on its point, and so it is better to replace this ideal state of proposition (1) by the penultimate state, in which the spinning body, like a sleeping top upright, has steadiness almost perfect.

With this limitation the axis of an elongated shot would move parallel to itself, on the whole, if fired in a vacuum as stated in proposition (1). But if fired in air, as in proposition (2), a couple arises as soon as the axis is oblique to the direction of motion, tending to place the axis of an elongated shot broadside to its motion and at right angles to the tangent of the trajectory, and this couple acting on the rotating shot will cause the axis to precess about the tangent. Even in the absence of air resistance and gravity, the resulting motion is of great complexity where the body is influenced by the stirring up of the surrounding medium, and the special case of a figure of revolution, discussed by Kirchhoff and Clebsch, is more complicated than the gyroscopic motion of a top spinning in a smooth cup.

The problem defies analysis when gravity and air resistance are taken into account: all we can say is that the frictional drag damps the nutation, and causes the axis of the shot to follow the tangent of the trajectory very closely, the point of the shot being seen to be slightly above the tangent and to the right, with a right-handed spin. The conditions of proposition (3) are secured then

independently of any supposition or condition of shape and density of the shot, provided the spin imparted by the rifling is suitable, and that the trajectory is not curved too much. A. G. GREENHILL.

The Atomic Weight of Nickel.

IN a paper on the absorption of Röntgen rays (*Journal de Physique*, p. 653, 1901) M. Benoist shows the connection between the transparency to X-rays of elementary substances and the atomic weight of those substances by means of a curve, which in general exhibits a fall of transparency with a rise in the atomic weight of the absorbing substance. In continuing investigations on secondary X-rays, Mr. C. A. Sadler and I have found that by replacing Benoist's primary beam by secondary beams from different substances, curves are obtained similar to that got by using a beam direct from an X-ray tube, except in the region of atomic weights near to that of the radiator. In those regions a strongly marked deviation occurs, showing a special transparency to the secondary radiation from a substance, by a sheet of the same substance, and a less strongly marked abnormal transparency of those substances with atomic weights differing little from that of the radiator. Also the nearer on the same side the atomic weight of the absorbing substance is to that of the radiator, the greater is the deviation from the normal transparency. This effect does not indicate that the secondary rays as emitted by the atoms of a substance are specially penetrating, but simply that in emerging from the interior atoms to the surface a selective absorption has occurred, leaving the remainder specially penetrating to further layers of the same substance and to a less extent to substances of neighbouring atomic weights. This is not a property of secondary rays alone, for experiments on primary beams which have passed through thin sheets of metal show the same effect.

In making such experiments on a number of metals it was found that the radiation from nickel was much more abnormally penetrating to copper than to iron, indicating a proximity of atomic weight to that of copper. On the other hand, when cobalt was used as a radiator the rays were much more abnormally penetrating to iron than to copper, indicating that the atomic weight of cobalt is nearer that of iron than of copper.

The two experiments together furnish what seems to us to be the strongest evidence, based, not only on empirical law, but on theory, that the atomic weight of nickel is not slightly less than that of cobalt (the accepted values are Ni 58·7, Cr 59), but is considerably greater.

The evidence, however, does not end here. In a paper on secondary Röntgen radiation I suggested a method of determining atomic weights—based on the fact that the radiation is purely an atomic property—by graphically plotting the absorbability of the secondary radiation proceeding from different elements subject to X-rays and the atomic weight of the radiator. A periodic curve was obtained in many portions of which the slope was so great that atomic weights might be obtained by interpolation with considerable accuracy.

Using a thin plate of aluminium as the absorber, the relation between the absorbability of the radiation and the atomic weight of the radiator was found to be approximately a linear one for a long range of atomic weights on both sides of nickel. Nickel itself, however, can only be brought into line by assigning it an atomic weight a little above 61. Many absorbing substances have been used, and all give approximately the same value, the maximum variation in the values found from these different experiments being about 0·3.

The experiments on fairly good commercial specimens indicated an atomic weight of about 61·4. To make the evidence more conclusive and the numerical values as accurate as possible—though a 2 per cent. or 3 per cent. impurity could not materially affect the result—the purest specimens were used, and the atomic weight found by two separate series of observations did not differ by more than about 0·1 from the value previously obtained. We are thus forced to the conclusion that the atomic weight of nickel is about 61·3. Details of these experiments we hope to publish shortly. CHARLES G. BARKLA.

University of Liverpool, February 6.

ON HOMER LANE'S PROBLEM OF A SPHERICAL GASEOUS NEBULA.

§ 1. A HIGHLY interesting problem of pure mathematics was brought before the world in the *American Journal of Science*, July, 1870, by the late Mr. Homer Lane, who, as we are told by Mr. T. J. J. See,[1] was for many years connected with the U.S. Coast and Geodetic Survey at Washington. Lane's problem is the convective equilibrium, of density, of pressure, and of temperature, in a rotationless spherical mass of gaseous fluid,[2] hot in its central parts, and left to itself in waveless quiescent ether.

§ 2. For the full discussion of this problem we must, according to the evolutionary philosophy of the physics of dead matter, try to solve it for all past and future time. But we may first, after the manner of Fourier, consider the gaseous globe as being at any time given with any arbitrarily assumed distribution of temperature, subject only to the condition that it is uniform throughout every spherical surface concentric with the boundary. And our subject might be the absolutely determinate problem of finding the density and pressure at every point necessary for dynamical equilibrium. But for stability of this equilibrium, Homer Lane assumed, rightly as I believe is now generally admitted, that it must be of the kind which two years later[3] I called convective equilibrium.

§ 3. If the fluid globe were given with any arbitrary distribution of temperature, for example uniform temperature throughout, the cooling, and consequent augmentation of density of the fluid at its boundary, by radiation into space, would immediately give rise to an instability according to which some parts of the outermost portions of the globe would sink, and upward currents would consequently be developed in other portions. In any real fluid, whether gaseous or liquid, or liquid with an atmosphere of vapour around it, this kind of automatic stirring would tend to go on until a condition of approximate equilibrium is reached, in which any portion of the fluid descending or ascending would, by the thermodynamic action involved in change of pressure, always take the temperature corresponding to its level, that is to say, its distance from the centre of the globe.

§ 4. The condition thus reached, when heat is continually being radiated away from the spherical boundary, is not perfect equilibrium. It is only an approximation to equilibrium, in which the temperature and density are each approximately uniform at any one distance from the centre, and vary slowly with time, the variable irregular convective currents being insufficient to cause any considerable deviation of the surfaces of equal density and temperature from sphericity.

§ 5. A very interesting and important theorem was given by Prof. Perry, on p. 252 of NATURE for July, 1899, according to which, for cosmical purposes, it is convenient to divide gases into two species—species P, gases for which the ratio (k) of thermal capacity, pressure constant, to thermal capacity, volume con-

1 "Researches on the Physical Constitution of the Heavenly Bodies" *Astr. Nachr.*, November, 1905.)

2 By a gaseous fluid I here mean what is commonly called a "perfect gas," that is, a gas which fulfils two laws:—(1) Boyle's law. At constant temperature it exerts pressure exactly in proportion to its density, or in inverse proportion to the volume of a given homogeneous mass of it. (2) A given mass of it, kept at constant pressure, has its volume exactly proportional to its temperature, according to the absolute thermodynamic definition of temperature (Preston's "Theory of Heat," Article 290). According to the "Kinetic Theory of Gases," every gas or vapour approximates more and more closely to the fulfilment of these two laws, the smaller is the proportion of the sum of times in collision to the sum of times of moving approximately in straight lines between collisions.

3 "On the Convective Equilibrium of Temperature in the Atmosphere." (Literary and Philosophical Society of Manchester, January 21, 1862; re-published as Appendix E, Math. and Phys. Papers, vol. iii.)

stant, is greater than $1\frac{1}{8}$; species Q, gases for which k is less than $1\frac{1}{8}$. On looking at the page of NATURE referred to, it will be seen that Perry questioned or even denied the possibility of a gas of species Q. His theorem is:—*A finite spherical globe of gas, given in equilibrium with any arbitrary distribution of temperature having isothermal surfaces spherical, has less heat if the gas is of species P, and more heat if of species Q, than the thermal equivalent of the work which would be done by the mutual gravitational attraction between all its parts, in ideal shrinkage from an infinitely rare distribution of the whole mass to the given condition of density.*

§ 6. From this we see that if a globe of gas Q is given in a state of convective equilibrium, with the requisite heat given to it, no matter how, and left to itself in waveless quiescent ether, it would, through gradual loss of heat, immediately cease to be in equilibrium, and would begin to fall inwards towards its centre, until in the central regions it becomes so dense that it ceases to obey Boyle's law; that is to say, ceases to be a gas. Then, notwithstanding Perry's theorem, it can come to approximate convective equilibrium as a cooling liquid globe surrounded by an atmosphere of its own vapour.

§ 7. But if, after being given as in § 6, heat be properly and sufficiently supplied to the globe of Q-gas at its boundary, and the interior be kept stirred by artificial stirrers, the whole gaseous mass can be brought into the condition of convective equilibrium.

§ 8. In the course of the communication to the Royal Society of Edinburgh, curves were shown representing the distributions of density and temperature in convective equilibrium for four different gases, corresponding to the four values of k:—

Gas (1) $k=1\frac{2}{3}$ (approximately the value of k for the monatomic gases, mercury vapour according to Kundt and Warburg, argon, helium, neon, krypton, and xenon).

Gas (2) $k=1\frac{2}{5}$ (approximately the value of k for seven known diatomic gases, hydrogen, nitrogen, oxygen, carbon monoxide, nitric oxide, hydrochloric acid, hydrogen bromide).

Gas (3) $k=1\frac{1}{3}$ (approximately the value of k for water vapour, chlorine, marsh gas, bromine iodide, chlorine iodide).

Gas (4) $k=1\frac{1}{4}$ (approximately the value of k for sulphur dioxide).

Four of these curves agree practically with curves given by Homer Lane for $k=1\frac{2}{3}$ and $k=1\frac{2}{5}$, in his original paper to the *American Journal of Science*, July, 1870.

§ 9. In a communication to the Edinburgh Royal Society of February, 1887, "On the Equilibrium of a Gas under its own Gravitation only," I indicated a graphical treatment of Lane's problem by successive quadratures, which facilitated the accurate calculation of numerical results, and was worked out fully for the case $k=1\frac{2}{3}$ by Mr. Magnus Maclean, with results shown in a table on p. 117 of the Proceedings of the Royal Society of Edinburgh, vol. xiv., and on p. 292 of the *Phil. Mag.*, March, 1887. The numbers in that table expressing temperature and density are represented by two of the curves now laid before the society. The other curves represent numerical results calculated by Mr. George Green, according to a greatly improved process which he has found, giving the result by step by step calculation without the aid of graphical constructions.

The mathematical interpretation of the solution for Perry's critical case of $k=1\frac{1}{3}$, and for gases of the Q-species, is exceedingly interesting.

The communication included also fully worked out examples of the general solution of Lane's problem for gases of class P of different total quantities and of different specific densities.

§ 10. In my communication to the Royal Society of Edinburgh, of February, 1887, I pointed out that Homer Lane's problem gives no approximation to the present condition of the sun, because of his great average density (1.4). This was emphasised by Prof. Perry in the seventh paragraph, headed "Gaseous Stars," of his letter to Sir Norman Lockyer on "The Life of a Star" (NATURE, July 13, 1899), which contains the following sentence:—

"It seems to me that speculation on this basis of perfectly gaseous stuff ought to cease when the density of the gas at the centre of the star approaches 0.1 or one-tenth of the density of ordinary water in the laboratory." KELVIN.

THE PROBLEM OF THE RHODESIAN RUINS.[1]

THE recent investigation of some of the famous ruins of Rhodesia, conducted in 1905 by Dr. D. Randall-MacIver on behalf of the British Association and the Rhodes trustees, has resulted in an entirely fresh view of their origin and age. The hitherto generally accepted view, that these buildings were erected in very ancient days by a Semitic people, whose search for gold led them thus far afield, has received a serious check. Dr. MacIver's researches, conducted upon the lines of archæological investigation, point to the buildings in question being of comparatively recent date, not earlier, in fact, than late mediæval times. This result is the more striking when we remember that his previous researches have been mainly archæological, conducted chiefly in Egypt, and that, in consequence, we might expect a certain degree of bias in favour of retaining the ruins within the sphere of archæology. That a trained archæologist has been unable to find evidence of high antiquity upon the sites investigated is at least a strong point in favour of his argument.

Dr. MacIver made excavations on seven sites in various parts of Rhodesia, these being:—(1) Inyanga, on the Cecil Rhodes estate, sixty miles north of Umtali; (2) the Niekerk ruins to the north-west of Inyanga; (3) a site three miles south of Umtali; (4) Dhlo Dhlo, in the Incisa district; (5) Nanatali, sixteen miles east of Dhlo Dhlo; (6) Kami, fourteen miles west of Bulawayo; and (7) Great Zimbabwe, in the Victoria district, the site which hitherto had received the greatest attention. These sites were well selected as being distributed over a wide area, and, moreover, as differing considerably from one another both in general character and in special features, as also in the greater or less degree of elaborateness in their structure. It may be remarked at once that the distinctive features observable in comparing the different buildings are often no less remarkable than are the points of similarity. No two seem to be alike, and the divergences and specialisation render their individuality very striking.

