THURSDAY, DECEMBER 24, 1896.

PETROLEUM.

Petroleum: a Treatise on the Geographical Distribution and Geological Occurrence of Petroleum and Natural Gas; the Physical and Chemical Properties, Production and Refining of Petroleum and Ozokerite; the Characters and Uses, Testing, Transport, and Storage of Petroleum Products; and the Legislative Enactments relating thereto; together with a Description of the Shale Oil and allied Industries. By Boverton Redwood, F.R.S.E., F.I.C., Assoc.Inst.C.E., assisted by G. T. Holloway, Assoc.R.Coll.Sc., F.I.C., and others. 2 vols. 4to. 900 pp. (London: C. Griffin and Co., Ltd., 1896.)

Le Pétrole, l'asphalte et le bitume, au point de vue géologique. By A. Jaccard. Professeur Geologie à l'Académie Neuchâtel. 1 vol., 8vo., 292 pp. (Paris: F. Alcan, 1896.)

Petroleum: its Development and Uses. By R. Nelson Boyd, M. Inst. C.E. 1 vol. 8vo, 85 pp. (London: Whittaker and Co., 1896.)

AS frontispiece to his first volume, Mr. Redwood has adopted a map of the world; and thereupon are indicated by red spots, the known localities of the occurrence of petroleum: so treated, only a few parts of the map remain undotted, and these are mostly those which, in the world, are either permanently ice or ocean-covered, or those which, such as Central Asia, Central Africa, and Central Brazil, are still but little explored. The universality, far from being confined to the geography of petroleum, is one of the main distinguishing features of this unique subject: the chemistry, geology, mining, technical applications, and legal and fiscal aspects, all demand, for their due elucidation, the most experienced experts, inasmuch as each of these aspects is of a quite special character, a peculiarity which, in its turn, arises from the fundamental fact that petroleum is unlike anything else among the world's chief products.

To write, or to compile, a comprehensive text-book on petroleum demands, therefore, an acquaintance with dissimilar subjects, and with varying walks of life, very rarely centred in one individual. The present work is and will ever remain remarkable as the production of a man whose scientific attainments, and whose relation to the petroleum industries, were such that he, probably better than any other living man, was fitted to undertake the task.

But while the qualifications of Mr. Redwood singularly well fitted him for attacking a problem which even the German had not attempted, the inherent difficulties of compiling this treatise must be prominently kept before the mind in forming a judgment as to the quality of the author's work, and due allowance must be made for places where, to this geologist or to that chemist, to this inventor or to that lawyer, it might seem that the elaboration had been too restricted, or the facts presented too few. Certainly a sincere tribute must be paid to the great industry displayed in the production of this work, to the careful selection of its facts, to the eminent sense of proportion shown in the marshalling of the latter, to the pure and lucid style, and especially to the wonderful fairness and judgment shown in briefly indicating the views of the principal disputants in the more contentious regions of its scope. The work contains a vast volume of information, the errors are very few indeed, and to those familiar with the busy life of the author in the very vortex of petroleum matters, it will not be a matter of surprise to learn that the work is, whether treating of new petroleum fields, new methods of drilling, recent improvements in testing, or fresh legal enactments, modern in every sense of the word.

Though in an encyclopædic work of this kind originality is hardly expected, and is perhaps out of place, the author carries a curious, quite Plato-like, shrinking from the revealing of his individuality, to an unnecessary pitch: indeed, most readers will have to confess to some disappointment in being unable to get at Mr. Redwood's own opinion on most of the debatable points connected with petroleum. Thus, Section iv., "The Origin of Petroleum and Natural Gas"—one of the least satisfactory of the eleven sections into which the work is divided, is summed up in the following words:

"Probably, on the whole, the Höfer-Engler views at present have the largest number of adherents, and in respect, at any rate, to certain descriptions of petroleum, are the most worthy of acceptance. At the same time, a careful study of the subject leads to the conclusion that some petroleum is of vegetable origin, and it therefore follows that no single theory is applicable to all cases."

Here, and especially also in the section devoted to liquid fuel, there seems to be too much quoting of "authorities," and too little critical examination of the, not infrequently, intrinsically worthless, "views" which, because emanating from the high-placed learned, have been allowed to obscure the subject: Mr. Redwood would have done good service in pruning away some of these. Two of the most valuable of the sections are those dealing with the "Geological and Geographical Distribution of Petroleum" and with the "Testing of Crude Petroleum and Shale Oil Products, Ozokerite and Asphalt," respectively. In the first of these Mr. Redwood has introduced a series of most carefully drawn maps and sections, many of these being original, and at any rate so in the forms now presented: the maps, in fact, constitute one of the most valuable features of the work, being the kind of map brought forward by the man who has visited the locality personally. As to the matters dealt with in the second of the sections mentioned above, Mr. Redwood is, of course, *facile princeps*, and it cannot fail to be a source of justifiable pride to him to see how much he has individually contributed to modern methods of testing petroleum. Equally (in conjunction with Sir F. Abel) in the flash-point apparatus, in the viscosimeter, and lately in the flame-cap apparatus, used for the detection of dangerous amounts of hydrocarbon gases in tank-ships and elsewhere, and in many other ways, the technical development of petroleum owes much to his labours; much more than he has allowed himself, with characteristic modesty, to indicate here.

The text is accompanied by over 300 illustrations, all most carefully revised and examined; those dealing with drilling implements being particularly serviceable.

It may be said generally that any one mastering the work would have a very competent knowledge of the subject, and one which he could not obtain from any other single source.

To summarise, it must be allowed (1) that a text-book upon petroleum—at once comprehensive and authoritative—was greatly needed; (2) that there was hardly any one capable of compiling such a work; (3) that Mr. Redwood has most successfully essayed and accomplished the task by the production of this most excellent text-book.

Unlike Mr. Redwood's work, that of Prof. Jaccard is concerned solely with the geology of petroleum, though the geology is of that wide order that it embraces such subjects as the origin of petroleum and of natural gas, and the causes of "bituminisation."

The study of the various conditions under which petroleum occurs in nature, is remarkably clearly written and is, moreover, illustrated by many admirable little semi-diagrams, thoroughly French in character, and truly luminous to the text: the work is, however, marred by the narrowness of view, displayed in the selection of the sources drawn upon, by the not infrequent antiquity of these latter, and by the only too obvious circumstance that for many of the localities, whose petroliferous peculiarities are described, the author only knew the facts at second-hand. Thus the account given of the occurrence of Galician petroleum and of the industry founded thereupon, is ridiculously brief; its inaccuracies at once stultifying also the author's table showing the occurrence of petroleum in strata of various ages. Transylvanian petroleum, including the interesting deposits about Soosmezo, is, apparently, not even mentioned, while the Roumanian deposits, much less important than those of Austria-Hungary, are described at some length—or, rather, M. Coquand's reports upon them are abstracted at some length. From the above it will be gathered that that study so much needed at the present moment, viz. a critical comparison of the petroliferous rocks of the Carpathians, has not been attempted by the author.

Naturally, when treating of the Jura, Vosges, Hanoverian, &c., petroleum localities, subjects to which he has devoted individual attention, Prof. Jaccard speaks with unquestionable authority, and this is the most valuable part of the book.

The author seems to have attempted to put forth his greatest strength in the chapters dealing with the origin of petroleum and its conditions of occurrence in the rocks, and the causes of these conditions. Though he admits a vegetable origin for certain petroleums, he considers, largely influenced to this opinion by his studies of the fossils of the Jura deposits, that a bituminisation of certain animal (especially molluscan) remains may be fairly demonstrated.

In spite of the fact that the work of French geologists is too exclusively referred to, while the work of others is often ignored, yet the book is an eminently clear and readable one; and, regard being had to the existing works, treating of the geology of petroleum, an English translation would undoubtedly be useful at the present time.

It may be noted that, prefixed to the work, there is an account of the life and work of Prof. Jaccard (died January 5, 1895).

In Mr. Boyd's readable book of eighty-five short pages a well-known petroleum-expert glances rapidly over the whole range of the subject for the benefit, primarily, of those who wish to glean some smattering of petroleum-lore. The subject is one which is attracting increased attention from the general public, and this booklet will no doubt be found useful by a large class of readers. It is a pleasure to be able to add that the information contained in it is equally trustworthy within the scope contemplated, and entertaining, because well arranged and clearly explained.

The work would be still more attractive, and its sphere of usefulness enlarged, if in another edition there were to be added to it two or three sketch maps and an illustration of a drilling plant. E. R. B.

THE AIM OF BIOLOGICAL TEACHING.

Biological Lectures Delivered at the Marine Biological Laboratory at Wood's Holl, in the Summer Session of 1895. Pp. 188. (Boston, U.S.A., and London: Ginn and Co., 1896.)

"I TRUST that you all, when you leave the laboratory, will carry with you a deeper and loftier enthusiasm for original research, which is at once the chief duty and the chief privilege of the biologist." Thus Prof. Minot concludes the discourse which he has contributed to this volume; and the sentence not only serves to illustrate the object of the lectures themselves, but at the same time expresses the ideal of that movement in biological teaching of which the lectures are a sign. It is to the credit of American teachers of natural science, and more especially of the teachers of biology, that they, more faithfully and successfully than their fellow-workers in this country, have striven to keep in view the true end and aim of all scientific teaching—a training in that method, whose ultimate goal is the increase of knowledge by means of scientific research.

The lectures now brought together in volume form were delivered, as the title states, at the Marine Biological Laboratory of Wood's Holl, in the summer session of 1895. At the laboratory there are assembled during the summer months a considerable number of naturalists engaged in biological research, together with a large body of university students, who have not yet completed their biological course, and the excellent practice has been instituted of inviting the investigators to deliver lectures upon their work for the benefit both of their colleagues and of the students.

To students who have been taught to regard scientific research as the end towards which all their studies are directed, nothing could be more stimulating, especially at a time when they are brought into such intimate contact with nature, as a residence at a marine laboratory affords, than lectures such as these, delivered by men who are themselves actually working at the subjects about which they speak. Yet we cannot refrain from remarking, what no one who has been brought into contact with English students with the dead hand of the examination hanging over them will deny, that for the latter such discourses would possess but little interest.

Our students, indeed, would seem to have no time to be interested; all they demand is something that will "pay," when the examiners are met. And the result is, as might be expected, that when the goal at which they have aimed is reached, with memories ruined and enthusiasm killed, they are helpless in the presence of the simplest scientific problem, and have yet to learn the very elements of the methods of attack. What they have been taught is not how to gain knowledge, but how to undergo examination.

Turning to the lectures themselves, and regarding them from the point of view for which they were designed, namely to awaken enthusiasm for the scientific method and to stimulate research, it must be admitted that they have a somewhat unequal value. Perhaps the most successful are those—such as that by Dr. Locy, on "The Primary Segmentation of the Vertebrate Head"—which are simple, straightforward statements of the researches upon which their authors are themselves engaged, and in which they are, therefore, themselves most keenly interested. And without expressing an opinion on the morphological theories which the author advances, we would single out this lecture by Dr. Locy, as being likely for another reason to be specially instructive to the student who is feeling his way to investigations of his own. No idea is more frequently met with amongst those who have just completed their academic training, than that our knowledge of common things—of things which are easily procurable and, as it were, ready to hand—is complete, or, at any rate, as complete as it can be made with the methods at present available; and as a consequence of this idea it is presumed that only by seeking for strange objects in strange places, or by the employment of some new and complicated method of research, is there any prospect of adding to the knowledge which already exists. Now, as Prof. Kingsley points out in his lecture on the subject in this volume, the question of the segmentation of the vertebrate head has occupied the attention of leading anatomists since the beginning of the present century, and perhaps no problem could be mentioned which has been more thoroughly investigated and discussed without a satisfactory conclusion being arrived at. On the other hand, no vertebrate embryo—not even that of the chick—has been more studied than the Elasmobranch embryo. Notwithstanding these two considerations, we here have Dr. Locy bringing forward a theory of the segmentation of the head, based very largely on a minute study of many stages of early embryos of Acanthias, *chiefly in surface views*. We could almost hope that Dr. Locy's theories may prove to be correct, for the sake of the valuable lesson which his success would teach.