The principal questions to be determined in regard to these remarkable buildings were: By what people and at what period were they erected? The controversy, which is still active, centres mainly upon these two main points, and the older theory of their Semitic origin and great antiquity, urged by Mauch, Bent, Keane, Hall, and others, is being maintained steadfastly and strenuously by several authorities. Dr. MacIver in the title of his book, "Mediæval Rhodesia," has hoisted his fighting flag. His conten-

1 "Mediæval Rhodesia." By Dr. David Randall-MacIver. Pp. xv+106. (London: Macmillan and Co., Ltd., 1906. Price 20s. net.

tion is that none of these buildings are referable to an earlier period than mediæval or post-mediæval times. He argues that none of the objects hitherto discovered in excavating within the area of the ruins would be recognised by an archæologist as "more than a few centuries old; and that the objects, when not immediately recognisable as mediæval imports, are of characteristically African type." Inyanga and the Niekerk ruins do not appear to have produced any but native African objects, and at Umtali a fragment of glazed stoneware was the only foreign object found. At the better-known sites, Dhlo Dhlo, Kami, Nanatali, and Zimbabwe, a fair number of imported objects have been found, but here again Dr. MacIver holds that in no case is there evidence of a pre-mediæval antiquity. As far as possible, he endeavoured in his excavations to reach the lowest strata, and to explore the levels which must be contemporary with the earliest portions of the walls of the buildings, and the objects found therein were naturally considered by him of the highest importance.

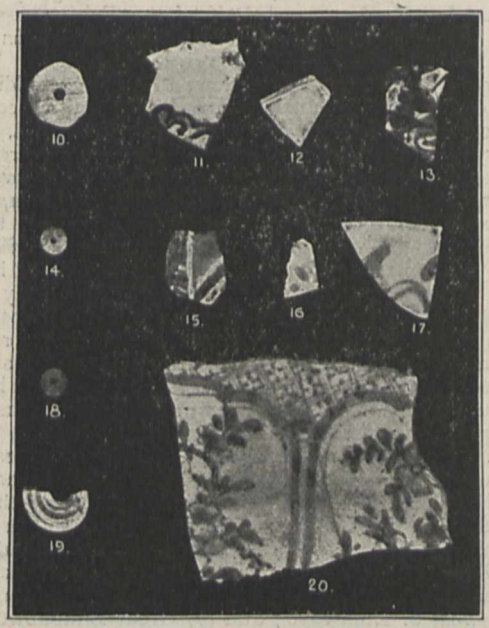

FIG. 1.—China and Ivory and Shell Beads found at Dhlo-Dhlo. From "Mediæval Rhodesia."

It was at Dhlo Dhlo that he discovered his most valuable piece of evidence. The absence of objects of foreign workmanship and of known date at the Inyanga, Niekerk, and Umtali sites rendered impossible the assignment of any definite period to the buildings there, although the negative evidence may be held to indicate the lack of foreign influence, which itself may possibly be regarded as pointing to these sites being earlier than the others which were examined, a view which is held by the author on structural grounds. At Dhlo Dhlo, on the other hand, numerous imported objects were found, and in excavating one of the platforms upon which a dwelling had been erected, and which Dr. MacIver asserts most positively is contemporaneous with the earliest portion of the building, he came across a piece of blue and white Nankin china in the unbroken cement floor of the dwelling. This fragment is shown (No. 20) in the illustration reproduced. If this cement floor was, as he maintains, erected at the same time as the oldest walls of the main building, we must certainly admit the validity of his contention that the building cannot antedate the fragment of porcelain, and that the date of erection, therefore, cannot be pushed back beyond late mediæval times. His critics appear willing to admit the validity of his argument as regards Dhlo Dhlo, but they urge that the buildings on this site are relatively late, and that this dating will not hold good in the case of the buildings at Great Zimbabwe, which they regard as much earlier.

Dr. MacIver regards the principal buildings, such as the so-called "Elliptical Temple" at Zimbabwe, as being fortress-kraals, and urges that the "Elliptical Temple" itself was the fortified residence of the Great Chief, or Monomotapa, whose sway extended over an enormous area and a very extensive population. To understand how architectural feats, such as the finer Rhodesian buildings at Dhlo Dhlo, Nanatali, and Zimbabwe, can have been achieved by the precursors of the modern South African natives, it is necessary to assume that in those days there was organisation of a far higher character than has obtained in recent years, organisation under great chiefs whose power and intelligence were of a relatively high order. This would appear, from the Portuguese and other records, to have been the case in the days of the Monomotapan empire of the Middle Ages down to the close of the sixteenth century. The Monomotapa, or paramount chief, may well have resided at Zimbabwe, and he is recorded to have had captains in various fortresses elsewhere. The organisation of labour implied by the elaborate and decorated stone architecture is certainly remarkable, more particularly when we compare these edifices with the results of the constructional efforts of the modern Kafir peoples; but under an intelligent and powerful ruler, and under stable conditions of life, a degree of culture may have been reached far higher than it is possible for smaller communities under lesser chiefs to maintain. It seems well within the bounds of probability that under such conditions even the finer buildings may have been erected by the more progressive and united precursors of the present native inhabitants of Rhodesia.

Even more remarkable, in some respects, than the huge "fortified kraals" are the terrace walls on the Niekerk site described by Dr. MacIver. These stone-built walls form irregular concentric rings round the hills upon which the villages were situated, and although structurally simple, cover an enormous area extending in close formation over a space of upwards of fifty square miles. They do not appear to have been erected as supporting walls for agricultural terraces, nor to have been connected with an irrigation system, and, in the absence of evidence to the contrary, one must assume that their purpose was defence, though one accepts this view somewhat reluctantly, for, when regarded as an elaborate system of defensive girdle walls, one cannot but admit that their practical value is hardly commensurate with the enormous labour expended upon them. They recall to one's mind the *sementera* walls of Luzon, in the Philippines, which also form long, irregular, though concentric alignments up the slopes of the hills, following their contours, covering, too, a very large extent of country. In the case of the *sementeras* there are transverse walls dividing up the terraces into sections. They are purely for agricultural purposes, and are mostly, though not all, connected with a wonderful system of irrigation. It might be of use to compare the *sementera* system with the Niekerk terrace walls, on the chance of a clue to the

latter being found, and it is to be hoped that an accurate survey may eventually be made. The scientific study of the ruins is still in its infancy, and a vast amount of work remains to be done. As has been said, there are two distinct and antagonistic theories of their origin. It is eminently to be desired that the Rhodesian authorities will in every way encourage, nay, promote, further detailed excavations by trained men of science. Such a work would redound greatly to the credit of Rhodesia, and would be followed with the greatest interest throughout the scientific world. It would imply the exploitation of one of the most valuable scientific assets of the country. Dr. MacIver makes out a strong case, but it is desirable to know more precisely to what group of Bantu peoples the buildings are assignable. Whence came they? Many of the native objects found are identical with those in use by the modern Kafir peoples; others, on the other hand, show affinities with a north-western culture, and appear almost out of place where found. Then again, the older gold mines themselves have hardly been examined at all in detail. They should yield material of importance. It is further desirable to explain more fully the individuality of the different settlements and of the arts of their former inhabitants, to diagnose, for instance, the presence of very numerous stone carvings at the Umtali ruin, excavated by Captain E. M. Andrews, in the light of their prevailing absence elsewhere.

It has been urged that the ruins have been shorn by Dr. MacIver of their romance. Taking the term romance in its strict sense, this may be true. For legendary uncertainty he has sought to substitute scientific fact. For ill-defined Semitic invaders he offers a native indigenous people; and King Solomon and the Queen of Sheba he replaces with the Monomotapa. How far he is justified will be shown by future investigations. At least he has presented his case in a straightforward and lucid manner in a very attractive and well-illustrated book, and it does not appear that the problem is in any way less fascinating or less worthy of accurate study for having, perhaps, been transferred from the province of archæology to that of ethnology.

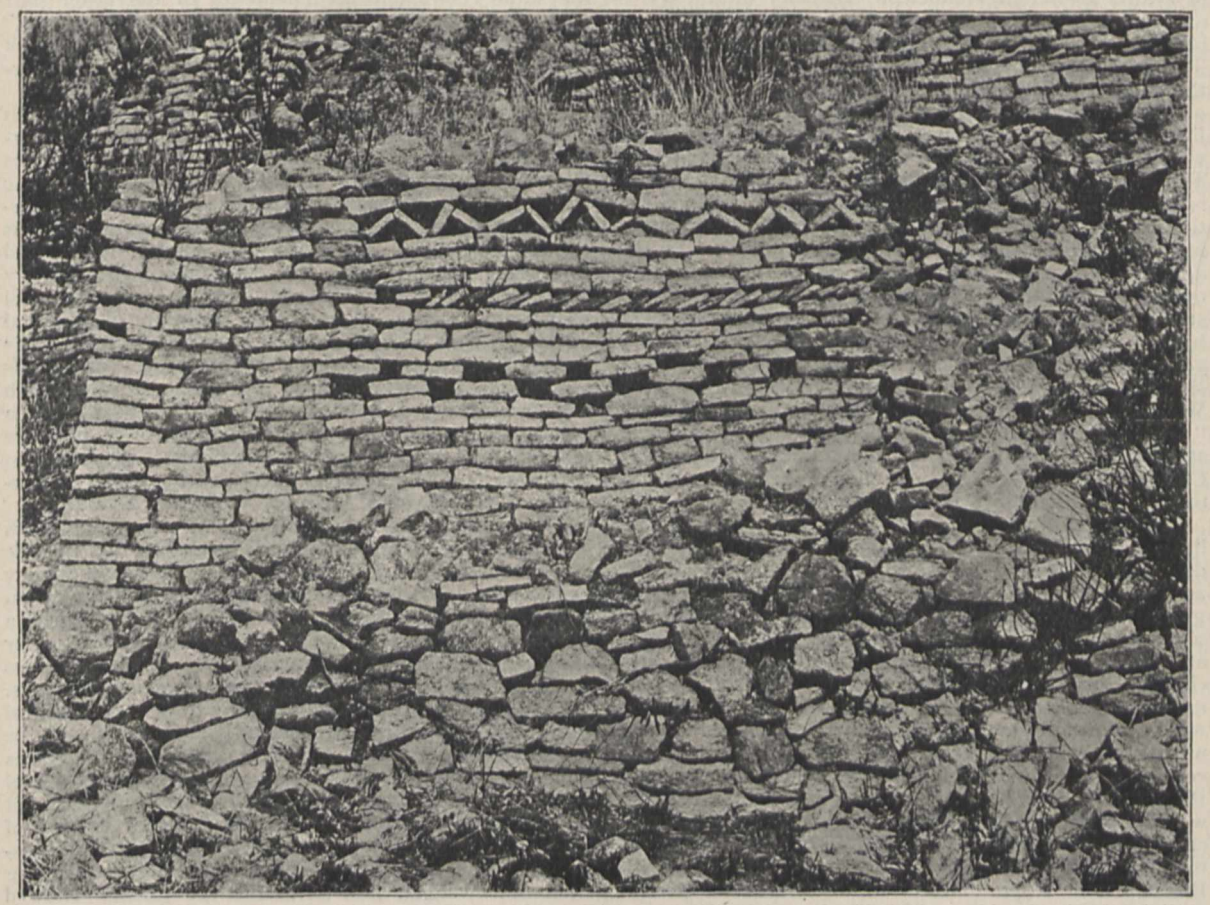

FIG. 2.—Decoration of West Side of Main Entrance, Dhlo-Dhlo. From "Mediæval Rhodesia."

PROF. D. I. MENDELÉEFF.

DEATH has been very busy of late among the army of men of science, and nowhere has he been more active than in Russia, where within the space of a few weeks three of that country's foremost chemical philosophers—Beilstein, Mendeléeff, and Menschutkin—all men of front rank and of a world-wide reputation, have submitted themselves to the strict arrest of the fell sergeant. An occurrence of like character and extent is almost unknown in the annals of science. The nearest approach to it is in our own history, when within an interval hardly greater we lost Wollaston, Young, and Davy.

To Beilstein's life and services to chemical science we have already made reference; of Menschutkin, whose death has only just been announced, we hope to speak later. Our immediate concern is with the most distinguished of the eminent triumvirate—Dmitri Ivanovitsch Mendeléeff. The chief facts of Mendeléeff's personal history have been given in No. xxvi. of the series of "Scientific Worthies," which appeared in these columns so far back as 1889. It is sufficient here to recall that he was a Siberian, born at Tobolsk on February 7th (N.S.), 1834. He died, therefore, within a week of his seventy-third birthday. He was the seventeenth and youngest child of Ivan Paolowitsh Mendeléeff, Director of the Gymnasium at Tobolsk, who, shortly after the birth of his son Dmitri, became blind and lost his position. The family thereby became practically dependent upon the mother, Maria Dmitrievna Mendeleeva, a woman of great energy and force of character, who established a glass works in the town, on the profits of which she brought up and educated her large family. The story of Mendeléeff's youth and early struggles is given in the preface to his great work "On Solutions," which he dedicated to his mother's memory in a passage of singular beauty and power. At the age of sixteen he was sent to St. Petersburg, but, owing to official restrictions, he was prevented from studying chemistry under Zinin at the University, as he had intended, and was transferred to the Pedagogical Institute, where he came under the influence of Woskresenky in chemistry, and of Lenz in physics. Whilst at the institute he wrote his first paper on "Isomorphism," and after serving in the Gymnasium at Simferopol and at Odessa, he gained his *Magister Chemiae* in 1856, and was made a *privat-docent* in the University of St. Petersburg.

At about this period he was attracted to the special line of inquiry and of speculation which was the dominant and most striking feature of his scientific activity, and which eventually culminated in the great generalisation with which his name is inseparably connected. It is easy to detect in these early attempts at tracing the relations between the physical and chemical properties of substances and their molecular and atomic weights the germs of the conception which eventually took shape as the Periodic Law. His work on specific volumes was begun in 1855, and was continued by him in Heidelberg, where he went in 1859, and where he remained until 1861. Germany would appear to have exercised no permanent influence on Mendeléeff. He worked alone, and seems to have derived nothing from personal contact with Bunsen and Kopp. It is significant of his perspicacity that he should at this time have clearly appreciated and publicly declared his belief in the value of Gerhardt's work on the determination of the chemical molecule—at the very period, in fact, when the whole weight of German authority was directed against the doctrine of the new French school. Returning to St. Petersburg, he became professor of chemistry at the Technological Institute. In 1866 he was transferred to the University, and in 1890 he was appointed head of the Standards Department.

Mendeléeff signalised his connection with the University by the publication of his "Principles of Chemistry," which has passed through many editions in Russia, and has been translated into German and English. It is not easy to avoid speaking of this work in terms which savour of hyperbole. Most treatises on chemistry owe a great deal to their predecessors. Indeed, there is probably no form of literature which so obviously proceeds on strictly evolutionary principles. But Mendeléeff's great work is a thing apart—something *sui generis*. The bare facts of chemistry, in greater or less detail, are common to all such works, but most of them, we fear, would be classed by Lamb among the books which are no books. It is not so with Mendeléeff's "Principles." In its insight, in its grasp of detail and of principle, in its extraordinary power of coordination, in its suggestiveness, and in its wealth of speculation, it is a book among books, and may be read with profit and a pleasure occasionally tinctured with amusement by every true student, no matter how old. To those who had the good fortune to know its author personally it reflects the man in every page. Even the footnotes are instinct with character and originality. Mendeléeff's "Principles" may be said to stand in the same relation to the chemistry of the latter half of the nineteenth century that Dalton's "New System" did to the chemistry of the earlier half. Each work was the definite and orderly presentation of the doctrine and philosophy of its author.

There is hardly a department of chemistry in which Mendeléeff did not labour, at one time or other, during the thirty years of his activity as a teacher. Chemical mineralogy, chemical geology, and the chemistry of aliphatic substances in turn, and apparently with equal zeal, attracted his attention. It is to this catholicity and power of taking broad and comprehensive views of the operations of chemistry that Mendeléeff owes his eminence as a chemical philosopher. But it is in the domain of physical chemistry that his fame as a worker chiefly rests. His early papers on the thermal expansions of liquids above their boiling points up to temperatures at which their cohesion and latent heats are *nil*, and at which the liquid becomes gaseous independently of pressure and volume, anticipated the researches of Andrews, and were, in their turn, a development of the observations of Cagniard de la Tour, Wolff and Drion.

The same faculty of perceiving the underlying basis of a physical generalisation is seen in the notable paper which he communicated to our Chemical Society in the year following his election into that body as an honorary foreign member, in which he developed a general expression for the expansion of liquids under constant pressure, analogous to that which expresses Dalton's law of the uniformity of expansion of gases. The formula $V=1+kt$ applies only to a so-called ideal gas; in like manner, Mendeléeff's expression is to be regarded only as a first approximation—that is, as applicable only to ideal liquids. In the case of actual liquids the deviations from the ideal form increase not only as the liquid approaches the point of change of state of aggregation, but also augment with diminishing density, increasing cohesion, and diminishing molecular weight, just as Mendeléeff himself showed that the deviations from Dalton's law were related to the molecular weights of the gases. Subsequent observers, by applying van der Waals's theory of the relation between pressure, volume, and temperature, have shown that the development of Mendeléeff's formula affords a simple and ready method of calculating the critical temperature of bodies from their thermal expansions as liquids—in other words, of reaching the same constant by a method analogous to that employed by Mendeléeff himself to the observations of Kopp and Pierre.

Mendeléeff's work on the relative densities of aqueous solutions of alcohol takes its place as a classic alongside the works of Blagden and Gilpin, and of Drinkwater and Fownes in this country, and, as in the case of these observations, has been utilised by Continental Governments for the purposes of revenue. These determinations were applied by Mendeléeff to the elucidation of a theory of solution, and in a paper, also communicated to our Chemical Society, he sought by means of them to reconcile Dalton's doctrine of the atomic constitution of matter with modern views re-

specting dissociation and the dynamical equilibrium of molecules. How far this attempt will be ultimately successful time alone can show. Mendeléeff had little sympathy with the theory of electrolytic dissociation, which, he declared, was not in harmony with the facts of observation, and was of little use in facilitating our comprehension of the true nature of solution. Nor was he more predisposed towards the conception of electrons, although perhaps his belief in the integrity of the atom was hardly so fundamental as that of Dalton, who would have gone to the stake rather than recant his declaration: "Thou canst not split an atom!"

The story of the rise and development of the Periodic Law is so well known that it is unnecessary now to dwell upon it. By a good fortune, which some may regard as evidence of predestination, Mendeléeff lived to see the verification of his predictions in the discovery, in rapid succession, of gallium, scandium, and germanium; and no seer ever prophesied more truthfully. It was the astonishing accuracy of Mendeléeff's prognostications, and the apparent boldness and confidence with which they had been uttered, that profoundly impressed the whole scientific world, and secured for his generalisation a respect and acceptance for which otherwise it would have had long to wait. This generalisation is now woven into the fabric of modern chemistry, and is universally accepted as the only rational basis of classification. Like many other great natural truths, we are able, on looking back, to discern its germs in the tentative efforts of previous thinkers who more or less dimly appreciated the significance of the facts upon which it is based, but it is perfectly certain that Mendeléeff knew nothing of the prior work of De Chantcourtois and of Newlands, and was no more influenced by it than was Dalton by Richter or by the "Comparative View of the Phlogistic and Antiphlogistic Theories" of William Higgins. In the memorable Faraday lecture which he gave to the Chemical Society in 1889, Mendeléeff, with a true nobility of mind and a modesty which revealed the real greatness of the man, gave adequate expression to his appreciation of the efforts of his predecessors, claiming for himself only courage and intrepidity in placing "the whole question at such a height that its reflection on the facts could be clearly seen."

The Periodic Law has so far stood the test of experience, and each new extension of the science is consistent with its previsions. The inert gases of the atmosphere find their place in the system, and the only radio-active substance the chemical properties of which have been sufficiently investigated has an appropriate position among its correlated elements. In the old days the followers of Stahl sought to make the conception of phlogiston an all-embracing doctrine. Mendeléeff anticipated these attempts as regards his own generalisation by showing that even the universal ether may be included within his system. In his last paper, published in 1902, entitled "An Attempt towards a Chemical Conception of the Ether," he starts with the assumption that the ether possesses mass, and that it has an atomic weight many times less than that of hydrogen, something of the order of 10^{-6} when $H=1$; that it is monatomic like argon and helium, and that by its small density and extremely rapid motion it permeates all matter and space. The ether thus becomes, not an affection of matter, but a distinct entity capable of being attracted by elements in proportion to the weights of their atoms, and he held that the phenomena of radio-activity could be explained by the gradual emission of this ether from such substances as uranium and thorium which have the highest atomic weights of the elements.

The truth embodied in the Periodic Law has led many to suppose that this generalisation lends support to, and is indeed the proof of, the validity of the assumption of a primordial matter. Mendeléeff himself declined to see that such an inference was warranted. He saw nothing in the law inconsistent with the idea of the individuality of the elements, holding that until it could be definitely shown that one element could be transformed into another, or that ether and matter were mutually convertible, the elements must be regarded as distinct and separate entities, immutable and unchangeable.

Mendeléeff not unfrequently visited this country, and was personally known to many British chemists, to whom he was always welcome. His tall and commanding presence, his fine head, with its tangle of long, wispy white hair, his expressive features, his guttural utterance, the wisdom and originality of his talk, his shrewdness and sense of fun, all stamped him as an uncommon and strong personality, which immediately made its presence felt in any company in spite of the innate modesty of the man. Of wide liberal views, intensely national, and a great power in the University, Mendeléeff was doubtless a thorn in the side of bureaucratic Russia, and it was currently reported that the frequent foreign missions on which he was sent were so many covert attempts to keep him at arm's-length.

Every scientific honour that this country could pay was awarded to him, and he was profoundly touched and deeply grateful for the sympathy and appreciation thus extended to him. On the occasion of his delivering the Faraday lecture it fell to the writer's duty, as treasurer of the Chemical Society, to hand him the honorarium which the regulations of the society prescribe, in a small silken purse worked in the Russian national colours. He was pleased with the purse, especially when he learned that it was the handiwork of a lady among his audience, and declared that he would ever afterwards use it, but he tumbled the sovereigns out on the table, declaring that nothing would induce him to accept money from a society which had paid him the high compliment of inviting him to do honour to the memory of Faraday in a place made sacred by his labours.

T. E. THORPE.

PROF. ANTONINO MASCARI.

BY the death of Prof. Antonino Mascari on October 18, 1906, solar physicists throughout the world, and more particularly those who were his intimates in the Italian observatories, have sustained a severe loss.

Born at Campobello di Mazzara (Sicily) on December 4, 1862, Mascari proceeded in due course to the University of Palermo, where he took the engineering course and obtained his degree in that faculty in 1887. It was while there that he developed the predilection for astronomical investigations, and, under the guidance of Prof. Riccò, worked with that activity and intelligent ability which were the outstanding features of his whole career. He was later appointed to the position of assistant to the Piazzi Foundation, and thus was fortunate enough to be able to continue his association with Prof. Riccò—an association which has proved of inestimable benefit to the study of solar physics.

In 1892 Mascari was appointed first assistant at the Observatory of Catania, where the solar prominence observations, commenced by Tacchini at Palermo in 1872, were continued. Probably only those who have had to use these Italian observations in discussions of collateral phenomena are aware how well this task was performed, and how much the science of solar physics owes to the indefatigable labours

and lucid exposition of Prof. Riccò's worthy successor. This work was continued right up to the commencement of his last illness, and we find that the discussion of the observations for the first semester of 1906 was carried out, and published in the *Memorie*, by Mascari.

Although his chief work lay in the province of solar physics, Mascari will also be remembered as a careful observer in other departments of astronomical physics. At the Catania and Etna observatories he made careful telescopic studies of various planets, Saturn and Venus among others. During the latter part of 1892 he noted several well-marked features on Venus, and, from their persistence in the same relative positions on the disc, he inferred that the short-period rotation of the planet was out of the question, thus confirming Schiaparelli's conclusion that the period of rotation is equal to that of the planet's revolution in its orbit. Tacchini's observations of about the same date also confirmed this fact.

Mascari was also an authority on the subject of the agitation of telescopic images, more especially that of the sun, due to movements in the earth's atmosphere. In collaboration with Signor A. Cavasino he published an exhaustive memoir on this subject in 1905, discussing the observations of the solar image which were carried out at Palermo and Catania during the twenty-three years 1881–1903.

With Prof. Riccò, Mascari was instrumental in carrying on the work in connection with the Catania zone of the Astrographic Chart and Catalogue, the taking and reduction of a large number of the requisite photographs being due to his personal labours. In 1904 he was nominated adjoint-astronomer at Catania, and took a prominent part in the admirable organisation and direction of the observatory work. But it was in the study of solar physics that Mascari's life-work lay, and it is in solar physics that his loss and the true value of his works will be most keenly recognised. This feeling is ably expressed in an obituary notice by Prof. Riccò, published in the *Astronomische Nachrichten*, to which we are indebted for some of the foregoing particulars.

W. E. ROLSTON.

NOTES.

THE death on Tuesday of Prof. H. F. Pelham, president of Trinity College, Oxford, and Camden professor of ancient history in the University, at sixty-one years of age, means a great loss to national scholarship and active study. Prof. Pelham took a keen interest in scientific progress, and while a member of the Hebdomadal Council at Oxford he was always on the side of learning and research. Women's education in Oxford had in him a powerful champion, and Somerville College in particular owed a great debt to him for his enthusiastic service on its council. He did much for the promotion and management of the British School at Athens and the British School at Rome, his zeal on behalf of these institutions being based on the conviction of the value of Greek and Roman life and literature as a subject of scientific study. Prof. Pelham was one of the first members of the British Academy.