In "Bibliography: a Study of Resources," Prof. Minot treats of a real difficulty which invariably confronts the young investigator at the outset of his work, and about which he is accustomed to receive little advice or help. The various methods are explained by which, amongst the vast mass of biological writings, the literature dealing with any particular subject may be most readily and completely discovered, and many practical hints on bibliography are given, which should prove exceedingly helpful to those for whom they have been brought together.

Prof. W. B. Scott's remarks on "Palæontology as a Morphological Discipline" contain many suggestive ideas, and Prof. Osborne gives some interesting "Reminiscences of Huxley." In reading these we cannot but call to mind how large a share Huxley took in establishing that system of biological teaching which, as at present carried out in this country, seems to call for serious condemnation; again an illustration of how a system, in its origin the embodiment of the thought of a master mind, may, in the hands of those that follow, become the mere corpse of an idea, better put from sight.

The least successful portions of the volume are the two lectures by Dr. Dolbear, entitled "Explanations, or How Phenomena are Interpreted," and "Known Relations between Mind and Matter." These are of a more or less metaphysical nature, and deal with some of the fundamental problems connected with the human mind and human knowledge. In treating such problems, especially before an assembly of students, the primary conditions of success must be that the propositions brought forward are stated in clear and definite language, without confusion of terms, and that there is not the slightest suspicion of any confusion of thought. That the lecturer cannot be congratulated upon having accomplished this, the following quotation is sufficient to show:—

"The spectroscope, an instrument for determining whether matter is solid or gaseous, when turned towards the sky showed that there were vast numbers of gaseous masses there and in many degrees of condensation. This discovery was held to corroborate the idea of Kant and Laplace, so that to-day there is no astronomer who does not hold the view that the Solar system as we see it to-day is a growth, that it was not made as it is, and that gravity with the simple laws of motion are sufficient in themselves to organise the Solar system as we find it, and an explanation of it is an exposition of how these factors brought it about."

We must be pardoned for expressing a doubt as to whether the students derived much benefit from these remarks.

Looking, however, at the lectures contained in this volume, as a whole, they must be regarded as possessing a very considerable value, not chiefly for what they themselves contain, but more especially as representing a movement towards a truer method of biological teaching, which cannot be too highly commended.

A STUDY IN SYMBOLISM.

The Buddhist Praying-wheel: a Collection of Material bearing upon the Symbolism of the Wheel and Circular Movements in Custom and Religious Ritual. By William Simpson. Pp. viii + 303. (London: Macmillan and Co., 1896.)

MANY people have seen a Buddhist praying-wheel, a small cylinder filled with written or printed prayers, and either surrounded by an outer case and turned by a twirl of a spindle, or else swinging round a spindle held in the hand. But besides these hand praying-machines, which so often find their way to Europe as curiosities, there are larger forms of the same instrument of devotion in the temples and villages of Thibet.

Huge cylinders inside the temples, turned by the priests, or rows of barrel-like cylinders along their outer walls, turned by a push of the hand of people passing in the street, or cylinders turned by water or wind, are common objects, and have never failed to attract the attention of travellers in that country. Such a traveller was Mr. William Simpson, who spent the hot seasons of 1860 and 1861 in the Himalayas, and in both years passed over the boundary into Thibet. He made sketches of the praying-wheels he came across, visited the temples, and watched the priests at their devotions endlessly turning the huge cylinders; he also bought one of the small hand-cylinders, and learned the proper method of using it. On his return to this country he collected what information he could, and, although in 1867 he wrote a magazine article on praying-wheels, his interest in the subject did not cease, for he continued his reading, the results of which are embodied in the book before us.

As its title suggests, Mr. Simpson has not confined himself to the Buddhist praying-wheel, but has extended his range of study to include the symbolism of the wheel in general which occurs in varied forms in different systems of religion, and has also touched on the circular movements and dances to be met with in the customs and ritual of many races. A glance at his index to book-references will show that Mr. Simpson has consulted a large number of very various works, from which he quotes passages which seem to bear on the wheel as a symbol, or on circular movements, and we gather that the principal contention or thesis that he seeks to establish is that the Buddhist praying-wheel, along with all forms of the wheel in symbolic art, has a solar origin, and that circular movements and dances which turn from right to left, are to be interpreted as symbolical of the apparent motion of the sun.

It has long been recognised that with primitive races sun-worship is a most important factor in ritual and belief; but that all symbolic wheels and circular dances can be referred to a solar origin in the wholesale manner our author appears to suggest, is a theory that most students of mythology will regard with some suspicion. Perhaps one of the most fundamental axioms of the modern science of folk-lore is contained in the strict line of distinction it draws between the beliefs of primitive and undeveloped races, and those of nations that for many centuries have enjoyed a highly-developed civilisation with an organised priesthood, and have been subjected to the various influences exerted by their own literature and the literatures of other nations with whom they may have come in contact. It has been abundantly proved that in two or three generations the influence of literature on a nation can work a complete revolution in its beliefs and superstitions; so that in tracing the origin and development of its rites and symbols, a completely different method of investigation and standard of judgment must be adopted to those employed in the case of less developed and more primitive races. The weakness of Mr. Simpson's theory, therefore, appears to us to lie in the fact that he does not lay sufficient emphasis on this fundamental principle. He has, in fact, approached his subject rather from the outside, to some extent neglecting—in the case of ancient and highly-cultured races—the infinite number of influences that have been at work to mould the form their beliefs subsequently assumed. It must be added, however, in fairness to the author, that he himself does not regard his theory as more than a tentative suggestion, and that he considers his book rather in the light of a collection of material: and as such it will, no doubt, be of considerable service to those who are interested in the subject. In conclusion, a word of praise should be given to the excellent illustrations scattered through the book, many of which have been reproduced from the author's own drawings.

OUR BOOK SHELF.

Physiography for Beginners. By A. T. Simmons, B.Sc., A.R.C.S. Pp. viii + 344. (London: Macmillan and Co., 1896.)

As an introductory science it is, perhaps, but natural that the scope of physiography should be somewhat nebulous and liable to occasional modifications; but after its long existence as a separate subject for the examinations of the Department of Science and Art, one would have expected it to have assumed fairly-defined boundaries. Nevertheless, although important alterations in the syllabus were made only a year ago, still more sweeping changes have been introduced during the present year. We learn from the official statement, that the syllabus "has now been so framed that it is, particularly in the elementary stage, a real introduction to the various branches of physical science. . . . One object of this revision has been to adapt it for pupil teachers who may be called upon to give object-lessons in their future career."

To meet the demand which has doubtless been created by the recent changes, is the object of the book under notice. It may be stated at once that the book covers the syllabus in the most complete and satisfactory manner, and we have no hesitation in saying that teachers will find it to adequately meet their requirements as a class-book. The descriptions are clear and not too long, and great pains have evidently been taken to ensure accuracy in every section. One of the best features is the great prominence given, for the first time we believe, to experimental illustrations of the subject, all those suggested in the syllabus having been incorporated, and others added to make a total of 216, all of which require but simple appliances. These, however, will absorb a certain amount of time; and, to economise a little, there is a summary at the end of each chapter which may well take the place of the notes which are frequently dictated to classes. Sets of questions to test the progress of the students are also included. The book is very generously illustrated, and although some of the figures are not new, they all admirably serve their immediate purposes. A complete list of the apparatus and materials required for carrying out the experimental work would form a very useful appendix to the book.

The Metric System of Weights and Measures compared with the Imperial System. By Prof. W. H. Wagstaff, M.A. Pp. vi + 121. (London: Whittaker and Co., 1896.)

ANYTHING that educates the public in the advantages of the metric system, and exhibits the cumbrous nature of the "weights and measures," preserved by British insularity to the detriment of British commerce, claims the commendation of men of science. For this reason we think Prof. Wagstaff has acted wisely in reprinting the four lectures on the metric system delivered at Gresham College a year ago. The resulting little volume contains a good general account of the metric system, and one which will excite interest in the subject. The best way to the introduction of the system is to instruct people in it; for as soon as a wide knowledge of metric

measures is obtained, the British system will drop out of existence as a natural consequence of the elimination of the unfit. Prof. Wagstaff not only describes clearly the metric measures, but he also brings together a number of facts and expressions of opinion for and against their introduction into the British Isles.

The Aurora Borealis. By Alfred Angot. Pp. xii + 264. (London: Kegan Paul, Trench, Trübner, and Co., Ltd., 1896.)

THIS is a translation of a book—"Les Aurores Polaires"—reviewed in this column in March 1895 (vol. li. p. 484). It is the eighty-first volume of the International Scientific Series, in the list of which it is correctly entitled "The Polar Aurora," instead of "The Aurora Borealis." Only upon the title-page and cover does the latter designation appear, each of the pages with even numbers bearing the former title. This inconsistency will probably lead to some confusion.

A comparison of the present volume with the original edition shows that the translation has been well done. We have, as the result, an interesting and lucid account of the present state of knowledge of the aurora in all its aspects, illustrated by pictures of the typical forms assumed. In an appendix, a list is given of the auroræ seen in Europe below latitude 55° from 1700 to 1890.

An index would be a valuable addition to the book.

Ros Rosarum: Dew of the Ever-living Rose. Pp. xxix + 292. (London: Elliot Stock, 1896.)

A SECOND edition has been issued of this delightful little volume. It contains extracts from works of poets whose songs have come down to us from all ages. In the interesting introduction the author states that many of the translations are due to the kindness of Lord Tennyson, Lord Lytton, Mr. J. A. Symonds, and many friends. Much information is also given concerning the history of the rose, and it is shown how highly this flower has been regarded at various times and in various countries. In both Athens and Rome it was recognised as the queen of flowers; there seems, indeed, to have been scarcely a time when it was not valued and appreciated. The book will be found very interesting; the quotations have been carefully collected and placed, as far as possible, in chronological order. It may also be added that one quotation from Lord Tennyson is not to be found in his collected works, a fact which adds interest to the little volume.

Knowledge. Vol. xix. January to December 1896. Pp. 288. (London: *Knowledge* Office.)

WE offer our congratulations to the editor of *Knowledge* upon the completion of this very attractive volume. The illustrations—many of them full-page collotypes—are most instructive pictures, and the figures in the text are just as good. The remarkably fine reproductions of astronomical photographs are particularly interesting. A series of twelve well-illustrated articles by Mr. Vaughan Cornish, under the comprehensive title of "Waves," also calls for special mention. It is not possible to keep up with the march of science in a monthly periodical; but *Knowledge* gives a good general idea of progress, and the present volume is full of interesting articles on comparatively recent work, illustrated by some of the best pictures it is possible to obtain.

Hygiene Diagramettes. By W. H. Knight. (London: Chapman and Hall, 1896.)