IN the course of a letter in Wednesday's *Times*, Prof. E. B. Poulton refers to the efforts which have to be made in this country to induce the official representatives of the nation to assist the advancement of science in any particular direction. Instead of seeking the best expert advice upon any subject in which science can be of service, the Government waits to be memorialised before it can be stimulated into action. "The disheartening distance," Prof. Poulton adds, "which, in this respect, separates us from Germany was forcibly brought to my mind at the meeting of the International Zoological Congress in 1901. The fact that the German Empire is penetrated by a belief in the importance and the dignity of science was impressed upon us by the splendid reception in Berlin, by our meetings in the building of the Reichstag, and by every kind of Governmental and municipal recognition and hospitality. . . . In this country, unfortunately, the conviction that science is of national importance is almost confined to that small part of the nation which includes the scientific men themselves. They know that the existence of the Empire depends upon science, and that, if disaster should overwhelm the island centre, it will be for want of science. Scientific men can fairly claim that there is love of their country no less than love of their subject in the attempts to conquer indifference and even dislike in those who bear the responsibility and wield the power."

AN aurora was observed in most parts of the United Kingdom last Saturday evening, February 9, and in many widely separated places the display is described as being brilliant. The time of occurrence was chiefly between 6 p.m. and 11 p.m., and it was accompanied by a considerable magnetic disturbance, particulars of which are given by Dr. Chree in our correspondence columns. It is noteworthy that sun-spots have been unusually prominent recently, and that at the present time no fewer than four distinct groups are visible, one of which can be seen with the naked eye. London, and, indeed, nearly the whole of the south-east of England, was enveloped in a thick fog on Saturday evening, which effectually prevented all possibility of the aurora being seen in this part of the kingdom, but it was seen at Oxford. Reports are numerous from the north and west of England, as well as from Scotland and Ireland. Many observers give the colouring as yellow, green rose-red, or purple, and allude to the flickering or quivering rays. Writing from Winchmore Hill, Amersham (Bucks), Mr. A. M. Davies says that between 10.30 p.m. and 11 p.m. he noticed that the sky was deep pink or crimson in the N.E. and pale green in the N.W. At intervals beams of light were seen at various points, all radiating from some way below the northern horizon. Sometimes there was also a flickering effect, as though horizontal bands of light and shade rose up in quick succession. Dr. W. N. Shaw, director of the Meteorological Office, has kindly sent us a letter received by him from Mr. G. A. Clarke, the observer at the Aberdeen University Observatory. The following extract from this letter describes the chief characteristics of the display:—"The first faint streamers were seen by me a few minutes before 6 p.m., directed from N.N.W. towards the zenith. About thirty minutes later these had increased in brilliancy, while an extended diffuse greenish glow was visible in the N.E., and a faint white band crossed the zenith from E.N.E. to W.S.W. This band rapidly increased in brightness and size until it finally became a bright greenish-white zone girdling the sky from E.N.E. to W.S.W. horizons, and between 50° and 60° south of the zenith. It passed right through the 'belt' of Orion. At 6.45 p.m. a patch of deep red appeared in the north, accompanied by some very bright greenish-yellow streamers. The streamers increased in quantity, and worked upwards toward the zenith, while the band above-mentioned remained steadily in its position until after 9 p.m. Two other faint bands formed near the zenith, but they were merely transitory. Between 7 p.m.

and 8 p.m. some more red and rosy glows were seen in the N.W., but the prevailing colour was greenish-white. At frequent intervals after 8 p.m. the sky at the zenith was occupied by very rapidly moving wavy bands of pale white, which, though rather confused in direction, yet seemed to possess a distinctly undulatory motion towards the S. The streamers continued to shoot upwards with varying brightness, the points of maximum brilliance being in the N.W. and N.E., and occasionally a slight corona was formed overhead. Probably the most noteworthy feature of the display was the fact that it continued from about 6 p.m. until after midnight."

WE record with regret the death of Lord Goschen on February 7 at seventy-six years of age. The deceased statesman's reputation was chiefly gained in the world of politics, though he was well known as an author, economist, and educationist. His masterly book on "The Theory of the Foreign Exchanges" still remains the highest authority on the subject. Another volume, "Essays and Addresses on Economic Questions," was published as recently as 1905. Lord Goschen showed a keen interest in educational matters; he was an early promoter of university extension, and took a leading part in the movement for the abolition of tests in the universities. He was elected a Fellow of the Royal Society in 1872. He was twice Lord Rector of the University of Aberdeen, and once of the University of Edinburgh. In 1903 he was elected Chancellor of Oxford University in succession to the late Lord Salisbury, an honour he enjoyed until his death.

THE gold medal of the Royal Astronomical Society was presented on February 8 to Prof. E. W. Brown, F.R.S., for his "Researches in the Lunar Theory." Mr. H. F. Newall, F.R.S., was elected president of the society in succession to Mr. W. H. Maw.

THE *Chemist and Druggist* announces that the Paris Municipal Council has voted a credit of 3800 francs (152*l.*) toward a monument to the late Prof. Curie in the Paris School of Physics and Chemistry.

REUTER'S Agency states that Major Powell Cotton has sent home a complete skeleton of an okapi, the skull of which is said to be probably one of the most remarkable specimens ever brought to this country. In addition, there is a beautifully marked and perfect skin in a better condition than that now in the national collection. Major Powell Cotton has also sent to England the skin of a young okapi. All are now at the British Museum.

THE American Geographical Society has awarded the Cullum medal for the year to Dr. Robert Bell, F.R.S., chief geologist of the Geological Survey of Canada, as a mark of its appreciation of the great value of his extensive surveys and explorations during a long period. This is the first time the medal has been presented to a geographer who is not a citizen of the United States, and this fact gives additional value to the award.

AT a general meeting on January 25 of the Paris Société d'Encouragement pour l'Industrie nationale, the gold medal of economic arts for the year 1906, on which is an effigy of Ampère, was awarded to M. d'Arsonval for his investigations in electricity. The society awards every year, on the recommendation of one of the six committees of the council, a gold medal carrying the likeness of some leader distinguished in science or art, to the authors—French or foreign—of works which have exercised the greatest influence on the progress of French industry during the six years preceding the award.

WHEN attention was directed last summer to the threatened danger to the continued efficiency of the Royal Observatory, Greenwich, likely to be caused by the London County Council electrical generating station erected half a mile due north of the observatory (NATURE, June 28, 1906, vol. lxxiv., p. 200), a special committee was appointed by the Admiralty to inquire into the working of the station. The committee, which consisted of Lord Rosse, representing the Royal Observatory, Prof. J. A. Ewing, representing the Admiralty, and Sir Benjamin Baker, representing the Council, has now issued its report, and the conclusions arrived at are contained in the following recommendations:—(*a*) The question, both as regards effects of vibration and obstruction through chimneys or discharge from chimneys, to be further reviewed after, say, two years, by which time experience should be obtained with the second portion of the station at work. (*b*) The generating plant for the second portion to be turbines, which, as well as the dynamos, must be of a perfectly balanced type, such as has been proved by trial not to cause vibration. (*c*) An undertaking to be obtained that when the plant in the second portion is available for use, the reciprocating engines of the first portion shall not in ordinary circumstances be used after 10 p.m., and their use shall be restricted as far as possible after 8.30 p.m. (*d*) The two chimneys of the second portion, at present incomplete, to be not higher than 204 feet above Ordnance datum. (*e*) The discharge of gases both from these and from the existing chimneys not to be materially hotter than the discharge is now from the existing chimneys—namely, about 250° F. (*f*) No further extension of the station to be made beyond the 20,000 kilowatts now contemplated in the equipment of the second portion.

THE annual dinner of the students' union of the London School of Economics took place on February 9. Mr. Haldane, in proposing the toast of the school, said that idealism is the source of power in religion, in war, in science, in organisation, and the London School of Economics owes its strength and vitality to-day to the fact that it was founded by men who believed in large conceptions, and who put them into execution without looking to the consequences. Modern applied economics penetrates into every sphere of public life. The result is that the work of such a school as this is not merely to teach, but to train. The Chinese Minister, responding, through his interpreter, to the toast of "The Visitors," said when he came to this country, three years ago, there was only a handful of Chinese students here, but now there are more than ten students in the University of London alone, and more than 100 in the whole of Great Britain. Chinese civilisation, he continued, can boast of the three greatest inventions which have revolutionised the whole world—printing, gunpowder, and the mariner's compass. We have improved those inventions with our Western skill, and have gradually built up what may be roughly called modern science. It is now the turn of the Chinese, he remarked, to learn modern science from us, and with their Eastern skill to build up the science of the future. Dr. Nansen, who also responded, said there has been a remarkable *rapprochement* between science and practical life as the centuries have marched on. If we go back some centuries we find science living its life to itself without being in touch with practical life at all; but as time passed on science became

the leading energy of modern society. To-day no nation can hope to have any success which has not adapted science to its own life. The necessity of adapting scientific methods to practical life has become more and more imperative, and it is, in fact, the secret of success of any nation to understand the scientific method of organisation thoroughly.

THE October (1906) issue of the Proceedings of the Philadelphia Academy contains the second instalment of a paper by Mr. H. W. Fowler on heterognathous fishes (Astyanax and its allies). One new species is made the type of a new genus, while several previously known forms are referred to new subgenera.

THE third and fourth parts (issued together) of the eighty-fifth volume of the *Zeitschrift für wissenschaftliche Zoologie* appeal solely to specialists, the early stages in the development of the ovum in the hedgehog and the formation of the primitive streak in the yolk of the tern forming the subject of two articles, while the third is devoted to the turbellarian worms of the Bernese Oberland.

To the January number of the *Entomologist's Monthly Magazine* Lord Walsingham contributes a further instalment of his account of Algerian Microlepidoptera, mainly based on specimens in his own collection; while in both the January and the February issues the Hon. Charles Rothschild describes new British fleas. A new lantern-fly (Fulgoridæ), infesting bamboos at Darjiling in such numbers as to be termed "a pest," forms the subject of a note by Mr. W. L. Distant in the earlier of the two numbers.

IN No. 1505 of the Proceedings of the U.S. National Museum (vol. xxxii., p. 1) Mr. W. M. Lyon describes and figures a specimen referred to the typical race of the bonte-quagga (*Equus burchelli*), now nearly, if not completely, extinct. It was purchased in 1855 from Messrs. Barnum, Bailey, and Hutchinson, and is now mounted in the National Museum. In some details of colouring it differs from the type-specimen figured by Gray, and in this respect comes nearer to one in the Bristol Museum. No. 1502 of the same publication is devoted to an account, by Mr. Lyon, of mammals from Butam Island, Rhio Archipelago, while in No. 1503 Messrs. Eigenmann and Bean discuss a collection of Amazonian fishes.

WE have received a separate copy of a paper by Mr. G. M. Thomson on the marine fish-hatchery and biological station at Portobello, originally published in the Transactions of the New Zealand Institute for 1905. Special attention is, it appears, being directed to the life-history of the more important New Zealand food-fishes, many of which have, unfortunately, usurped names—such as brill, flounder, sole, and lemon-sole—properly pertaining to European species. Some years ago an attempt was made to introduce the European lobster into New Zealand waters, but without success. At the date of writing the author states that arrangements were being made for a fresh consignment of these crustaceans, which it was proposed to introduce into situations better suited to their requirements.

ACCORDING to Fisheries, Ireland, Sci. Invest., 1905, No. 8, 1907 (this, by the way, being the unsatisfactory abbreviation given of an exceedingly cumbrous and inconvenient title), the season 1905-6 was a most successful one as regards the hatching of salmon and trout, the total output being 6,827,750 salmon, 582,000 white trout, and 381,000 brown trout fry, the last estimate being, however, probably far below the actual output. As regards salmon fry the output exceeds the previous record season by about one million, this excellent result being, as usual, mainly due to the hatching stations at Lismore and Blackcastle. Although no record is given (being probably impossible to obtain) as to the percentage of this fry which attains maturity, it seems likely that something has been done to increase this percentage by the greater attention now paid to the proper planting of the fry. Recent observations have shown that both salmon and trout fry require food at an earlier stage (long before the absorption of the yolk-sac) when artificially hatched than when naturally reared, and it appears that hitherto the importance of transferring the alevins into suitable waters so soon as they require adventitious nutriment has not been sufficiently recognised.

THE Bulletin of the Johns Hopkins Hospital for January (xviii., No. 190) contains an interesting article by Mr. A. W. Meyer on some characteristics of the medicine in Shakespeare, with a useful bibliography.

THE Sanitary, Maritime, and Quarantine Council of Egypt has published a volume of scientific reports by the members of its medical staff, and edited by the president, Dr. Ruffer. It includes several valuable papers on cholera vibrios and the diagnosis of cholera, on agglutinins, hæmolytic and hœmosozic sera, nephritis, &c.