THIS is a collection of twenty-four photo-zincograph reductions from large diagrams designed for teaching hygiene. Upon the page facing each of the illustrations are given brief descriptions of the separate drawings and tables. These notes, together with the instructive diagrams, should be very serviceable to teachers and students. It is a pity that the inscriptions attached to some of the illustrations are illegible, owing to the reduction of the originals having been carried too far.

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.*]

Leonids of November 15, a.m., 1896.

THE display of Leonids on the morning of the 15th ult. was observed here under very favourable conditions of the sky for noting the progress of the shower in numbers and in brightness, and in the position and distinctness of the meteors' radiant-point or centre of divergence. As observations of this kind collected in the present early stages of the shower's gradual increase to greatest brilliancy seem likely to be very useful to improve our knowledge of the past history and mode of advent of this meteor-stream into the solar system, I send the following leading particulars of the shower as it was here observed.

The sky was cloudless during my watch from midnight until dawn appeared rapidly at six o'clock on Sunday morning, the 15th, excepting only in the hour from 4½ to 5½ a.m., when clouds spreading slowly hid nearly all the sky in the latter half of the hour, but dispersed quickly then in time for a perfectly clear half-hour from 5½ a.m. till daybreak. At this latter time the radiant in Leo, then preceding the mean sun as it did, about six hours in R.A., had reached its highest southern altitude of a little over 60°, or nearly that of the sun at midday in midsummer, while in the hour from midnight to 1 a.m. it was, like the sun in June-July at 6–7 in the morning, 20° to 30° above the E. by N. horizon, having risen above the horizon in that quarter a few minutes after ten o'clock. The moon, however, a little past her first quarter, shone strongly still in the west, hiding 5th magnitude stars till one o'clock, and only set, leaving the sky quite clear, at about 1.45 a.m. It may be owing to the obstacles of clouds in one, and of moonlight in another hour of the watch, that only one Leonid was recorded in each of the two hours from 4½ to 5½, and from 12 to 1 o'clock; but observations made elsewhere under better sky conditions, by Mr. W. H. Milligan in Belfast, and by Mr. H. Corder at Bridgwater,[1] show that there were really lulls in the shower's intensity before 2, and towards 4 o'clock, though it regained its brightness in the later hour from 5 to 6 o'clock; and neither the comparatively low altitude of the radiant-point, nor the moderate strength of moonlight till 2 o'clock seem sufficient to account satisfactorily, considering the brightness of most of the meteors which showed themselves very little later, for the marked scarcity of Leonids noted in the first two hours of the watch. The following numbers of Leonids and of sporadic or non-Leonid meteors were recorded (and most of their apparent paths were mapped) in the successive hours (or half-hours) ending at

	1	(1½)	(2)	3	4	(4½)	5½	(6) a.m.
Numbers of Leonids ...	1	1	2	11	7	5	1	6; Total, 34
Numbers of Sporadic Meteors	—	—	2	3	4	1	1	1; ,, 12

Ratio of Leonids to Sporadic Meteors, nearly 3 : 1.

Hourly Numbers of Leonids	1	2–4	11	7	(10)	[*2]	(12); [*, cloudy].

Meteor-magnitudes. Equal to	♀	♃	Sirius	1st	2nd	3rd	4–5th.
Numbers of Leonids ...	1	4	2	6	8	8	5; Total, 34
Numbers of Sporadic Meteors	—	—	—	—	1	2	9; ,, 12

The second table shows how much the Leonids surpassed in brightness, as they also did in numbers, the ordinary appearances of shooting stars on a November night. The brightness of the display, and its rather sudden commencement, apparently at about 2 o'clock on the morning of the 15th inst., seem to point to that morning as having been at least a very conspicuous date of its return this year, although eager expectation of a shower on the morning of Saturday, November 14, was awakened in the

[1] *English Mechanic*, November 27, 1896:—"From 12½ to 2" (? Irish time, = 1–2½ English time) a.m., Mr. W. H. Milligan noted "9 Leonids; hourly number about 6." This was a rather low rate of appearance in that period. Mr. Corder began watch at 2 o'clock, and saw eight Leonids and two sporadic meteors in the first half-hour, "after which the numbers fell off; but when the radiant had risen higher, about 5 to 6 o'clock, 16 meteors were seen in an hour, nearly all Leonids." Descriptions of the shower's appearance on the preceding morning (of November 14), by Mr. Corder and Mr. E. R. Blakeley, in the same issue of the *English Mechanic*, and descriptions of the apparent paths of several bright Leonids seen in a clear hour at daybreak on November 15, by Mr. W. E. Besley, at Walthamstow, in the next preceding number of the same journal (November 20), are extremely interesting in this connection, and will presently be again referred to.

preceding days by ably written articles on the phenomenon in the leading daily journals, which could not be fulfilled and realised in England from the unfavourable state of the atmosphere for observations.

The earth should indeed have crossed the main meteor-stream of the two great showers of 1866 and 1867, supposing the node of the meteor-current's orbit to have been advancing at its accustomed pace on the ecliptic in the intervening years, at about daybreak, or between 3 and 9 o'clock a.m. on Saturday morning, the 14th, as predicted; but certain attendant meteor-clouds or clusters also exist, accompanying the main stream, and on 1865, November 13 (a.m.), a grand display of the Leonids was widely observed in Europe and America from midnight until daybreak, which, it was shown by Mr. B. V. Marsh[1] of Philadelphia, U.S.A., constituted a branch-stream twelve or fifteen hours earlier in the times of its maximum recurrences than the principal meteor-stream of the two great November-exhibitions of the next two years. And again, near Pekin in China, on November 15 (a.m.), 1867, and in America on November 14 (a.m.), 1868 (agreeing also with showers observed in England on November 14 (a.m.), 1868, and November 15 (a.m.), 1871[2]) bright showers of Leonids scarcely inferior to the main stream's apparitions were witnessed, which, as was pointed out at the same time by Mr. Marsh, belonged to a branch-stream following the main stream, instead of preceding it, by about the same time of between twelve and fifteen hours as the other one, in its appearances. The Leonids of the 15th ult. appear thus to have appertained to this following branch-stream which the earth was probably passing through with sensible sparse gaps and condensations, for about 14 hours (according to its formerly observed durations) between dusk and daybreak on the night of the 14th–15th ult.; and if the two following and preceding side-streams are equally long, evenly extended belts with the main stream of meteoric matter, it may perhaps be expected that on the mornings of November 14 and 15 next year, the earth will come to be immersed in the preceding and following meteor-belts, respectively, while the main current encountered like the fellow-streams, six hours later than their predicted times this year will be traversed in the daytime of November 14, 1897, producing a principal meteor-shower then which in the full daylight will not be visible in England. In the years 1899 and 1900, on the other hand (the latter year a non-leap year), it seems probable that the brief but imposing scene of the earth's passage through the main stream, if no disturbances in its path since 1866-7 have warped the current out of its expected course, will occur more opportunely and more favourably for English watchers about at midnight and at 6 o'clock a.m. respectively, and one or both of them perhaps in pretty full completeness, on the mornings of November 15.

The general colour of the heads and streaks of the Leonids seen on the 15th ult. was dull yellowish white, or yellow, but some of the largest had bright white nuclei with white streaks. The head of one very fine one only, at 5.58, was slightly greenish, when brightest; but the long and broad dense streak which it left visible for 6 seconds, was of the same golden yellow colour as that which prevailed in the fainter streaks of ordinary durations (2–4 secs.), and of ordinary lengths (10°–20°), and which was now and then seen most distinct and vivid in the spindle-shaped foreshortened streaks left near the radiant point. This green and yellow-tinted meteor, brighter than Jupiter, and the last which I observed, shot through 40°, overhead across the dawn-lit sky, from the direction of *κ Leonis* so exactly to *β Aurigæ*, and directed there towards *Capella*, that that bright star-pair, prolonging the line of the streak's golden wand, as it appeared, which just reached the former star, looked with the streak like a grand jewelled sceptre in the sky, whose long staff only slowly faded.[3]

Fine meteors leaving streaks along their whole path-lengths for four or five seconds appeared at—

Hour.	Mag.	Apparent path: From	Apparent path: To	Path-length and duration.		Streak; Appearance; and Remarks.
a.m.		°	°	°	'	
1.54	>1	152 + 52	210 + 89	40	1½	
2.2	2	45 + 67	352 + 36	40	1½	
2.29	>1	70 − 3	54 − 10	20		Low in S.W.
2.33	2	134 − 10	132 − 16	6		Low in E.
3.6	Sirius	100 + 8	82 − 1	20		In S.; white streak.
3.11	2	22 + 14	17 + 9	6	1¼	In W.; (approx. path.).
3.12	Sirius	26 + 45	6 + 25	25	1·0	In W.; white streak.
4.14	2	165 + 10	176 + 44	35	1¾	From μ Hydræ (?); white; with broad white streak for 6 secs.
4.45(?)	>1	173 + 9	179 + 4	8	1·0	
5.58	2	135 + 30	87 + 45	40	1½	Long yellow streak for 6 secs.

Seen also apparently, at Walthamstow, by Mr. W. E. Besley, with the following description, and positions :—

5·59	2	141½ + 23	95 + 22	43	—	(The *English Mechanic*, November 20, 1896.)

The meteors nearly all moved very swiftly, and described their paths, in general, at rates of about 10°–15° in half a second.

Much careful selection was needed from the mapped paths of the Leonids to obtain a satisfactory position of the radiant-point, as quite a volley of fine long-pathed streak-leaving meteors from a radiant, apparently in *Crater* or *Hydra*, far south of *Leo*, streamed in direction across *Leo* and *Cancer*, surpassing the Leonids in speed, brightness of the heads and streaks, and lengths of path, and frequently confusing themselves with the cometary shower as if they were exceedingly erratic members of it. One very resplendent one, whiter and brighter than Jupiter, set out, at 4.14 a.m., exactly from Jupiter in the middle part of *Leo*, and shot swiftly up across *θ*, *δ Leonis*, 35° to near the hindermost foot of *Ursa Major*, leaving a dense white streak 5′ broad for about six seconds all the way—a path which it would be difficult to reconcile with a radiant point near *gamma Leonis*, although the meteor in all respects, except in its globular white head, exactly resembled a Leonid. A position is given for December in Prof. Heis' and Dr. Neumayer's "List of Southern Radiants," of 1867,[1] at 148°, − 34°, which although much further south than one near λ *Hydræ* at about 150°, − 12°, which seemed to be active on the 15th ult., yet shows that there are showers with southern declinations at this time of the year near the meridian of the shower from *Leo*, almost as oppositely directed (and consequently as swift) in their motions as the Leonids are, to the motion of the earth. The meteors of the 15th ult. and of a few neighbouring nights, also showed signs of radiation from near *δ*, or *α* and *κ Cancri*, at about 137°, + 17°; and on a chart of meteor-paths recorded last year on the mornings of November 13–15, I find four long-pathed tracks traced back to a common radiant-point at 132°, + 17°, near *δ Cancri*, which they fitted well, and which perhaps confirms this place.

Omitting then as doubtful Leonids for this reason (or else for their distances from the chief focus of the radiation), out of the thirty real or possible Leonids mapped, all but those whose courses' prolongations backwards would cross the small area of the sky formed by completing the circle half traced by stars in *Leo's* sickle, the twenty-two paths remaining, all diverged from a circular tract 10° in diameter, having a point at 148°, + 23°, near the small star *x Leonis*, at its centre. But a circle only 6° in diameter, round a centre at 149° + 24°, also includes nineteen of these tracks very evenly distributed, if three at the south-west border of the larger circle are omitted; and accord-

1 British Association Reports, 1869, pp. 302–3.

2 *Ibid.*, 1872, pp. 96–7. See also 1866, pp. 64–5 and 137.