THE papers in the *Journal of Anatomy and Physiology* for January (xli., part ii.) are of a technical nature. Among others, Mr. D. E. Derry describes certain predynastic Egyptian tibiæ showing flattening for which it is difficult to account; Prof. Symmers writes on accessory coronary arteries; and Dr. T. Lewis discusses the interpretation of sphygmographic tracings.

A VALUABLE bulletin, compiled by Dr. G. F. White, and entitled "The Bacteria of the Apiary, with Special Reference to Bee Diseases," has been received (technical series, No. 14, U.S. Department of Agriculture, Bureau of Entomology). It summarises the characters of various bacteria which have been isolated, both from normal and from abnormal bees. In America, "foul-brood" appears to be a disease different from the European one, and to be due to a bacillus (*B. larvae*) distinct from the *B. alvei* of Cheshire and Cheyne.

WE have received a reprint of an article by Mr. P. D. Strachan on undulant (Mediterranean) fever in South Africa, showing that this disease is widely distributed in that part of the world. The majority of those who had suffered from the fever used goats' milk, and in several instances the blood and milk of some of the goats agglutinated the *M. melitensis*. The researches of the Mediterranean Fever Commission have shown that in Malta the goats are frequently infected and transmit the microbe in their milk, and Mr. Strachan's investigations in South Africa thus help to strengthen the view that the disease is mainly conveyed to man by the milk of infected goats.

UNDER the title of "Competition in the Production of Raw Silk," Mr. S. Ito has written a valuable treatise on the economics of the silk industry, published as vol. ii., part iv., of the Journal of the Agricultural College, Sapporo, Japan. Commencing with the early records of cultivation in China and its subsequent extension to other countries, the writer proceeds to contrast the conditions

of the industry in China, Japan, and south European countries. Finally, he offers some pertinent remarks as to future production and the directions in which improvements may be effected.

As an instance of a superstition connected with the moon's phases, Mr. E. P. Stebbing refers in the *Indian Forester* (November, 1906) to a popular idea among the natives of India that bamboos should not be felled when the moon is full on account of the increased danger of attack by boring beetles. While, as usual, the argument is unsound, there would appear to be a germ of truth in the superstition, as experiments, inconclusive, it is true, tend to show that the beetles attack bamboos stacked in the shade in preference to those placed in full light; but with regard to the wider question of felling bamboos, there is more reason for believing that this is best performed during months in the cold season when the beetles do not appear on the wing.

THE annual report for 1905–6 of the Agricultural Department, Jamaica, has arrived at a time when the sympathy and assistance of the mother country and many of the colonies is being extended to the inhabitants of that island. After suffering from a severe hurricane in 1903, agricultural industries were again expanding, and the director of the public gardens and plantations in his report records a large increase in the export of bananas, citrus fruits, cocoa, and coffee. Reference is made to trial plots of tobacco at Hope Experiment Station and experiments with cassava, showing that the tubers grown for starch provide a serviceable crop for poor soils. Date-palm suckers and Kafir plum plants, *Harpephyllum caffrum*, are the latest introductions. Dr. H. H. Cousins refers in his report to the investigation of the rum industry as the chief line of chemical work.

THE December (1906) number of the Journal of the Royal Horticultural Society contains an account of chrysanthemum cultivation in Japan, by Mr. N. Hayashi, describing the favourite varieties; the preference of the Japanese for light and artistic flowers is well shown in the types chosen for illustration. Even more characteristic are the various effects that are obtained by careful and pre-considered treatment, such as stopping stem and branches in succession until as many as a thousand flowers are produced on a single plant. The same writer communicates an account of plants grown in Japan for their edible products, in which it is noted that the Japanese cultivate tiger-lily bulbs for food, but grow cherry trees mainly for show. Mr. R. H. Farrer expresses an English opinion on Japanese flowers, and among the list of suggested plants alludes to the beauties of *Rhododendron dilatatum*, *Lithospermum erythroxylon*, *Schizocodon soldanelloides*, and *Iris gracilipes*, but owing to the difference in soil and climate it is doubtful whether these plants can be successfully cultivated in the British Isles.

AT the Ceylon Rubber Exhibition it was suggested by Dr. J. C. Willis that, instead of, as at present, drying the plantation rubber until it only contains about 0·5 per cent. of moisture, it might be advisable to block it in the wet, freshly coagulated condition. Experiments with this object were at once carried out by Mr. Kelway Bamber, the Ceylon Government chemist. He prepared the rubber with creosote (to prevent decay and mould) and blocked it at once, getting blocks containing about 9 per cent. of water. These sold in London for 5*s*. 6*d*. per lb. against 5*s*. 7*d*. to 5*s*. 9*d*. for the ordinary dry Ceylon rubber, thus really getting a much better price. A circular (Circular and Agricultural Journal of the Royal Botanic Gardens, Peradeniya, vol. iv., No. 1) has been lately issued dealing with this matter, and it would seem likely that the old way of making dry biscuits or sheets will soon be extinct.

THE Geological Survey of Queensland has issued an interesting report (Publication No. 201) on Black Ridge, Clermont, by Mr. Lionel C. Ball. The Black Ridge and the country northwards is at present the mainstay of mining in the district. The plateau is covered with basalt, which is underlain by Coal-measures and auriferous deposits, the gold occurring in the lowermost portion of the basal conglomerate of the Coal-measures. It is believed that the gold was brought in by the same percolating waters that carried the cementing material of the conglomerate, and that it was precipitated by hydrogen sulphide. Carbonaceous matter and pyrites do not appear to have been the precipitants. In another Publication (No. 205) Mr. Ball describes the Oaks View gold mines near Rockhampton, and the mines of the Talgai and Thane's Creek goldfields.

THE last issue of the *Central* contains a most interesting article, by Mr. Maurice Solomon, on carbon making, and it is especially valuable from the fact that Mr. Solomon is able, from personal knowledge, to describe the processes employed in the only British carbon manufactory which has ever produced carbons of satisfactory quality. Mr. Solomon gives comparative tables of tests on carbons, and voltage records for the same. The comparisons are based on tests made by the National Physical Laboratory.

THE *Electrical Review* for February 8 contains a description of the radio-telegraph installation for signalling across the Wash which has recently been completed by the Amalgamated Radio-Telegraph Company for the Post Office. The plant is installed at Hunstanton, in Norfolk, and Skegness, in Lincolnshire, in both instances at the coastguard stations, being operated by coastguard officers appointed by the Admiralty. The installation is primarily for coast communication, but will be used by the Post Office for experimental work. The mast is of the special design which is as yet confined to the De Forest system, being composed of rectangular baulks of timber bolted together, and is 120 feet in height. The aërial consists of six 7/20 tinned copper wires, and is so arranged as to be readily lowered or raised. Illustrations are given showing the general view of the radio-telegraph station, and diagrams showing the construction of the mast, aërial connections, sending and receiving circuits are also interesting. The working of the Wash installation commenced on December 1, 1906, and has been most successful, a speed of about thirty-five words per minute having been obtained in the electrolytic receiver and telephone circuit.

IN the January number of the *Journal de Physique* an interesting article on magnetic detectors and the action of electric oscillations is contributed by M. Ch. Maurain. The author comments on the very complex and apparently contradictory results obtained by the recent experiments of various investigators with magnetic detectors. In the first part of his paper M. Maurain shows (*a*) that whenever electric oscillations act on magnetism under given conditions, the result can be foretold; (*b*) on what the result depends. In the second part he deals with magnetic detectors, on which it is possible to note the action of electric oscillations with regard to hysteresis in a revolving field. He refers for his conclusions to a previous article of his in the *Journal de Physique* (June 17, 1906), in which he mentions the works of MM. Gerosa, Finzi, and Mai, and to subsequent experiments made by himself.

In an illustrated article on "Recent Progress in Wireless Telephony," by Prof. Fessenden, in the *Scientific American* of January 19, an account appears of a public demonstration given by the National Electric Signalling Company at its Brant Rock and Plymouth stations, which are approximately eleven miles apart. During the demonstration, not only speech, but also phonographic talking records and music were transmitted, and were all successfully received with perfect clearness and distinctness. No extraneous noises of any kind were heard in the receiver, the wireless telephone being so far an advance on the usual wire lines. The National Electric Signalling Company has for some years past been working on various devices to get rid of the extraneous noises which have until lately attended any system of wireless telephony. In the recent demonstration a specially designed dynamo was used in these tests capable of giving 80,000 alternations per second, but the usual number employed is from 50,000 to 60,000. It is claimed that, as developed at present, the system is capable of maintaining communication between ships 100 to 150 miles apart, and wireless telephone messages are now being printed on their reception at the receiving station. A new telephone relay is said to have been invented for use in connection with the above system of wireless telephony, and a diagram of connections for this for talking between local exchanges is given, but no details of the relay itself are published. We can only hope that a fuller account of these experiments will shortly appear, and that further improvements will follow which, combined with the recent work of Mr. Poulsen and Prof. Slaby, will make wireless telephony of practical value.

Messrs. Kerman, Ltd., have published a translation, by Mr. H. W. Armit, of the fifth German edition of Prof. August Forel's "Hypnotism or Suggestion and Psychotherapy." The book is described in a subtitle as "A Study of the Psychological, Psycho-physiological and Therapeutic Aspects of Hypnotism," and its price is 7*s*. 6*d*. net.

A translation, by Mr. F. Legge, of Dr. Gustave le Bon's "L'Évolution de la Matière" has been published by the Walter Scott Publishing Co., Ltd. The original volume was reviewed at length in our issue of September 21, 1905 (vol. lxxii., No. 1873), and reference may be made to that notice for information as to the subjects dealt with by the author.

Travellers to the East will welcome the new guide-book by Mr. A. G. Plate, which Mr. Edward Stanford has published for the Norddeutscher Lloyd Company, of Bremen, under the title "A Cruise through Eastern Seas, being a Traveller's Guide to the Principal Objects of Interest in the Far East." The volume, with its profusion of illustrations and its interesting text, should soon become popular. Its price is 6*s*.

OUR ASTRONOMICAL COLUMN.

The French Eclipse Expedition.—From a message published in No. 5 (1907) of the *Comptes rendus* we learn that the French eclipse expedition under the direction of M. Milan Štefánik was unsuccessful owing to the fact that the sky was covered with clouds during the whole eclipse. It would thus appear that none of the official expeditions dispatched from Europe for this eclipse obtained any photographs, for, as we noted previously, the German and Russian observers were equally unsuccessful.

The Spectroscopic Binary *o* Leonis.—An interesting discussion of the system of *o* Leonis is published in No. 4151 of the *Astronomische Nachrichten* by Herr W. Zurhellen. The discussion is based on observations made with the spectrograph of the Bonn Observatory during April, 1905, and April, 1906. The results obtained from numerous lines of each of twelve plates measured are given separately, and then discussed as a whole. The apparent semi-axis of the relative path of the two components is found to be 0·15884 of the sun's distance, whilst the masses of the components relative to the sun's mass are 1·358 and 1·185 respectively.

Stars with Variable Radial Velocities.—Lick Observatory Bulletin No. 107 contains a number of radial-velocity results obtained at the Lick Observatory and by the D. O. Mills expedition to the southern hemisphere. The former set includes the discovery of eight spectroscopic binaries, the latter the discovery of four.

The radial velocity of Antares is also discussed in the same bulletin. A comparison of the earlier with the more recent spectrograms of this star afforded a strong indication of variable velocity, which has been confirmed by new observations and the re-measurement of the old plates. A faint superimposed spectrum is indicated on some of the plates, but this is supposed to be due to the telescopic companion of Antares.

The Recent Maximum of Mira.—In the February number of *Knowledge and Scientific News* Mr. P. M. Ryves discusses a number of magnitude observations of Mira made during the rise to maximum brightness which took place in the latter part of 1906. The observational results, obtained on forty-two days between July 30, 1906, and January 10, 1907, showed that the magnitude on the former date was about 9·0, whereas by October 17 it had reached 7·0. A more rapid rise in brightness then set in, so that by December 2 the second magnitude was attained, that is to say, the light was increased about one hundredfold in less than fifty days. For the nineteen days between October 26 and November 14 the rise in brightness was particularly abrupt, the star passing from the sixth to the third magnitude. From Mr. Ryves's results the actual maximum appears to have taken place about December 10, 1906 (J.D. 2417555), when the recorded magnitude, on the Harvard scale, was 1·85.

The United States Naval Observatory.—The report of the superintendent of the U.S. Naval Observatory, for the year ending June 30, 1906, follows the usual lines of its predecessors. Rear-Admiral Asa Walker succeeded Rear-Admiral Chester as director in March, 1906. In many departments the ordinary routine work was greatly hindered by the preparations for the eclipse of August, 1905, and the absence of a number of the observers with the eclipse expedition. The final plans for a self-registering right-ascension micrometer, for use with the 6-inch transit circle, have been adopted, and the instrument is being made. Solar photographs were obtained on 168 days, and showed spots and faculæ on all but two days. With the meridian and equatorial instruments, observations of the normal character were made, and the usual chronometer and time services were well maintained.

Sun-spots in 1905.—The results of the Greenwich measures of sun-spots for the year 1905 appear in No. 3, vol. lxvii., of the Monthly Notices (R.A.S.). The increase in spotted area during the year, as compared with 1904, was 144 per cent.; the mean daily area, 1191, was greater than that of 1883, but less than the corresponding areas for 1892, 1893, and 1894. The increase in area of the faculæ was about 48 per cent. The mean latitude of the spots during the year, about 13°, points to 1905 as being the year of maximum in the present spot-cycle, although the continued preponderance of the spotted area in the northern hemisphere corresponds with the condition obtaining some two years before maximum in the two preceding cycles. The outstanding feature of the year 1905 was the great number of abnormally large spots, one spot seen from January 29 to February 11 exceeding in area any other spot as yet measured at Greenwich.

No. xcvii. of the *Astronomische Mitteilungen* contains Dr. Wolfer's annual summary, for 1905, of sun-spot frequency and heliographic distribution, with which he compares the results obtained from the measures of magnetic declination.

ITALIAN VOLCANIC ROCKS.[1]

ALTHOUGH the Tertiary and Recent volcanic tract along the western side of the Apennines is classic ground to the geologist no less than to the historian, we still possess only meagre information concerning the many remarkable, and often unique, rock-types for which these Italian volcanoes have long been famous. A comprehensive and connected study of a large part of the assemblage by a well-qualified authority is therefore peculiarly welcome. Dr. Washington has devoted much attention to the subject, both before and since the publication, ten years ago, of his "Italian Petrological Sketches."

"Comagmatic region" is synonymous with "petrographical province," and the author's reasons do not convince us of the necessity of abandoning a now familiar term. The Roman region is defined as extending from Lake Bolsena to the Phlegræan Fields; and probably few petrologists will dissent from the proposition that the community of characters among the volcanic rocks of this region points to a real genetic relationship of the several

Sketch Map of Italian Comagmatic Regions.

Roman Region. V = Vulsinian District; Ci = Ciminian District; S = Sabatinian District; L = Latian District; H = Hernican District; A = Auruncan District; Ca = Campanian District; Ve = Vesbian Volcano; P = Phlegræan Fields; 1 = Ischia; 2 = Campiglia; 3 = Massa Marittima; 4 = Roccastrada; 5 = Monte Amiata; 6 = Tolfa; 7 = Cerveteri; Tuscan Region. Venetian Region. Apulian Region. B = Berican Hills; E = Euganean Hills; Vu = Monte Vulture; Et = Etna

magmas. The author separates, though somewhat doubtfully, the smaller "Tuscan region," lying farther to the north and west, which we hope will be the subject of a future memoir. It can scarcely be denied, however, that a certain community of characters unites all the Italian volcanic districts on this side of the Apennines (with Monte Vulture in the mountain-belt itself), the resemblance being emphasised by contrast with the rocks of the Euganean Hills on the opposite side of the main orographic line.

The body of the memoir before us consists of two parts. The first is purely descriptive, the several rock-types being treated in order, succinctly but thoroughly. The special features of this part are the quantitative element constantly introduced into the mineralogical descriptions, and the addition of a large number of new and carefully-made chemical analyses of the lavas. The peculiarity which has made the region famous in petrography is the abundance and variety of leucite-bearing rocks. The non-leucitic types are for the most part of trachytic affinities, though with a proportion of soda-lime-felspar which caused the author (in his former papers) to distinguish them under the names vulsinite and ciminite.

The second part of the memoir, discussing the mutual relations of the associated rocks, is headed "Petrology" (the first part being "Petrography"). It would seem more convenient to use the name petrology for the whole science of rocks, including the descriptive branch (petrography) and the rational. The author gives an interesting discussion of the facts which he has brought together, and touches on the genetic problems which underlie those facts. In particular, he attempts a calculation of the average composition of the magmas for the several districts and for the whole region. In the central part of the region all the lavas carry leucite, basic leucite-tephrites and leucitites being largely predominant; while at the two extremities of the region the trachytic types are in greater force. No definite order of succession in time can be made out.

While taking care to make his work intelligible to the ordinary petrologist, Dr. Washington employs throughout the methods and terminology of the Quantitative Classification, of which he is joint author. The memoir thus written does, as he claims, serve to make that system clearer by showing it in actual operation, and this is an incidental gain; but, although it is here seen at its best, as applied to a cognate collection of types, most of which possess strongly marked characteristics, we do not find our fundamental objections to the new classification weakened by a closer acquaintance with it. If a rigidly quantitative, and therefore artificial, classification be desirable, which we do not concede, it might be sought in the actual mineral composition of the rock (here estimated in most cases) rather than in the imaginary composition which is called the "norm." In reading the descriptions and discussions, it needs no very perverse fancy to construe many sentences as censuring Nature for departing from the "norm," or commending her for approximately conforming to it; and this air of artificiality must somewhat discount the usefulness of what is undoubtedly a very valuable monograph.

A. H.

[1] "The Roman Comagmatic Region." By Henry S. Washington. Pp. vi+199. (Washington: Carnegie Institution, 1906.)

INVERSION TEMPERATURES FOR AIR AND NITROGEN.

THE Bulletin of the Cracow Academy of Sciences for December, 1906, contains a preliminary note, by Prof. K. Olszewski, on the determination of the temperature of inversion of the Joule-Kelvin effect for air and for nitrogen when subjected to different pressures. The apparatus used was similar in principle to that adopted in 1901 in determining the inversion temperature for hydrogen, but details had to be modified owing to the necessity of working at much higher temperatures. The table which follows shows the inversion temperature of the gas when allowed to expand from the initial pressure p (expressed in kilograms per square centimetre) to the pressure of the atmosphere. Above the temperature t_i a thermo-element showed a heating effect on expansion, whilst below this temperature a cooling effect was observed.

Air		Nitrogen	
p	t_i	p	t_i
	°		°
160	+259	159	+243
100	249	126	238
90	244	102	233
80	240	90	228
70	235	80	223
60	226	68	217
40	198	55	205
20	124	30	163

It is seen that the inversion temperature is a continuous function of the pressure, confirming the recent theoretical views of Witkowski and Porter. The value of the in-

version temperature for air, however, calculated by Witkowski from the empirical formula of Rose-Innes, was +360°, whilst the van der Waals formula was found to require an inversion temperature of +500°; in the latter case, however, the calculation is based on the assumption of a small difference of pressure (1 atmosphere) accompanying the expansion, whilst the experimental values refer to expansion over a wide range of pressure. The shape of the curve for air connecting the inversion temperature with the initial pressure at which expansion occurs shows that below 80 atmospheres a rapid fall of the inversion temperature occurs as the pressure is diminished. Very little cooling effect is therefore to be anticipated with air allowed to expand from pressures below 80 atmospheres; such, indeed, is actually observed to be the case, liquefaction only taking place readily in the apparatus described by Prof. Olszewski in 1902, so long as the initial pressure does not fall below this limit.

STUDENTS IN GERMAN UNIVERSITIES.

ACCORDING to the *Chemiker Zeitung*, the total number of matriculated students in attendance at the German universities during the present winter semester is 45,136, as against 44,942 last summer, and 42,390 in the preceding winter; five years ago the attendance was 35,518, ten years ago 30,043, twenty years ago 27,080, and thirty years ago, that is, in the winter 1876–7, it was only 17,457, upon which total the present number shows an increase of 27,679, or 159 per cent. It is of more than passing interest to compare the number of students at the different universities to-day with those of thirty years ago :—

	1906–1907	1876–1877		1906–1907	1876–1877
Berlin	8188	2490	Tübingen	1522	903
Munich	5567	1280	Marburg	1503	382
Leipzig	4466	3026	Würzburg	1407	1028
Bonn	2992	793	Jena	1275	439
Halle	2250	854	Königsburg	1140	621
Breslau	1961	1219	Giessen	1097	318
Göttingen	1831	991	Erlangen	1056	474
Freiburg	1744	293	Kiel	877	219
Strassburg	1652	707	Greifswald	827	468
Heidelberg	1603	473	Rostock	645	156
Münster	1533	313			

The distribution of these students in the various branches of academic study is as follows :—

	1906–1907	1876–1877
Law students	12215	4835
Art students	10873	3874
Medical students	7035	3374
Mathematical and science students	6116	2009
Evangelical theology	2208	1518
Pharmaceutical students	1865	680
Catholic theology	1708	1164
Students of economic sciences and forestry	1235	155
Agricultural science	985	369
Dentistry	870	8
Veterinary Science (only matriculated at Giessen)	110	0

Against these numbers it is to be remarked that the large number of applied and pure science students attending the Technische Hochschulen is not included here, while the number of arts students is too high by nearly 1000, owing to the modern custom in the Prussian universities' returns of including among such students those whom they place under the tabulation heading "Sonstige Studienfächer der philosophischen Facultät."

Out of a total number of 45,136 students in attendance at German universities during the present winter half-year, 4151, or 9·2 per cent., are described as foreigners, against 8·6, 8·4, and 7·5 per cent. in the preceding half-years. The absolute increase of 596 on the number for the corresponding semester of last year (namely, 3555) is almost exclusively due to an increase in the number of Russian students, who have increased from 1326 to 1890 in one year. Of the 3717 students belonging to European countries, 681 are from Austria, 341 from Switzerland, 144 from England, 139 from Bulgaria, 83 from Roumania, 61 from Servia, 58 from France, 57 from Holland, 53 from Luxemburg, 47 from Greece, 40 from Turkey, 33 from Italy, 32 from Scandinavia, 23 from Spain, 19 from Belgium, 9 from Portugal, and 5 from Denmark. From America, mainly from the United States, are 302; from Asia, chiefly Japanese, 113; from Africa, 13; and from Australia 6. The distribution of this foreign element at the universities is as follows :—

University	Foreign students: Number	Foreign students: Per cent.	University	Foreign students: Number	Foreign students: Per cent.
Berlin	1189	14·5	Giessen	84	7·6
Leipzig	662	14·8	Breslau	77	3·9
Münich	496	8·8	Würzburg	67	4·7
Heidelberg	259	16·1	Marburg	60	4·9
Halle	254	11·3	Tübingen	59	3·9
Jena	186	14·6	Greifswald	43	5·2
Göttingen	169	9·2	Erlangen	28	2·6
Freiburg	164	9·4	Rostock	13	2·0
Königsberg	134	11·7	Kiel	12	1·4
Strassburg	96	5·8	Munster	11	0·7
Bonn	88	2·9			

These foreign students are taking as their chief studies :—evangelical theology, 185; Catholic theology, 34; law, 580; medicine, 1080; philosophy, languages, or history, 951; mathematics and science, 714; agricultural sciences, forestry, &c., 573; dentistry, 24.

STANDARD ELECTRIC GLOW LAMPS.

THE report of the Engineering Standards Committee on the British standard specification for carbon filament glow lamps, which has recently been issued, is of great interest, more especially as it has been published at a time when so many important papers and discussions on carbon and metallic filament lamps are occupying the attention of men of science and engineers. The specification gives at the beginning a list of standards and definitions, and goes on to state what the committee has decided as to the tests a standard lamp shall comply with. A lamp of 12 candle-power is suggested in addition to the usual 8, 16, 25, and 32, and this should prove a very useful size; although it has already been used, it has not been kept as a stock lamp usually. The standard lamps are to be divided into two classes, having a useful life of 400 and 800 hours respectively, and all lamps purporting to be British standard lamps are to be marked with the trade mark or name of manufacturer, the standard mean horizontal candle-power, the voltage, and a reference letter in a circle, which is to show which class—whether 400 or 800 hours—the lamp is intended for. This reference letter is, we think, a mistake, as the ordinary consumer will not know to what it refers, and we do not see the objection to marking plainly on the lamp the useful life hours. The insulation resistance between cap and filament seems to us to be rather high (1000 megohms). The limits for mean horizontal candle-power and total watts, on the other hand, allow plenty of margin, but doubtless these will be reduced after the standards have come into force, which we understand they will do in July next. At present, however, we do not see that the ordinary consumer will benefit very greatly by the specification when it does come into force, for, as we pointed out a few months back, unless the borough councils or local authorities erect special testing laboratories where tests on lamps can be carried out by an expert for a very small fee, or even free of cost, the ordinary consumer will be in practically the same position as he is at present. Of course, the fact of his being able to ask for a standard lamp may tend to make the article sold him slightly better, and with truer candle-power and consumption figures marked on; still, we are afraid that, from the consumer's point of view, until he can get his lamps tested locally, not very much improvement will be seen. The report is, however, of very great interest to those connected with that branch of the electrical profession, and is certainly a long step in the right direction.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE Government of the French Republic has, by a decree of the Minister of Public Instruction and Fine Arts, conferred upon Prof. J. Wertheimer, the principal of the Merchant Venturers' Technical College, Bristol, the order of Officier d'Académie.