3 Had I provided myself with a hand-spectroscope for this occasion, this meteor's streak and a few of the most enduring ones left by the brightest meteors of the shower, would doubtless have presented very interesting features for spectroscopic study. By comparison with the sky-positions recorded of this meteor's apparent path at Walthamstow by Mr. Besley, a real path of the meteor is obtained by the base line of 28 miles W.S.W.–E.N.E. between the stations, from 90 miles over a point on the border of Sussex and Hampshire, halfway from Midford to Alton, to 27 miles over a point 5 miles east from Didcot, directed from a radiant point at 150° + 22°, then 60° above the S. by E. horizon; the length of the sloping path being 74 miles, which the meteor described, as was noted here, in 1¼ second. The beginning and end heights, and the speed of flight thus indicated by the calculation of nearly 50 miles per second, not surpassing much the real meteor-speed—43 miles per second—of the Leonids, lend much probability of correctness to the view adopted here, that though differing in the apparent magnitudes, and somewhat in the estimates, as described, of the path's apparent lengths at the beginning and end points, the two accounts at Walthamstow and Slough really referred both to the same bright long-pathed shooting-star seen to begin its course at both the stations in remarkably close proximity to a radiant-point almost identical in position with the principal one on that night in Leo. Seven meteor paths of Leonids were mapped in the hour from 5.38 to 6.42 a.m. on November 15, by Mr. Besley, of 1st–3rd magnitudes, and the last of them in strong-growing daylight, as bright as Jupiter. This bright white one, and three others, all beginning in and near Leo's sickle, diverged almost accurately from a common point at 149° + 22°, the remaining three only deviating, in respect to radiation, from 4° to 8° from that position.

1 British Association Reports, 1868, pp. 405–6.

ingly this latter point, still very near to *x Leonis* in the middle of the sickle, was a very well defined and exactly marked centre of the shower's radiation, since nineteen out of thirty, or 63 per cent. of all the tracks of possible Leonids recorded, proceeded from within 3° or 3½° from it, outwards towards all directions.

The chief apparent wandering from this centre shown by the eleven erratic-flighted Leonids was south-westwards, towards α, κ *Cancri*, where seven of those outlying tracks (including the three wide-circle-grazing path-lines) are loosely collected; but of these seven, some may have belonged, as was surmised above, to contemporaneous sparse showers at about 135°, + 17°, and 150°, − 12°; and as the four paths which strayed north-eastwards from the sickle, though forming a fan-like group roughly focused at about 155°, + 35°, near *f*, *g Leonis Minoris*, were no doubt Leonid stragglers, shooting in proper numbers for their own half of a field supposed to be about evenly strewn with them, from no really existing radiant centre there, there would thus seem to have been among the strayed Leonids themselves no tendency that could be noticed to move in side-flows and tangent-streams presenting laterally drawn-out and branching radiations strong or distinct enough to be discernible. No such lateral dispersions or divisions, therefore, seemed, from all the tracks' projections, to have affected the shower's radiation with any perceptible apparent changes from the very exactly defined centre, with even, and not very great dispersion round it, which has been usually observed as a strikingly conspicuous feature of this star shower's radiation at its principal returns.

Positions of this after-shower's radiant-point, obtained formerly and in the present year, are not in very perfect, although in fair general accordance; as even in its bright display of November 14 a.m., 1868,[1] places were assigned to it, at Rome, "at the centre of the five stars of Leo's sickle" (149½°, + 22½°) at Moncalieri, Piedmont, "exactly between γ and δ, ζ *Leonis*" (153°, + 22°), and at Madrid, "close to η *Leonis*" (150°, + 17°; mean of these places, 151°, + 20½°). In NATURE, November 30, 1871, a description of the shower's appearance in England on the morning of November 15, 1871, assigns the radiant-point's position from twenty-six Leonid paths as "not very well defined, but approximately close to ζ *Leonis*" (152°, + 24°). On the morning of November 15 in the present year, Mr. Corder obtained a position of 150°, + 24°, from forty-three Leonids; and four of the seven paths mapped at Walthamstow at daybreak on that morning by Mr. Besley (see note on p. 174) diverged accurately from 149°, + 22°—all slightly onward in R.A. from the principal radiant-point in Leo at 148°, + 23°; but the positions are too slenderly consistent to make this small difference appear to be of very much importance.

In a watch for the Leonids, from 4 to 6 a.m. on the 15th ult. at Bristol, Mr. Denning mapped the apparent paths of ten Leonids and five sporadic meteors. Three of the Leonids (one of them a foreshortened flash as bright as Jupiter) diverged accurately from 150°, + 23°, the other seven (also including one as bright as Jupiter) being directed eastwards from the lower part of *Leo's* sickle-circle. Of the three true-pathed Leonids, a small, very foreshortened one, of 3rd mag., leaving a streak, which fell at 5.45 a.m., about 2° from η down the sickle-handle, was also seen and mapped at Slough, at 5.44½, of 2nd mag,. leaving a streak for two seconds, but shooting through 12° in half a second to near α *Orionis* from the stars in the head of *Monoceros*, this path among the stars being from 50° to 60° removed by parallax (owing to the long base line of 84 miles, nearly due east and west, between Slough and Bristol) from the short course in *Leo* which it seemed to have from Mr. Denning's place of observation. The meteor's real path was found to be from the mean radiant-point of the shower at 150°, + 23° (then about 60° high above the S. by E. horizon), shooting steeply down through 24 miles, from 70 miles over a point 8 miles south, to 50 miles above a point 7 miles W.N.W. from Blandford, in Dorsetshire, the earth-point of this course being near enough to Bristol (about 20 miles south) to give a nearly end-on view there of the swift flight, subtending only 2°, while at Slough, where the flight was seen breadthwise, though more distant there than from Bristol, it subtended an arc in the sky of fully 12°. The computed speed of flight, 48 miles per second, although certainly terrific, does not exceed the known meteor speed of the Leonids, 43 miles per second, very greatly. One of the sporadic meteor-paths observed by Mr. Denning was directed from the vicinity of λ *Hydræ*, and the other four apparently from *Gemini* or *Taurus*, and from *Ursa Major*.

A fairly satisfactory comparison of this year's observations of the Leonids with the views obtained of them last year, although much frustrated by the cloudy weather which prevailed in England on those nights, in both years, when the earth's passage through the densest part of the meteor-system was expected, may be made rather scantily, but perhaps not insufficiently to show the increased intensity of the display this year in its gradual progress onwards towards its maximum The subjoined figure was prepared to assist the recognition of the separate streams of which returning signs have no doubt been visible in some of the present year's and of the last two years' watches. The relations of the leading and following side-showers, *a* and *b* in the figures, to the central one A, in duration and separation-distance, are supposed to be as shown by Mr. Marsh's similar projection in a figure[1] of the chief showers in 1865–68; for the leading showers, 12 hours, ending 6½ hours before, and for the following shower, 13½ hours, beginning 6 hours after the limits of the middle-shower's duration, whose entire range, in time, on the ecliptic also only reached 4½ hours for the two tracts together in which the earth there met with and passed through the middle stream in 1866–7.

The central stream's node on the ecliptic is also supposed to have been constantly, and to be still advancing at the mean rate, found for it by Prof. Newton and Prof. Adams, of 28′ or 29′ from a fixed, or of 57′ from the mean movable equinox, in each complete period (33¼ years) of the stream's revolutions; so that the earth returns to the meteor-node in 41½ minutes more than a true tropical year (amounting to 23 hours in a meteoric cycle), and in 30½ minutes more than a mean Julian year. The Leonid showers thus recur in successive years, as the figure shows, 6½ hours later in each year than in the previous year; but the 6 hours in this amount are corrected every fourth year, as in the present leap-year, by the supernumerary day, and only the half-hours accumulate in long times, and made the return of the after-stream *b* this year fall 14½ hours later, on November 14, than its appearance 28 years ago, in 1868[2] (for 13 or 14 hours, from near midnight in Europe until after daybreak in America) on the morning of the 14th then; and even shift its time of appearance into lasting on now, apparently through all the morning hours of November 15.

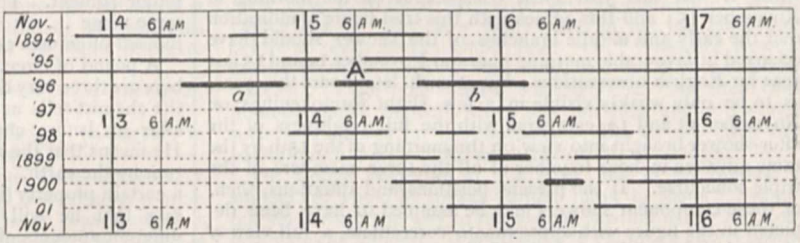

FIG. 1.—Probable times of recurrences of the Leonid meteor-shower and of its lateral branches, in the recent and coming years, 1894–1901; assuming the node of the meteor-orbit to have moved since 1866–7 with its observed and calculated mean motion.

No striking exhibitions this year of either the middle or the preceding showers A and *a* appear to have been noted. At Slough, on the morning of November 13, only one true-pathed Leonid, with two from Cancer and Hydra, and three sporadic meteors were recorded in a sky half-clear, from 2 to 4 o'clock. In a watch of two or three hours on the same morning at Bridgwater, Mr. Corder noted twenty meteors, at a rate of eight per hour, and only five of these, or about two per hour, were Leonids. On the morning of the 14th, when the sky in England was generally overcast, similar numbers were observed; by Mr. Corder, in a sky often foggy, thirty-three meteors being seen at

[1] Reports of the British Association, 1869, pp. 293–4.

[1] Given in the discussion of those showers by Mr. B. V. Marsh, already cited above, in the Reports of the British Association, 1869.

[2] *Ibid*, 1869, pp. 289–94.

the rate of 8–13 per hour, of which only a small proportion still were Leonids, and by Mr. Blakeley at Dewsbury, who noted, from 12 to 4½ a.m., with two hours of quite clear sky at last, forty meteors, never appearing faster than fourteen per hour, among which were twelve Leonids with an hourly rate never exceeding six. Four or five of the Leonids were very bright, and their radiant-point was well defined at 150°, + 24°; but the whole display fell considerably short in brightness of that observed in 1895.[1]

Perhaps the three close-following meteor-showers may all have fallen a little later this year than the figure represents them; but the first few hours of watches on the mornings of November 13 and 14 should at least, as the diagram shows, have been (as they were) both slenderly productive times, while a bright meteor-shower should have prevailed (as it did, rather vividly) on the morning of November 15. On last year's November dates the case was different, a rather bright array of Leonids being seen on the morning of November 14, followed by a smaller one on November 15, while after the latter date a generally clouded state of the sky in England prevented further observations. At Bridgwater, on November 14, Mr. Corder mapped eleven Leonids between 2 and 4¼ a.m., and found their radiant point at 152°, + 23°. Five or six Leonids were recorded here between 12 and 3 a.m. on that morning, with a radiant-point at 151°, + 23°, to which were also traced the paths of two Leonids mapped between 1 and 2½ a.m. on the next morning of November 15, when the shower seemed to be passing off, and when clouds on that and in the next night's watch prevented a complete view of the shower from being obtained at Bridgwater, and generally in England. The spectacle was thus most prominently seen last year on the mornings of November 14 and 15, while it was this year most conspicuous on the morning of November 15; and this agrees with this trial-figure's indication that the early and middle branches of the shower should have occurred at favourable morning hours on November 14 and 15 last year for English observations; but at such late hours this year, as to be only weakly visible in a few slight foretokenings on November 13 and 14, compared with the full brightness of the after-shower brought into view on the morning of the 15th by the same advance in hour together of all the three members of the triple concourse. If the present positions and durations, then, of these component showers may be assumed to have been depicted in the figure with approximate correctness, a full view *of the end* and middle portions of *the first* shower beginning to appear in the next two years, 1897 and 1898 after midnight (a.m.) on November 14, will afford means of comparing in strength and brightness those phases of the leading shower with *the middle and early parts* respectively of the *after*-coursing one, then still well visible on November 15, to gauge their relative extents in length and width, and the relative looseness or compactness of their structures, which may perhaps not offer themselves again so favourably for some years.

It will also be very useful in coming years' watches for these detached clouds of fragments from the meteor-comet, to note exactly the hours of the watches kept, the states of sky and moonlight, with the numbers and brightnesses of the Leonids and sporadic meteors seen, to enable a true distinction to be drawn between bordering diffuseness of the streams, and really distinct branch-currents or offshoots from the meteor-cloud; for between 4 and 6 a.m. on November 17, and from 2 to 5 a.m. on November 18, last year, Mr. Corder found true-pathed Leonids almost as numerous (11 out of 22 meteors, and 8 out of 30 meteors) compared with the sporadic shooting-stars, as on November 14 (11 out of 26 meteors), from 2 to 4 a.m.; while on the previous morning of November 13, from 2 to 4½ a.m. only 3 or 4 Leonids were seen among 18 meteors; showing that both gaps and condensations reaching to considerable but as yet not fully determined distances from the main streams exist to either side of them, of which the extents and the changes, or the fixity of distribution would be very interesting particulars of their modes of assemblage to endeavour to trace out by observations.

On the morning of the 27th ult., in clear sky, between 1½ and 3 a.m., seven small meteors were recorded here, two of which, of 1st and 2nd mags., and orange colour, at 2, and 2.42 a.m., between *ι* and *o Honorum*, radiated with short slow courses from between *β* and *δ*, and from near *γ Andromedæ*, and were evidently fore-shortened Andromedes; but the first of them, at least, was quite as erratic from the true centre, near *γ Andromedæ* of the Bielan shower, as the tracks through *Cancer*, *Hydra*, and *Leo Minor* of the recent showers of Leonids have been from their native shower's true radiant-point. The horary scarcity of these small Andromedes on their annual date this year, showed that no brisk Biela meteor-shower was then in active progress. On the two evenings immediately preceding and following this short morning watch, the sky here was quite overcast.

A. S. HERSCHEL.

Observatory House, Slough, December 9.

[1] The *English Mechanic*, November 27, 1896. At Funchal, in Madeira (1h. 8m. W. long. from Greenwich), Leonids were seen falling at the half-hourly rates of 6, 9, 6 in half the sky, from 4½ to 6 a.m. (about 5.40 to 7.10 a.m., Greenwich time), on November 14; the similar rates between 2 and 4½ a.m., in equally clear sky, having been only 3, 1, 1, 2 and 1 in half an hour.—Letter from Mr. W. Anderson, in the *English Mechanic*, December 11, 1896. *Note*, December 15.—A. S. H.

The Force of One Pound.

DR. LODGE has some right to complain of the friendly post-card. I wanted the *Poundal* difficulty to be threshed out in public, and we had just been writing to each other about it, but I quite forgot that my post-card might give him the wrong notion that my general remarks referred to him. Dr. Lodge knows that the real question before us concerns the Poundal; he knows that his advocacy of it has helped to maintain that unit in its academic position, and yet he now leaves its defence to others. He professes his love for all units, and attacks the poundalists and the poundists impartially, for suggesting adherence to any system in particular. This is better than his own maintenance of the Poundal, and I hope that it presages a complete change of front. His maxims are of the best: "Urge clearness of idea and accuracy of speech on all who deal with the junior student. These should not call different things by the same name . . ." But what if they continue to do so? He himself often uses *velocity* when he only means *speed*.

A pound of force, a pound of stuff, the inertia of a pound; here are three very different things all with the same name. When the chemist tells us that there is the same quantity of matter after as before chemical combination, what does he mean? He means that the *weight* of it is the same; the force of attraction by the earth. A certain amount of oxygen is equivalent in a certain property (its weight), to a quantity of hydrogen, and he says that he will call the quantities equal. Certain quite different amounts of them are *equivalent* in another property; he has exactly the same reason for calling these other amounts equal. A ton of iron is equivalent in a certain property to two ounces of gold. Why not call these amounts equal?

A pound of gold is no more the same as a pound of iron, because their weights and inertias are the same, than two chairs are the same as one table because they may be equal in value. I hope that Prof. Fitzgerald may be induced to say something on this head, the "huggermugger" of confounding quantity of matter with inertia; for I think with him that this is what produces far more confusion in the minds of students than the use of many different units for things of the same kind. The practical engineer has uncommon good sense, he hates the Poundal, and I think that Prof. Fitzgerald is right when he says that it is not merely because it is a new unit, but because it is founded on "huggermugger." Let Dr. Lodge read Mr. Jackson's letter which followed his own. He will see that Mr. Jackson cannot comprehend how anybody can avoid using the pound of stuff as a fundamental unit, and how it must be innate perversity which causes engineers to adopt as their unit of inertia (or mass, as they have unfortunately to call it), the inertia of a body to which the unit force gives unit acceleration. This is the fruit of the Poundal; no doubt its inventor thought of inertia. Mr. Jackson thinks of quantity of stuff, which is a conventional or metaphysical idea.

The standard units of time, of force, of inertia; we can only keep them in indirect ways. Assuming that waste is prevented and that the weight and inertia of a certain body measured under the same circumstances at the same place are always the same, any standard body with proper comparing instruments gives us our standards of force and inertia. The instrument for comparing forces is ready to hand, a good weighing balance. There is no instrument which can be relied upon for comparing inertias, so we fall back upon an indirect method, assuming that inertia at any place is proportional to weight. But it is to be noticed that all our practical acquaintance with inertia and with what we call quantity of matter is based upon our measurement of *weight*, of

force. A piece of metal is kept in London; it is defined as having there the weight of 1 pound, but only if weighed in a vacuum. Because it has this weight it is called 1 pound of stuff. Because it has this weight its inertia is said to be that possessed by a body whose weight is 1 pound. Now there are your standards in one piece of metal and in its environment, and in your instruments. You can keep the name 1 pound as the *weight* according to law, or you can call 1 pound the *inertia* of the body, but you cannot call it 1 pound of quantity of any material except of that particular kind of P*t*. Which is more convenient? To call it the unit of a kind of P*t* is too restrictive. To say that it has 1 pound of inertia is not more scientific than saying that its inertia is 1/32·19. As to convenience, note that we almost never need to speak of the *inertia* of a body except on our way to a dynamical calculation. The claim of *weight* of 1 pound as a unit of force is ever so much greater; for (1) there is the legal unit in existence. It might have been defined as the force required to elongate a certain spring, but this also would have been indirect. (2) All practical men use the unit already, and it is hopeless to try to alter their systems of working. All applied mechanics and engineeering books written in the English language, from Rankine's superb treatises to the commonest pocket-book, use this unit; not one such book of repute can be mentioned in which the Poundal is used and in which this unit is not used; Joule used it, and many others of our best experimenters; even physicists never compare their forces in any other way than with the weights of bodies, and the pound is legally the English unit of weight. (3) The unit is so exceedingly easy to understand that years have now to be spent in driving it out of a pupil's mind; there is no part of our universe which we can reach where we might make experiments, where the unit is not easily derivable by a small and often negligible correction from the weight of a body whose weight in London is equal to that of the standard piece of platinum, and such bodies are to be found wherever men buy and sell by weight.

I think that Mr. Jackson is well answered in a quotation, slightly altered, from Dr. Lodge:—

"To identify quantity of stuff and inertia is barbarous, to denote their units by the same name is unwise."

By the bye, I should like Dr. Lodge to point out where I have lost sight of the dimensions of *g* and treated it as a mere equivalent for 32·18. One might say that it was stupid, or thoughtless, or academic, but I hardly think that Dr. Lodge is happy in his use of the term "illiterate." Anyhow, I did not do it. Engineers do not do things of that kind.

Mr. Cumming thinks that a system of theoretical dynamics can be built upon our basis; he does not seem to be aware that the system is already built; the ordinary dynamical expressions have no more to be altered when our units are employed than when the C.G.S. units are employed, and we do not need even to introduce Dr. Lodge's method of writing, which gives so much trouble in all but the very simplest algebraic expressions, but which certainly enables him to use any units whatever. I am afraid that it is known only to a few people as yet, but it is well worth knowing, being almost a necessity if one uses the Poundal or the Hogshead. It is simply this: every quantity goes about with a label as of a sandwich-board round its neck. Parenthetically I may say that Mr. Cumming is mistaken in thinking that engineers use the C.G.S. units in working with such fundamental equations as

$$V = \left(R + L\frac{d}{dt} + 1/K\frac{d}{dt}\right)C.$$

They use volts, amperes, ohms, secohms, farads, and seconds. Why else were the practical units invented? They were invented by practical engineers who at the same time invented the C.G S. system, because they found that for the working of engineering problems, accurate answers and not merely academic logic was wanted. Unfortunately the academic 4π trouble was introduced, and till it is removed the practical man feels that life is a burden. These engineers were, as so many of our best engineers have been, trained at Cambridge, and this is one reason why I do not like to hear Dr. Lodge throw so much blame on Cambridge text-books. My opponents are not in agreement among themselves. I wish they were all as catholic in their sympathies as he. He wonders why people object, and who they are who object to the term *centrifugal force*. I think he must know many; anyhow there are certainly some, for they have told me so themselves during the last few weeks. And even he is now disposed to prohibit the use of a word, never used wrongly by engineers, because the present generation of academic persons have found out that their predecessors had very wrong notions.

I do not see why he should speak so disrespectfully about that most wonderful property of a body, its attraction by and for the earth, which I will call its *weight*. He calls it "a curious and ill-understood deportment," and his dislike for it is due to its having "laid such hold of the engineer's imagination that he has begun to think it the most fundamental property of matter." I am glad that he concedes the engineer an imagination in spite of his not understanding the so easily understood "etherial stress." For my part, I acknowledge great ignorance about it, and I think it the most fundamental property of matter.

His students are very happy; they know all about etherial stress; they know how to use all units, any units, to get along with no units, and, in fact, Dr. Lodge seems to think that what he himself knows, after all his years of study, must also be known to his students because he has told them. I may say that I also delight in using all sorts of units.

I perhaps go further than Dr. Lodge, for I regard algebra as the best of all mediums for translating phenomena into mental processes, and I should not object to the multiplication of a cows + b bridges with c cows + 5 tons of sugar, if I could see any use in giving a meaning to such things as cow × cow or cow^2 (curiously enough, Dr. Lodge would object to cow squared as a colloquial reading of cow × cow), or cow × bridge. But surely the student described by Dr. Lodge is a very exceptional philosopher, a boy of eighteen, with all Dr. Lodge's knowledge. Is he not assuming that because a student gets marks on an examination paper, he really knows his subject? How easy it is for a student to get full marks for "What is Ohm's law"? But how many years of his life must elapse before he really knows Ohm's law? Or "What are Newton's laws of motion"? How very easy, and yet how exceedingly difficult. Take force = mass × acceleration. A student thinks he understands perfectly what you tell him, and can work all sorts of exercises on this statement. But let the thing come before him in a new form, and where is his knowledge?