DR. DONALD MACALISTER, fellow and director of medical studies of St. John's College, Cambridge, Linacre lecturer of physic, and president of the General Medical Council, has been appointed principal of the University of Glasgow in succession to the late Principal Story.

M. LIARD, Vice-Rector of the University of Paris, has informed the Paris Municipal Council that it is the intention of the University of London to return the visit made to it last year by the Paris University. The representatives of the University of London are to arrive in Paris in the middle of May, and a luncheon will be given at the Hôtel de Ville to the members of both universities.

MR. F. DARWIN has been nominated to represent the University of Cambridge at the celebration of the two-hundredth anniversary of the birth of Linnæus, to be held at Upsala in May. Dr. Hill, Dr. A. Caldecott, and Mr. D. H. S. Cranage have been nominated to represent the University at a federal conference on education, convened by the federal council of the League of the Empire, to be held in London on May 24 to June 1.

IT would be difficult to find a more useful book for parents selecting a school for their sons than the "Public School Year-book" (Swan Sonnenschein and Co., Ltd., price 3*s*. 6*d*. net), the eighteenth issue of which has just appeared. Full particulars of all the schools represented at the headmasters' conference are given, and these are supplemented by much useful information about preparatory schools, the entrance to the professions, public examinations, and kindred subjects.

WE have received from Washington copies of the reports of the librarian of Congress and of the superintendent of the library building and grounds for the fiscal year ending June 30, 1906. The amount expended on the library during 1906, exclusive of sums spent on printing and binding, reached 117,500*l*. During the same year the net accessions to the library were nearly 35,000. The librarian's report gives interesting particulars of numerous bequests and gifts to the library and information concerning the complete system of cataloguing which has been elaborated. The second report deals with such matters as the cost of care and maintenance.

HIGHER education in the United States continues to benefit by the generosity of public-spirited American men of wealth. We learn from *Science* that an announcement has been made that Mr. J. D. Rockefeller will endow the University of Chicago with 600,000*l*. to maintain a pension fund, the institution having been excluded from the scope of the Carnegie foundation, owing to its denominational control. It is also reported that Mr. Rockefeller has agreed to give 400,000*l*. for the endowment of a university for Louisville, provided a similar amount is raised by those interested in the new institution. The chair of chemistry at the University of Pennsylvania has been anonymously endowed by a gift of 20,000*l*. Mr. S. W. Bowne has given to Syracuse University a chemical laboratory, costing 20,000*l*. Finally, the packing interests of Chicago have offered to the University of Illinois the sum of 50,000*l*. with which to establish in that city a veterinary college.

MR. J. D. ROCKEFELLER has given the General Education Board, which is designed to help educational institutions, 6,400,000*l*. for the purpose of assisting the work of the Board throughout the country. Referring to this announcement, the New York correspondent of the *Times* remarks that the donation is believed to be the largest single sum ever given for a philanthropic purpose. So far as is known, Mr. Rockefeller has up to the present made donations for educational purposes amounting to a total of 18,000,000*l*., and he is believed to have given anonymously 6,000,000*l*. more. The General Education Board will now be in a position to aid educational institutions all over the United States. No State universities share in its gifts, and in every case the Board endeavours to encourage institutions which may eventually come to be self-supporting rather than those dependent on charity for their maintenance.

THE report of the higher education subcommittee of the London County Council, which was adopted at a recent meeting of the Council, recommends that certain grants be made to the governors of fifty secondary schools. The total amount available out of the current estimates is 120,000*l*. It is estimated that 11,945*l*. will be required in respect of the building grants voted in March, 1906. The proposals amount to 74,825*l*., of which 2355*l*. is for equipment. Last year the corresponding figures were 66,745*l*., of which 3895*l*. was for equipment. This represents a gross increase of 8080*l*., of which about 6000*l*. may be taken as the cost of the education of the increased number of the Council's scholars. To make the comparison accurate, however, this sum should be increased by 1789*l*., the amount of the grants paid last year, which for different reasons are not included in this year's list. The net increase in aid, apart from the cost of the Council's scholars, is therefore under 4000*l*.

DR. M. W. TRAVERS, F.R.S., who is at present making a tour in India in connection with the Tata Research Institute, of which he is the first director, has, the *Pioneer Mail* reports, expressed disappointment at the standard required for degrees in science at Indian universities. In chemistry the courses are defective, Dr. Travers finds; few of the universities introduce quantitative practical courses, and the theoretical courses are hardly up to the intermediate standard of English universities. The lack of suitable students among bachelors of science will be a drawback to research in the Tata Institute, and may lead to a difficult situation. Indian universities have hitherto confined their research courses to masters of arts or science who have received two years' special training after graduating. The total number of research students in all the Indian universities is probably considerably less than twenty. It is consequently feared that there may be a difficulty in supplying the Tata Institute with properly qualified students.

THE report of the Departmental Committee on Education Rates, appointed in October, 1905, has been published as a Blue-book (Cd. 3313). An important section of the report deals with expenditure on higher education—in this connection an elastic term including all forms of instruction other than elementary. A summary, relating to the rates required in 1905–6 by county and county borough councils for the purposes of higher education, shows that the councils of nineteen counties raised no rates for higher education at all, and that seven county borough councils had the same unenviable notoriety. Of the forty-three counties levying such a rate, sixteen required something under 1*d*. in the pound, nineteen under 2*d*., seven (including the London County Council) less than 3*d*., and one between 3*d*. and 4*d*. Of sixty-five councils of county boroughs, one (West Ham) required more than 5*d*. in the pound, three more than 4*d*. but less than 5*d*., nine more than 3*d*. but less than 4*d*., six more than 2*d*. but less than 3*d*., thirty-four more than 1*d*. but less than 2*d*., and twelve less than 1*d*. The sum of 2,477,327*l*. was devoted in 1904–5 to higher education of the kind explained, and of this amount 31·5 per cent. was raised by rates, 20·6 per cent. was received from the Board of Education, and 38·1 per cent. was allocated from Exchequer contributions. The report states, as, indeed, is much to be hoped, that the expenditure of local authorities in respect of higher education may be expected to continue to increase in amount. Altogether, the Blue-book provides an abundance of useful information.

THE fourteenth annual general meeting of the Association of Technical Institutions was held on February 8 and 9 in London. The meeting was preceded by a luncheon given to the members of the association by the Cloth-workers' Company. Sir Horace Plunkett, the president for 1907, delivered an address, during which he said that among the many admitted defects of our educational system there is one most hopeful sign—the evening technical institutes, of which we may be justly proud. It is true

that their very success emphasises the defectiveness of the present condition of things in regard to higher technical training. This condition is due to the difficulty of securing attendance at day courses in our many excellent institutions. There has been some improvement in this respect, but the number of students taking systematic higher courses is lamentably small. Sir Horace Plunkett is convinced that the tendency to bring the instruction in the evening technical institutes into the closest relationship with industrial requirements will go far to secure what is admittedly one of the most important desiderata to-day—the cooperation of employers and workers. It must be frankly recognised that the *raison d'être* of the evening technical school is industrial efficiency, that the apprenticeship system under modern industrial conditions must fail to educate the young worker effectively, and that the evening technical school must now undertake some of the teaching previously conferred in the workshop. The great usefulness of American technical institutions is due in a large measure to the individual interest taken in the students, not only during their attendance at the school, but during their subsequent career. The following papers were read and discussed:—The cooperation of adjacent authorities in the supply of higher technical education, by Principal A. F. Hogg, of West Ham, and monotechnic institutions, by Mr. Charles Harrap, of the St. Bride Foundation Institute, London.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 1, 1906.—"The Nitrification of Sewage." By Dr. G. **Reid.** Communicated by Prof. Gotch, F.R.S.

The author gives an account of certain observations he recently made which point to the conclusion that by using fine-grain filter particles the depth of percolating filters may be greatly reduced. A filter composed of ⅛-inch medium, which had been in constant use for three years, was tapped at four depths in such a way that samples could be collected to show the degree of purification effected at 1-foot intervals downwards, and the conclusions arrived at are based upon the analysis of numerous samples collected during a period of about twelve months, the delivery to the filter being constant throughout and at a rate of 200 gallons per superficial yard. As regards the organic matter, both in suspension and solution in the septic tank effluent applied to the filter, the author found that the work of purification was effected at a depth of 1 foot from the surface, leaving very little work for the deeper layers to accomplish.

The following are the means of the more important figures of analyses:—

—	Parts per 100,000				
	Septic Tank	1 ft.	2 ft.	3 ft.	4 ft.
Solids in Suspension	7·60	0·25	0·09	0·14	0·00
Free Ammonia ...	1·716	0·036	0·020	0·009	0·043
Albuminoid Ammonia	0·340	0·052	0·037	0·031	0·027
Oxygen absorbed in 4 hours at 80° F. ...	2·184	0·328	0·286	0·244	0·259
Nitrous Nitrogen ...	0·000	0·003	0·007	0·008	0·002
Nitric Nitrogen ...	0·00	2·07	1·99	1·85	1·99

As regards the carbonaceous matter, the oxidation appeared to be equally rapid, for not only did the reduction in oxygen absorbed reach practically its maximum at 1 foot depth, but the air collected from the filter at different depths gave the following amounts of CO_2 per 1000:—1 foot, 19·5; 2 feet, 21·5; 3 feet, 20·0; 4 feet, 20·0. As regards the suspended organic solids, they are practically all retained within the first foot, where liquefaction is effected (it is suggested by aërobic organisms). In confirmation of this, the following mean figures of percentage loss on ignition of filter particles taken from different depths are given:—6 inches, 3·25; 1 foot, 0·99; 2 feet, 0·65; 3 feet, 0·53; 4 feet, 0·53.

As regards the remarkable increase in the free ammonia in the samples from the lowest tray, it is suggested that the circumstance may be accounted for by a revival of anaërobic changes, the result of the asphyxiating effect of the products of combustion produced above.

Anthropological Institute, January 22.—Annual General meeting.—Prof. W. Gowland, president, in the chair.—Address on the dolmens and burial mounds of the early emperors of Japan: the **President.** It is extremely probable that the Japanese obtained the idea of raising mounds from the Chinese, the earliest burial mound in China dating from 1848 B.C. Little is known about the earliest Japanese mounds, but the later ones are always more or less large, and invariably contain either a sarcophagus or dolmen. There is an extremely large number of these mounds in Japan, and Prof. Gowland himself examined 406. It is of interest to note that the dolmens are always near the coast or in the basins of the larger rivers, which points to the fact that at the time of their erection the Japanese only occupied these districts, the other parts of the country being inhabited by the primitive aborigines—the Ainu. The distribution of the early Imperial mounds is also of importance historically. They are found in four districts, which goes to prove that at an early date the country had no central Government, but that there were at least four independent tribes, each occupying one of the districts where the large Imperial mounds are found. The date of these mounds is between the second century B.C. and the fifth or sixth of our era. As to the mounds themselves, the Imperial ones are double, with a conical peak at one end. They are all of very great size, and are terraced and moated. In plan they are seen to be a combination of the square and circular varieties, but whether this has any significance is not known. One interesting feature is that round each terrace a series of terra-cotta tubes—"Haniwa"—about 18 inches high and 15 inches broad, are set in rows. They may have been placed there for structural reasons, or they may represent the wives, attendants, &c., who formerly were buried with the emperor. This practice was discontinued in 2 B.C., and by an Imperial decree terra-cotta figures were substituted for the human victims. Many of these figures have been found, and in some cases they terminate in a "Haniwa." The largest of the Imperial mounds are in the central provinces; the largest of all is 2000 feet long, and covers approximately an area of eighty-four acres. The interment is always in the conical peak of the circular part of the mounds. They are, as a rule, entirely artificial, but occasionally a natural eminence has been turned to account.

Physical Society, January 25.—Prof. J. Perry, F.R.S., president, in the chair.—The strength and behaviour of brittle materials under combined stress: W. A. **Scoble.** The results described in the paper are a continuation of a series obtained from tests on a ductile material. The bars were of cast iron, ¾-inch diameter, 30 inches between the bending supports, subjected to bending and twisting to fracture. The maximum principal stress and the maximum shear, calculated on the assumption that there was no yield, each varied about 40 per cent. Plotting the corresponding bending and twisting moments, the points lie on an ellipse, the twisting moment being about 3000 lb. inches, and the bending moment 2200 lb. inches at fracture. In all cases, except that of simple bending, the fracture was a spiral, completed by a part making a small angle with the axis and invariably coming under the knife-edge.—Recent improvements in spectrophotometers: F. **Twyman.** The paper deals with a form of Hüfner spectrophotometer designed in 1904, and consists of two parts:—(A) The evaluation of the errors due to the polarisation produced by the dispersion-prism and by the Hüfner rhomb which brings about the accurate juxtaposition of the two beams of light the intensities of which are to be compared; and the method by which in the recently constructed instruments it is arranged for these effects to neutralise one another. (B) The use of the instrument as a spectropolarimeter by placing in the space between the dispersion-prism and the second Nicol the media the optical rotations of which it is required to measure.