Dr. Lodge *thinks* in all his units, and in my opinion the students of whom he speaks cannot think in them. I want to put students in the way to the mental position which Dr. Lodge postulates as the best. I want them to get into a higher position still, that of the engineer who is able even to think of the same sorts of terms in one equation being in quite different units.

Dr. Lodge would dilate on the ignorance shown by this engineer. Mr. Barrie, in describing two boys in one of his books, says, "Shovel knew everything, but Tommy knew other things."

In my article I refer to the persistent scorn of the academic philosopher for the engineer and the harm that it has done. Surely Dr. Lodge might restrain it a little in a public discussion. All English-speaking engineers use the force of one pound as their unit, and Dr. Lodge sneers at it as the colloquial unit of the shire in which an engineer happens to live. The shire is a very extensive one. It needs a globe to show it all. He sneers at the Heaven-born engineer of whom I spoke, and of his wish to advance in his profession, and the mutilated fragment of science and pocket-book information which serves for commercial purposes. He seems to be very proud of his ignorance of these commercial purposes to which so many students of higher physics mean to devote themselves, and yet he is not backward in expressing his opinions concerning them. He says: "May I tell Prof. Perry what is at the root of the perennial debate between engineers and teachers of mechanics? It is the subject of *acceleration*. An engineer's bodies are nearly always either at rest or in uniform motion, their accelerative stages he is usually able to ignore." If anybody can speak on this subject, surely it is I. I was trained in the shops and at college as an engineer, and I have done a good deal of engineering work, and I teach mechanics. I beg to say that Dr. Lodge is quite wrong in this. When I wrote about professors and engineering students I did not once think of him. I think now that he has written in haste, and that he cannot seriously put forward the view that the very most elementary idea of kinetics is unnecessary to the actual professional work of the engineer! Is it, then, of no use in any practical work of anybody? Has Dr. Lodge no students who think of the forces acting between the parts of reciprocating machinery, of the balancing of engines, of the action of governors, of the effects of centrifugal force? It

is a very grim joke, but we must bear with it and many others of the same kind, and in the meantime we do say that we agree with Dr. Lodge in his notion that our true and only natural foes are ignorance and prejudice. This ignorance of the needs of mere mechanical persons and prejudice against attempts to teach them, are fashionable now among scientific men. At the recent dinner of the Royal Society quite a genteel titter greeted a casual reference to technical education in one of the speeches.

I like algebra myself, but I do not think that it is the only possible conventional way of making an exact statement. However, taking Dr. Lodge's student with his "true from the bottom upwards and entirely true," mariner's formula to find a certain academic distance; is it quite certain that he will think of using it in a practical case? In my experience it is the very last thing that will enter his mind. I should not call him an ass, as Dr. Lodge does; he only follows Plato's maxim, not altogether neglected in English education, that philosophy ought to serve no useful purpose. The Wrangler's naïve faith, when he does condescend to a practical problem, is generally shocked in finding that such problems require the addition of a little common sense to the formula. Now I do not object to a man's finding out the usefulness of a rule (call it a mere numerical rule if you like, but it is evidently a very different thing), in actual practical examples before he understands how it is derived, for I am confident that he will then be easily induced to inquire how the rule is arrived at; he will go further and think of the evidence for the roundness of the earth, and indeed it may prove to be the starting-point in his scientific education. I grant you that he will not go far if his instructor makes him begin his studies with the six books of Euclid. Why does the mariner remain so ignorant of mathematics although he uses the results every day? Surely he wants to know the why? Yes, indeed he does, but you have taught him that he cannot know the why unless after years of quasi-philosophic worry.

When I spoke of the practical knowledge needed by the engineer, I meant to include such knowledge of physics as is possessed by Dr. Lodge himself; I mean no mere pocket-book knowledge. Before a student can get to this higher region he needs to be taught to think, and it is in our notions of this preliminary training that I differ from Dr. Lodge.

I do not care much what a man's system of teaching may be; if it is his own, however faddy, he will teach his students better than on a better system, not his own. But we must acknowledge that the average teacher needs a system to be given to him, and this ought to be the best system. Well, I think that the existing system is about the very worst possible. We compel a student to boggle at imaginary difficulties. We worry him for years over four books of Euclid; we have given up the fifth book, and even the supplement to the fifth, but we still worry him with the sixth, and then go on to geometrical conics. Now even the sixth book merely involves ideas which every boy takes in without much difficulty; it is so natural to think of using any unit of length, that Dr. Lodge forgets how the ideas of the sixth book are needed in his simple mariner's rule. But as soon as a student begins his work in physics, he is rushed over difficulties to which the difficulty of thinking about the mere ratio of lines is nothing. I do not say that he ought not to be suddenly surrounded with ideas of the sums and differences and ratios of all sorts of scalar and vector conventions for quantities, and told to sink or swim among them. I think this the very best thing for him; but what of your consistency in mind-training, of the philosophy of your methods? Dr. Lodge compels me to describe my non-academic way of teaching. I thought that everybody knew it, but evidently he does not.

I believe in using the experimental method from the beginning; of squares and ratios of sides of all sorts of right-angled triangles being figured out by the boy of eight years of age, to see how near he gets to tabulated sines and cosines. I believe in his measuring time and lines and forces with the watches and scales and balances which are in common use; in testing the rules of mensuration of areas and volumes, and the finding of weights of bodies by calculation; and it is only when a boy has a good quantitative knowledge from his own experience that I trouble him with the philosophy of mathematics and physics, and then I do it cautiously. I make beginners plot curves on squared paper—curves showing the rate of increase in the price of silk or cotton or the height of the barometer, or the National Debt or other things given in Whitaker's Almanac—in telling them about the slope of a curve and its analogy with velocity and acceleration and dy/dx and ds/dt and d^2s/dt^2. They "graph" all sorts of curves; they add and subtract vectors by actual drawing, and their lectures and laboratory work and graphical and numerical exercise work go on simultaneously.

Some of my academic friends not only refuse to let a student use a formula, but they refuse to let him use a table of logarithms until he can calculate logarithms. To be consistent they ought to refuse the use of a watch or of clothes until a student has shown aptitude in the watchmaking and tailoring trades. I let my students use any appliance whatsoever if I think that it will give them a better acquaintance with natural phenomena; anything that will cause them to think. As a student gets on I let him take all sorts of liberties in regard to units; he uses w/g for m; he speaks of centre of gravity instead of centre of mass or centre of area.

Also, I venture to tell Dr. Lodge that the very best of my students, who know something of Bessel functions and spherical harmonics and elementary St. Venant work on the torsion and bending of prisms, and something about generalised coordinates, are taught to have the very highest respect for the rule-of-thumb practical methods of calculation in use among engineers. They are taught that the engineer has to deal with things that are by no means so simple as the ordinary laboratory phenomena, and that rules arrived at through the trials and errors of generations of practical men are worthy of some respect.

Lastly, I may say that we are tired of the whole academic system which recognises no philosophy or literature or art which is not studied as a dull grind for examination purposes, and I am thankful to say that we have indeed "a sympathetic faith in a much larger training."

JOHN PERRY.

December 17.

The Earthquake of December 17.

IT may interest your readers to know that the recent earthquake of December 17 was shown slightly on the declination curve, and more distinctly on the horizontal force curve, at Kew Observatory. The time of commencement was 5h. 35m. a.m. (± 1 minute) G.M.T. The disturbance on the horizontal force trace approximately equalled what would have been produced by a change of 0·00004 C.G.S. units in that force.

CHARLES CHREE.

Kew Observatory, Richmond, Surrey, December 19.

EARTHQUAKE shocks occurred in Worcester at 3.35 and at 5.31 a.m. on Thursday. The 3.35 shock was feeble, of short duration, and was noticed but by few persons. But the visitation of 5.31 exceeded in violence any previous instance of seismic energy here within the present century. There were in the 5.31 instance two shocks following each other with a bare interval. The shocks consisted of a series of rapid vibrations, too rapid to admit of count. These shocks were preceded by a roar as of thunder. Some describe the roar as that of the noise of a "rushing mighty wind." My house was shaken with appalling violence, displacing roof tiles, and forcing open a closed chamber door. To me the shocks seemed to proceed from north to south. The duration of the shocks lasted between four and five seconds. Some say the shocks lasted fifteen seconds; but if the earthquake had lasted so long, my house would have been down. As it was the house was rocked to its foundation, and the sensation was appalling. Persons whose bedrooms faced the north, saw a great light accompanying the earthquake. This peculiarity is by some attributed to lightning, by others to the effect of a large meteor. Mr. Russell Dirrell, of North Piddle, a place seven miles east of Worcester, saw at the time of the earthquake a great blaze of light low in the northern horizon, continuing for two or three seconds. He was unable to attribute the blaze to a lightning effect. At the homestead of Mr. Walters, of Hallow, three miles north of Worcester, the inmates were thrown out of bed, as was the case in several other instances in the same village. Here the shocks were most severely felt at places on the west of the Severn. In Worcester the shocks created general alarm. Bells were set ringing, shut doors forced open, windows rattled, heavy wardrobes displaced, earthenware scattered about, in some instances broken, but no one was injured. A strong fixed wash-hand basin in a lavatory was split to pieces. The church clock of All Saints, on the east of the Severn, was stopped at 5.15 a.m. As seems to be usual in such cases, poultry and pheasants flew down from their perches and showed signs of distress, birds flew aimlessly about and

clamoured. Graziers noticed that their milch cows were greatly trembling and seemed dazed, and horses ran about the pastures. During the shocks the river Severn here suddenly surged and angrily foamed up to the level of its banks, subsiding to its former level on the cessation of the 5.31 shocks. At Hallow, a labourer stooping to lace his boots was pitched headlong into the fire.

The season here has been marked throughout by exceptionally low readings of the barometer, such as 28, 50, 28, 70, and 29. The thermometer in my bedroom at 5.31 on the 17th was 38. The direction of the wind was northerly.

Worcester, December 19. J. LLOYD BOZWARD.

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(1) THE only record that I have seen here, undisturbed as yet, of the measurable displacement of any object by the shock, is that of a large iron ornamental vase on pedestal, weighing at least 100 kilos., standing in the middle of a lawn on a stone foundation sunk in the ground. This has been moved sideways on its foundation through a space of 3 cm. I laid a long straight lath close to it in the approximate direction of displacement, and took compass readings near each end of the lath (to eliminate any deflexion due to the mass of iron). The mean of the readings gives magnetic N. 18° 30′ E., as the direction of displacement of the mass. The true direction may, however, have been rather nearer to magnetic N., for the pedestal is square and slightly sunk below the surface; and as the sides were forced obliquely against the turf, the motion may have been deflected from the line which would have been taken if there had been no resistance.

(2) One piece of evidence that the plane of the oscillation here was mainly, at any rate, horizontal, may be worth giving. I have a barograph (Richard Frères pattern) screwed firmly to a bracket attached to one of the internal walls of the house. The long recording arm of this is so sensitive to changes of vertical pressure, that the mere employment of a housemaid's brush near the instrument is enough to cause a vertical displacement of 1–2 mm. in the ink-trace; and, contrary to instincts of tidiness, I have had to give a caution against dusting operations in the neighbourhood, so many "dust-storms" have been graphically registered.

If, then, there was any vertical movement in the wall during the shock, there would undoubtedly be a straight vertical line on the ink-trace. If the movement was purely horizontal, the pen would simply be jerked away from the paper, and would fall back to its former position.

I examined the register shortly after the shock, and could find no trace whatever of any vertical irregularity in the barometric trace. The air-pressure, I may also mention, was remarkably uniform during many hours preceding and following the shock.

(3) Lastly I would note, as an evidence of weakness and probable strain in the strata of this district, the extensive line of fault (or rather two parallel adjacent faults) which runs nearly N.N.E. and S.S.W. through Newent, between the Malvern Range and Hereford, where the shock seems to have been most severe. On the west side of these faults, we have on the surface the Old Red Sandstone; on the east side, the Keuper Marls, the Old Red having been thrown down at least 4000 feet.

Gloucester, December 19. E. R. P.

THE EARTHQUAKE.

UNTIL last Thursday, the great Essex earthquake of 1884 held the premier place among British earthquakes of the last few centuries. So far as structural damage is concerned it is not yet displaced from that position, for, though in many places chimneys were thrown down by Thursday's disturbance (at Hereford at least one of the pinnacles of the Cathedral was damaged), yet there does not appear to have been that wholesale destruction which marked the Essex earthquake at Colchester and the surrounding villages. With regard to disturbed area, however, the inequality is reversed.[1] Though the recent shock occurred at a time (5.32 a.m.) when many observers were asleep, there can be little doubt that it was practically felt over the whole of England and Wales. At present we have only to exclude the terminal counties of Northumberland, Norfolk, Suffolk, Kent and Cornwall; and possibly these exceptions will disappear when fuller details are obtained. So far, no record has come from Ireland, but there can be little doubt that it must have been felt along the east coast, if not for some distance inland.

With regard to my own observations, I was roused at 5h. 32½m. from a dream of earthquakes, by a series of fairly strong regular vibrations of approximately equal intensity. Those I felt obviously belonged to the second half of the shock; they were eight in number, occupied exactly three seconds, and were of equal period, except that between the fourth and fifth the interval was half as long again as between the others. The motion was distinctly lateral, from a nearly westerly direction, the return movement being less perceptible than the forward, so that the shock appeared to consist of a series of firm powerful shoves. No sound was heard during these last three seconds, though I awoke with a feeling that the noise had just ceased; and this fact led me at once to assign a somewhat distant origin to the shock, possibly somewhere in Wales. As telegrams gradually arrived from various parts, it became evident that the epicentre must lie to the south-west, at some fifty miles from Birmingham.

The area within which buildings were damaged, includes Hereford, Ross, Worcester, Gloucester, Dursley, Cinderford and other places, and is not less than thirty miles in length. It would be premature to make any definite statement as to the exact position of the epicentre, or to suggest any fault with which the earthquake may be connected. But when these places are plotted on a map, one cannot but be struck by the fact that the district within which they lie agrees very closely with the epicentral areas of two previous earthquakes, those of October 6, 1863,[1] and October 30, 1868.[2] The former of these was a distinctly strong shock; and even now, in making earthquake inquiries in the district, I frequently receive references to it.

As I am collecting materials for a memoir on the earthquake of Thursday, I should be glad if I might take this opportunity of appealing to all readers of NATURE who can in any way help me, either by describing their own observations, or inducing others to do so. A brief list of questions having recently appeared in NATURE (vol. xlvi., p. 401), it is unnecessary to reprint them here.[3] They will also, I hope, be found in many local newspapers. If those who have the opportunity would examine the records of self-registering instruments, some useful information might be obtained with regard to time of occurrence at different places. I need hardly say how interesting it would be to have photographs of buildings which have been in any way damaged by the earthquake. I should also be very grateful for any notes, however scanty, on the earthquakes of 1863 and 1868; for, if the suggested connection between them and the recent shock should prove a true one, they will in all probability furnish important evidence as to the later stages in the growth of the originating fault. C. DAVISON.

373 Gillott Road, Birmingham, December 19.

P.S.—Since the above was written, I have received records from places in each of the counties mentioned above as apparently undisturbed, and from one place in Ireland (co. Wicklow). C. D.

December 22.

[1] The disturbed area of the Essex earthquake is estimated by Messrs. Meldola and White at about 50,000 square miles. This has been exceeded on two later occasions by the Pembroke earthquakes of August 18, 1892, and November 2, 1893, a paper on which will be read before the Geological Society on January 6 next.

[1] E. J. Lowe, F.R.S. "History of the Earthquake of 1863, October 6." Brit. Meteor. Soc. *Proc.*, ii., 1865, pp. 55-99.

[2] Symons's *Meteor. Mag.*, iii., 1868, pp. 153-154.

[3] See also *Knowledge* for August 1896, pp. 190-191.

NOTES.

THOSE who take a great interest in the welfare of our Colonies will be glad to hear that the Queen has been pleased to appoint General Sir Henry Wylie Norman (Chairman), Sir Edward Grey, Bart., and Sir David Barbour, to be Commissioners to inquire into the conditions and prospects of the West India Sugar-Growing Colonies; and Mr. Sydney Olivier to be their Secretary. Mr. Daniel Morris, Assistant Director of the Royal Gardens, Kew, will accompany the Commission as expert adviser in botanical and agricultural questions. The appointment of Mr. Daniel Morris as scientific adviser is a proof that Kew has been working for the last quarter of a century on the right lines, and that its policy is a sound one. Of all the Colonies in the West Indies, Jamaica is the only one in a fairly prosperous condition. This has been brought about mainly by the work of the Botanical Department, and the encouragement given by it to improve agricultural methods and introduce new industries. The Commission starts early in January, and will be away altogether about four months. It is regarded as one of the strongest that has ever been sent from this country.

AT the annual meeting of the Paris Academy of Sciences, on Monday, an Arago medal was awarded to Lord Kelvin in honour of the jubilee of his professorship in Glasgow University. M. Cornu (the President) is reported by the *Times* correspondent to have referred in glowing terms to the celebration at Glasgow. "Nothing," he said, "was more touching than the number and unanimity of the testimonies offered from all parts of the world to this descendant of a family of Irish farmers, who by his intellectual power has gained universal renown, and has earned from the suffrages of his admirers the highest scientific dignities, and from the Government of his country the highest social rank. Nothing is more consoling for the future than the spectacle of these honours rendered by delegates of all nations to great men of science like Lord Kelvin and Pasteur, who so worthily represent science in its loftiest and, at the same time, most beneficent aspect. Modern nations, though crushed by the yoke of material interest and by the barbarous law of blood and iron, know how on great occasions to raise their eyes towards the serene regions above animosities and covetousness, and to honour in unison the great men whose labours increase the common patrimony of intelligence and their country's prestige, as well as the welfare of mankind."

PROF. ARTHUR SCHUSTER announces to us the discovery of a somewhat important new law, connecting the wave-lengths of different lines of the same element. If the lines of an element be divided into series according to Kayser and Runge, the law may be enunciated as follows: "The difference between the frequency of the fundamental vibration and the frequency towards which the lines of the principal series converge, gives the convergence frequency of the two subordinate series." Prof. Schuster finds that the law holds in all the cases for which Kayser and Runge have established the existence of a principal and subordinate series, *i.e.* for the alkalis and the two constituents of cleveite gas.

SEVERAL communications on the recent earthquake will be found in other columns of this issue of NATURE. As observations of the times at which the disturbances were felt are of importance, we add that Mr. Alderman Andrews, of Coventry, informs us that he was awakened by a loud rumbling noise at 5h. 35½m. Mr. George J. Burch, of Oxford, did not note the exact time, but he carefully observed the phenomena. He says: "I was awakened by the hooter at 5.30, and had not gone to sleep again. About ten minutes later I was aroused by a movement of the door, as if some one was about to come in, but became instantly aware that the sounds proceeded from the whole of that side of the room. Immediately after, there was a heaving motion of the bed, as if powerful hands had gently raised the mattress slightly on that side, and let it drop. By this time I was sitting up, and distinctly felt the room rock two or three times like a small boat when a steam-launch has passed at some little distance. This was followed by a sudden strong lateral vibration lasting several seconds. There was a good deal of rumbling noise at this time, undoubtedly due, to a great extent, to the creaking of the house and rattling of the furniture, but whether entirely so or not, I am not able to say. Taking all things into consideration, I conclude that the line of the shock was north-east and south-west, and, judging from the sensation, it appeared to come from the north-east."

THE tercentenary of the birth of Descartes was celebrated at Tours, on Monday last, by the local Archæological Society.

M. LIARD, the Chief of the University Department of the French Ministry of Education, has been elected a member of the Academy of Moral Sciences, in succession to the late M. Jules Simon.

WE learn from the *British Medical Journal* that the Czar of Russia has conferred on M. Gérard, Director of the Paris Municipal Laboratory, the Cross of the Commander of the Order of St. Anne. The Cross of St. Stanislas has been conferred upon Dr. Bordas, sub-Director of the Laboratory, and Dr. Bertillon, Director of the Anthropometric service.

REFERRING to the decoration which Dr. Roux has just received from the Emperor of Germany, the Paris correspondent of the *Times* recalls the fact that "two years ago Pasteur was offered the highest German decoration which the Emperor could confer, but the great investigator refused the honour. The Emperor was apparently touched and certainly was not offended, for he has now decorated the famous Dr. Roux, the discoverer with Dr. Behring (who, moreover, be it said to the honour of the French Government, received at its hands a decoration which was approved on both sides the Rhine) of the vaccine against diphtheria, and the intimate friend and successor of Pasteur. Dr. Roux has accepted the honour, although hasty scruples of loyalty to his master might for a moment have caused him to hesitate. To a reporter of the *Matin* Dr. Roux has explained—as if explanation were necessary—his decision to accept this decoration. 'Pasteur,' he said, 'was Pasteur. His decoration had an importance and significance quite other than that which mine has or possibly can have. And then, no doubt, Pasteur had his reasons, which I have not—special memories, for instance, of 1870. In a word, he could permit himself to assume towards the German Emperor an attitude that for me is out of the question, for I repeat he had that reason which excuses him—he was Pasteur. What was extremely fine on his part, and was everywhere approved, would be incomprehensible on the part of another, and would be blamed as coming from me.' Nothing could be more proper, and the whole incident does as much honour to the modest but distinguished investigator as to the Emperor who recognises his pre-eminence."

THE *Lancet* publishes the following interesting information received from its correspondent at Rome:—"The week has witnessed one of those pleasant demonstrations of the truly fraternal spirit which scientific investigation evokes and encourages among its accredited votaries. Prof. Grassi, on whom the Royal Society of London conferred the Darwin medal for original work in illustration of the theory of evolution, was entertained at dinner by his colleagues of the Faculty of Sciences of the School of San Pietro in Vincoli and of the Faculty of Medicine. Representatives of all the fields of

research bearing directly or remotely on nature-study and biology took part in congratulating the guest of the evening on his having obtained one of the blue ribbons of scientific merit—among the said representatives being Signor Francesco Brioschi, the eminent mathematician, who presides over the Accademia dei Lincei, and Prof. Semeraro, rector of the University. The first to speak was the veteran professor of chemistry, Signor Stanislao Cannizzaro (himself a former recipient of Royal Society honours), who, in the name of the University of Catania, dwelt on the gratification felt by that seat of learning and shared by all others in Italy at the English recognition of their compatriot. After him came Signor Francesco Todaro, professor of anatomy at the Sapienza, whose speech was dedicated to an exposition of the motives that guide the Royal Society in awarding the Darwinian medal. A third speaker was Prof. Semeraro, rector of the University, who, in the name of the Senatus Academicus, thanked Prof. Grassi for the honour he had conferred on their common *alma mater*. Prof. Grassi's reply was exemplary for its modesty, its recognition of the brotherhood of science, its lofty view of the motives and methods of scientific investigation, and its bright forecast of the future. Referring to the aid, encouragement, and inspiration he had received from his academic colleagues and brethren of the biological laboratory, he dwelt with grateful insistence on the helping hand extended to him by Dr. Baccelli, who was present. The banquet closed in animated conversation, among the topics of which was the *rapprochement*, just signalised in Prof. Grassi's case, between British and Italian research."