Challenger Society, January 30.—Mr. E. W. L. Holt in the chair.—Fishes captured by the Marine Biological Association's fishery steamer *Huxley* in November, 1906, at the channel entrance from the Bay of Biscay: L. W. **Byrne.** The collection was chiefly interesting as providing records of species already known from deeper water, *e.g. Synaphobranchus pinnatus*, and *Scopelus glacialis*, *S. punctatus*, and *S. crocodilus*. Attention was also directed to specimens of the little-known *Onos biscayensis* and the recently described *Pteridium alleni*.—The Decapoda collected by H.M.S. *Research* in the Bay of Biscay, 1900: S. W. **Kemp.** The chief interest of this collection was in a fine series of *Acanthephyra purpurea*, which ranged from the length of 4·3 mm. up to an adult of 81 mm. Unlike *A. debilis*, in which Contière has shown that the larva is hatched with peræopods, uropods, and pleopods fully formed, this closely allied species leaves the egg as a Zoœa. The series of larvæ was fully described and figured, and shows a remarkable reduction at a certain stage of the cornea and rostrum, followed by their subsequent growth. Other interesting captures were *Sergestes arcticus*, *Gennadas parvus*, and *Acanthephyra debilis*. The author also described and figured an unknown larva allied to Caricyphus of Spence Bate.

Society of Chemical Industry (London Section), February 4.—Mr. R. J. Friswell in the chair.—Chemical composition of some motor-tyre rubbers: Dr. P. **Schidrowitz** and F. **Kaye.** The authors conclude (1) that in many cases tyre trouble is directly referable to chemical defects (such as over or under curing, unsuitability of the quality of the rubber, excess of mineral matter, &c.) of the rubber mixings; (2) that manufacturers are by no means agreed as to nature and quantity of the various ingredients and conditions of manufacture to be employed; (3) that it is apparent from the widely divergent results obtained in some cases with tyres of the same size and make that the process of manufacture is not always conducted on sound scientific lines, but, on the other hand, they point out that some of the results of their investigations indicate that even and constant quality may be obtained by adequate supervision of manufacture.—Composition of some new crude rubbers: Dr. P. **Schidrowitz** and F. **Kaye.** The authors give the results of examination of rubbers from the newer sources of supply, such as Ceylon, Uganda and Malaya, and also of a sample of *Castilloa elastica* from Mexico. The results of experiments on a series of Ceylon biscuit rubbers distinctly support the view that it is a mistake to turn out rubber in thin biscuit form, and the authors make some observations on the apparent nature of the changes produced in rubbers prepared in this manner. They also describe a modification of the Ditmar method of analysis of crude rubbers which they have devised, and give some preliminary figures referring to the nature of the proteids, resins, and mineral matters in some of the rubbers examined.—Sources of carbon dioxide in the determination of nitrogen in organic compounds by the absolute method: C. **Young** and B. **Caulwell.** The authors described a modification of Theile's apparatus (*Annalen*, 1889, 253, 242) for the evolution of carbonic acid in an external generator. The design of the mercury trap and safety tube are novel. The carbon dioxide produced is claimed not to contain 0·1 c.c. of air per 5 litres.

PARIS.

Academy of Sciences, February 4.—M. A. Chauveau in the chair.—The secretary announced to the academy the death of Prof. Mendeléeff.—Researches on the solar atmosphere. Vapours with dark lines and clusters of particles: H. **Deslandres** and L. **d'Azambuja.** A detailed account of the work done at the Observatory of Meudon during 1906 with various forms of apparatus.—Autopsy of the African elephant "Sahib," which died on January 29 at the Museum: Edmond **Perrier.**—Determinism of the superiority of the energy expenditure due to the assimilation of albumenoid foods: A. **Chauveau.** The author's experiments are described in detail. Of the numerous conclusions drawn from these results, the most important is that it is necessary to give up the use of the heat of combustion as a guide in the theory of food.—A new contribution to the study of trypanosomiasis of the Upper Niger: A. **Laveran.** A study of a new species closely allied to *Trypanosoma dimorphon*, arising from the blood of an infected sheep. A close comparison of *T. dimorphon* with the new organism shows that the two are not identical, and the name *T. pecaudi* is proposed for the new species.—The relation between falls of barometric pressure and the evolution of fire-damp in mines: G. **Bigourdan.** A comparison of the times of the colliery explosions in the Lens and Saarbruck basins on January 28 with the heights of the barometer shows that here, as in other cases, the explosions occurred at the time of a rapid fall of the barometer following a long period during which the readings of the barometer had been high.—Prince Roland Bonaparte was elected a member in the place of the late Raphael Bischoffsheim.—Some new variable stars with very rapid variations in light intensity: Jules **Baillaud.** In the photography of the chart of the sky the negative receives small successive displacements at intervals of thirty minutes, so that each star is represented by three contiguous images. These images will be similar if the condition of the sky has not changed, different if it has varied, but in the latter case all the images will be affected similarly. In some of the photographs obtained at Paris during 1906 several of these triple images vary considerably in the intensity of the images, and two at least of these cases appear to be due to very rapid variations in the brightness of the star. In one instance the three images are respectively of magnitudes 14·5, 13, and 12·7. Of the forty plates examined this year by MM. A. Boinot and J. Baillaud, containing more than 50,000 stars, only three other stars have been found exhibiting this peculiarity, and two of these are due to a grain of dust on the plate.—The quadrature of curved surfaces: Zoard **de Geöcze.**—The comparative study of helices and aëroplanes: P. **Tsoucalas** and J. **Vlahavas.**—The refraction of compound gases: Jules **Amar.** The author examines the proposition that the refraction of a compound gas is the sum of the refractions of the atoms which enter into the molecule, and shows that this proposition holds within the range of experimental error.—The resonance phenomena in the case of transformers with open magnetic circuit, and their utility in the production of strong electric sparks: G. A. **Hemsalech** and C. **Tissot.** Resonance effects are generally avoided in alternating-current circuits on account of the harmful results on the insulation; but there are certain cases in which there is a considerable advantage in establishing resonance, and one of these is the production of powerful electric sparks. An account is given of the construction of a coil in which this resonance effect is utilised. A transformer of the type described is useful, not only in spectroscopy, but also in wireless telegraphy.—Experimental researches on dielectric solids: Louis **Malclès.**—An attempt at a theory of phosphorescence and fluorescence: J. **de Kowalski.** A development of some views of Prof. J. J. Thomson on the production of light under the influence of electric discharges. The theory is in general agreement, both qualitatively and quantitatively, with experiment.—The molecular weights of various gases calculated by the method of critical densities: Daniel **Berthelot.** Regarding the correction for the compressibility of a gas, the author points out that it is not a matter of indifference which formula is used for the variation of pv. This expression has been taken as a linear function of the density or of the pressure; the former is correct. The atomic weight of chlorine, deduced from the density of hydrochloric acid, falls between 35·454 and 35·478; that of sulphur, from sulphur dioxide, between 32·050 and 32·064.—The ethyl ether oxide of $\alpha\alpha$-dichloro*iso*propyl alcohol and on dibromoacetic aldehyde: P. **Freundler.** A preliminary notice indicating the line of work on which the author is engaged.—Some reactions of sodium amide: Louis **Meunier** and E. **Desparmet.** Sodium amide reacts with ethylene bromide, the products being acetylene, ammonia, and sodium bromide. With chloroform, the reaction starts with difficulty, but once started becomes explosive, ammonia, together with a mixture of sodium chloride and cyanide, resulting. The application of sodium amide to the preparation of diphenylbenzylamine, sodium diazo-

amidobenzene, and the sodium derivative of ethyl malonate is described.—The composition of the plant juices extracted from stems and leaves: G. **André.**—The chemical composition of the Koch bacillus and its binding material. Relation with resistance to acids: Jules **Auclair** and Louis **Paris.** The fatty matters were extracted by successive treatments with alcohol, ether, and chloroform, petroleum ether alone being incapable of extracting the whole of these substances. These fatty matters, the protoplasm, and cellulose all give the Ehrlich reaction.—Autopsy of the African elephant "Sahib," which died at the Museum on January 29: Mme. Marie **Phisalix.** The death resulted from an accidental chill, leading to inflammation of the lungs, there being no sign of any chronic disease.—A new view of the Blastodinideæ (*Apodinium mycetoides*): Edouard **Chatton.**—The chain of the Puys and the lesser Puys: Ph. **Glangeaud.**—Note on the Palæozoic strata of the eastern edge of the Central Plateau: Albert **Michel-Lévy.**—The direction of the earlier folds in the central and eastern Pyrenees: Léon **Bertrand.**—The age of the Eocene deposits of the Armorican massif and of the Ronca zone: Jean **Boussac.**

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), part v. for 1906, contains the following memoirs communicated to the society:—

July 28.—Questions of crystal-physics, ii., the action of a magnetic field on the optical behaviour of pleochroitic crystals: W. **Voigt.**

October 27.—Real and apparent "transgredient stratification": A. **von Koenen.**—Measurements of the ionisation and radio-activity of the air over the open sea (Atlantic and Pacific): F. **Linke.**—Meteorological kite observations in Samoa: F. **Linke.**—Eulerian integrals: J. **Thomae.**

December 8.—The behaviour of sulphides of the heavy metals in aqueous solution: Oskar **Weigel.**

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 14.

ROYAL SOCIETY, at 4.30.—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.—Investigation of the Law of Burning of Modified Cordite: Major J. H. Mansell, R.A.—The Thermomagnetic Analysis of Meteoric and Artificial Nickel-Iron Alloys: S. W. J. Smith.

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

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.

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.

MONDAY, FEBRUARY 18.

VICTORIA INSTITUTE, at 4.30.—The Spread of the European Fauna: Prof. J. Logan Lobley.

TUESDAY, FEBRUARY 19.

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

ROYAL STATISTICAL SOCIETY, at 5.

ZOOLOGICAL SOCIETY, at 8.30.

FARADAY SOCIETY, at 8.—The Present Position and Future Prospects of the Electrolytic Alkali and Bleach Industry: J. B. C. Kershaw.

INSTITUTION OF CIVIL ENGINEERS, at 8.—(*Continued discussion*) Modern Motor-vehicles: Col. R. E. B. Crompton, C.B.

WEDNESDAY, FEBRUARY 20.

SOCIETY OF ARTS, at 8.—Cold Storage and Food Supply: Hal Williams.

ROYAL MICROSCOPICAL SOCIETY, at 8.—An Early Criticism of the Abbe Theory: J. W. Gordon.—Some Tardigrada of the Sikkim Himalaya: James Murray.—On Some Rhizopods from the Sikkim Himalaya: Dr. Eugène Penard.—*Exhibition:* Slides of Marine Zoological Objects lent by Mr. Flatters.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Report on the Phenological Observations for 1906: E. Mawley.—The Metric System in Meteorology: R. Inwards.

THURSDAY, FEBRUARY 21.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* The Estimation of Chloroform in the Blood of Anæsthetised Animals: G. A. Buckmaster and J. A. Gardner.—On Electrical Seed-Testing: Prof. T. Johnson.—On Longitudinal Symmetry in Phanerogamia: Prof. Percy Groom.—And other Papers.

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

CHEMICAL SOCIETY, at 8.30.—The Constitution of Oxyazo-compounds: W. B. Tuck.—The Influence of Solvents on the Rotation of Optically Active Compounds, Part ix., A New General Method for Studying Intramolecular Change: T. S. Patterson and A. McMillan.—The Reduction Products of ortho- and para-Dimethoxybenzoin: J. C. Irvine and A. M. Moodie.—Replacement of Halogens by Hydroxyl, i., The Hydrolytic Decomposition of Hydrogen and Sodium Monochloroacetates by Water and by Alkali, and the Influence of Neutral Salts on the Reaction Velocities: G. Senter.—The Reaction of Ammonium Salts with the Constituents of the Soil: A. D. Hall and C. T. Gimingham.

LINNEAN SOCIETY, at 8.—The Percy Sladen Trust Expedition to the Indian Ocean, Introduction, Part i., Ceylon to Mauritius: J. Stanley Gardiner.—Land Nemerteans, with a Note on the Distribution of the Group: R. C. Punnett.—Land Crustaceans: L. A. Borradaile.—Hymenoptera: P. Cameron.—Dragon Flies: F. F. Laidlaw.—Fourmis des Seychelles, Admirantes, Farquhar et Chagos: Prof. A. Forel.—Pycnogonidæ: G. H. Carpenter.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Lecture on "Modern Theory of Conduction of Electricity in Metals": Prof. J. J. Thomson, F.R.S.

FRIDAY, FEBRUARY 22.

ROYAL INSTITUTION, at 9.—Flame in Gas and Petrol Motors: Dugald Clerk.

PHYSICAL SOCIETY, at 5.—Transformer Indicator Diagrams: Prof. Lyle.—Ionisation of Gases by α Particles of Radium: Prof. Bragg.—A Micromanometer: B. Roberts.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Impurities in Boiler Feed-water; their Nature, Effect and Elimination: F. E. Walker.

SATURDAY, FEBRUARY 23.

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

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