THE announcement made last week to the effect that Dr. Thorne Thorne is inspecting the vaccination systems abroad is confirmed by a statement in the *Times* that the Government has a full intention of introducing next Session a Bill to promote free vaccination throughout England on some such plan as obtains on the continent. In order that the Local Government Board should have details of the mode of dealing with this question abroad, a small committee, presided over by Dr. Thorne Thorne, principal medical officer of the Board, has been for the last fortnight in France and Belgium. The committee first visited Paris, where the members were shown over the Institut Vaccinal, affiliated to the municipality of Paris, and afterwards saw the mode of treatment at the Académie de Médecine, where vaccine lymph is distributed gratuitously, after admixture with glycerine, throughout France at the expense of the State. From Paris Dr. Thorne Thorne and his assistant travelled to Brussels, and were there shown over the École de Médecine Vétérinaire, the State Department for Belgium, and afterwards the whole work of vaccination was explained at Dr. Janssen's Vaccination Department under the municipality of Brussels. It was intended to extend the inquiry, but, other medical foreign departments not being quite ready to receive the expert committee, Dr. Thorne Thorne has returned to London. The committee will start again in a couple of weeks for Germany, to examine the question there, and this will be of a more extended nature, as German vaccination depôts are more widespread.

THE trial trip of the torpedo boat *Turbinia*, which has been built by the Marine Steam Turbine Co., Limited, for the purpose of testing the application to marine propulsion of the Hon. Charles Parsons' steam turbine engine, was a really remarkable performance. An account of this trip, which took place on the 15th inst., is given in the *Newcastle Daily Chronicle* for the 17th, from which we make the following extract:—"Several most successful runs were made, and the very high speed of 29·6 knots was attained over the measured mile. It is believed that this is a speed greatly in excess of anything that has ever been previously accomplished by a vessel of the small dimensions of the *Turbinia*, which is only 100 feet in length, 9 feet in beam, and has but 42 tons displacement when fully loaded. Indeed, the speed already attained upon this preliminary trial trip by this small boat nearly approaches the maximum limit of speed so far attained by the largest torpedo boat destroyers, which have more than twice her length and about six times her displacement. Having regard to the fact that this was only a preliminary trial, and that it was shown that there was a considerable reserve of power still to be called upon, it is anticipated that a still higher speed materially in excess of the remarkable result already obtained will eventually be realised. In any case, the obtained results as recorded above, are such as cannot fail to be of extreme interest to all naval architects and marine engineers." A correspondent writes:—"The circumstance that the time-honoured piston engine seems to be beaten for marine propulsion at high speeds by what may be looked on as a more primitive machine, is striking. The *unexpected* speed of all modern torpedo boats is indeed a matter of much interest to the students of even theoretical hydrodynamics."

THE Congrès des Sociétés Savantes will be opened at the Sorbonne, Paris, on April 20, 1897, and will continue in session for three days.

TWO of the three Royal Institution's Christmas lectures, on "Visible and Invisible Light," will be given by Prof. S. P. Thompson, F.R.S., on Tuesday and Thursday afternoons next week.

THE following are among the papers to be read at the meetings of the Society of Arts after Christmas:—The roller boat of M. Bazin, by Émile Gautier; English orchards, by George Gordon; the prevention of fires due to leakage of electricity, by Frederick Bathurst; dairy produce and milk supply, by M. J. R. Dunstan; the transmission of power by alternating electric currents, by W. B. Esson; London water supply, by Prof. Percy F. Frankland, F.R.S.; the chemistry of tea, by David Crole; children's sight, by R. Brudenell Carter; light railways by Everard C. Calthrop; cycling—historical and practical, by George Lacy Hillier.

WE regret to announce the death of Mr. Sidney Waters, a familiar figure at the Royal Astronomical Society, and the author of several interesting papers and charts. He was elected a Fellow of the Society in 1873, in which year he read two papers on the distribution of resolvable and irresolvable nebulæ, and the distribution of the clusters and nebulæ. A paper on the distribution of the stars in the southern hemisphere appeared in the *Monthly Notices* for 1878, and his last work consisted of two very fine maps showing the distribution of the nebulæ and clusters in Dr. Dreyer's Catalogue. Mr. Waters will be sorely missed and deeply regretted by every one who knew him.

A LARGE meteor was seen to pass over New York City from west to east at twenty minutes past five on December 4, while it was still daylight. It was noticed by observers over a wide range of locality, from points nearly twenty miles north, to Staten Island on the south.

THE New York Aquarium at Castle Garden was opened on December 10, with about one hundred species of fish already collected. The galleries will not be entirely finished for a month or two. The stock will be increased in the spring by importations from Florida, Bermuda, California, and elsewhere. Over 11,000 people visited the Aquarium on the opening day.

AFTER conducting the *Zoologist* for exactly twenty years, Mr. J. E. Harting has resigned the editorship owing to increased demands upon his time, and in order to be able to devote himself to the preparation of new editions of some of his books on birds, and to complete an original work on "British Quadrupeds," for which he has been collecting material since 1874. The *Zoologist* was founded in 1843 by the late Edward Newman,

who conducted it until his death in 1876, when Mr. Harting undertook to carry it on. There has thus been but one change in the editorship from its foundation until the present time. Some difficulty has been experienced in finding a competent successor, but it is now announced that the new editor is to be Mr. W. L. Distant.

THE establishment of a big game preserve in British Central Africa has been noted by us upon several occasions. It is now stated that Mr. Alfred Sharpe, the Acting Commissioner, has just issued a series of regulations providing that on and after September 15 last a certain portion of the protectorate shall be "considered and treated as a preserve." In this district "it shall be illegal for any person or persons to shoot, trap, net, or in any way molest any description of wild game within such limits without a written permission from Her Majesty's Commissioner and Consul-General." The regulations further provide for the inspection and, if necessary, withdrawal of any licences granted by the Commissioner, and for the punishment of any breach of the regulations. The tract of country thus reserved is known locally as the Elephant Marsh, and lies on the Shire River above Chiromo. It abounds in buffalo, water buck, and zebra, but unless some such regulations as those just issued were passed it is believed that at the rate at which they were being shot all these animals would have practically disappeared in a few years.

THE *Bulletins* of the Constantinople Meteorological Observatory for March and April contain a study, by Dr. G. Agamennone, of an earthquake felt in the north-west of Asia Minor on April 16. The observations forwarded to the central office are neither numerous nor detailed, and it has not been found possible to determine the origin even approximately. Considerable damage was, however, produced in the village of Amed (lat. 39° 17′ N., long. 29° 15′ E.), and it is probable that the epicentre was not very distant from this place. The shock was felt over a district about 325 km. in diameter, and nearly 80,000 square km. in area. A good time-record was obtained at Constantinople, but the pulsations do not appear to have affected distant pendulums, unless a small movement recorded by the Vicentini microseismograph at Padua can be referred to this earthquake.

THE Pilot Chart of the North Atlantic Ocean for the month of December, issued by the Washington Hydrographic Office, shows that between the Azores and Newfoundland much bad weather was experienced during November, and that fresh to strong gales, principally from the west, followed each other in quick succession over the area between the Grand Banks and the British Isles. The subject of floating derelicts as a danger to navigation is again being brought prominently forward, and the chart plainly shows that the advent of the stormy season has considerably increased the number of the derelicts. Between the south-east coast of the United States and Bermuda the number of abandoned ships, mostly of the schooner build, is particularly noticeable. The ocean was free from ice east of Newfoundland, and the month was remarkable for the small amount of fog reported.

THE last number of the *Mittheilungen von Forschungsreisenden und Gelehrten aus den deutschen Schutzgebieten*, besides a map of the southern part of Togoland with valuable geographical notes appended, contains some important contributions to our knowledge of the meteorology of German possessions in Africa. Observations made at five stations in the Kamerun district during 1894 and 1895 are discussed, one important result being to bring out Debundja (lat. 4° 8′ N., long. 9° 0′ E.) as the wettest station in all Africa, and to place it only second to Cherrapunji in the world, with a mean rainfall of somewhere about 350 inches. As Debundja stands almost at sea-level, the rainfall on the hills above it, exposed as they are to the full effect of the sea-breeze, is probably considerably greater. In September 1895 alone, 74 inches were measured at Debundja, including one record of 7·40 inches in 24 hours. Another paper gives an excellent summary of existing observations of rainfall in German East Africa.

IN connection with the recent important investigations on the artesian waters of Queensland, Mr. Gibb Maitland, of the Geological Survey of that colony, has contributed to its Roya Society a review of the structure of artesian "basins" in North America. Nowhere in this area, with one possible exception, are the water-bearing rocks disposed in those ideal basins that do duty in the common text-book diagram. On the contrary, they have a uniform dip, so as to form only the half of a syncline, and the water, as in Queensland itself, is discharged either into the sea or into important inland springs.

A RECENT number of the *Centralblatt für innere Medicin* contains a notice of some further investigations by A. Pfuhl and K. Walter on the presence of influenza bacilli in the central nervous system. Pfuhl's previous identification of these bacilli in the central nervous system, and his contention that they are always to be found there in cases of influenza which have ended fatally, have received confirmation from these researches. It is, however, pointed out that along with the influenza bacillus large and small streptococci, as well as bacteria, associated with putrefaction, are found. As the colonies of influenza bacteria isolated from the nervous system only develop very sparsely on artificial culture media, and might easily escape recognition in the presence of other bacteria, Messrs. Pfuhl and Walter recommend that their cultivation should be carried out on perfectly clear agar-agar, the condensed water from which has been got rid of by keeping it in a slanting position for two or three days in the incubator, after which human or pigeon's blood is spread over the surface. It is best to discard tubes and employ instead dishes or plates, so as to increase the surface area of the culture material, and the latter should be inoculated by making several streaks with a very fine platinum needle containing the substance to be examined. In this manner all the colonies which subsequently develop can be closely watched under the microscope, and the identification and isolation of the influenza bacillus is materially assisted. That the influenza bacillus, and not the other bacteria found with it, is the actual cause of the disease, has been shown by Nauwerk, who described a case which ended fatally where influenza bacteria and no other varieties were present in the nervous system.

SEEKERS after rare and valuable scientific books should obtain a copy of the Catalogue (No. 165) just issued by Mr. Bernard Quaritch, Piccadilly, London, W.

IN his address as retiring President of the Botanical Society of America, delivered at the last annual meeting, Prof. W. Trelease considered the subject of "botanical opportunity," and pointed out the difference between the conditions which controlled and made possible scientific work, even a few years ago, and those which prevail to-day. The address is printed in full in the *Botanical Gazette*. In it, what is referred to as "botanical opportunity" is considered under the two-fold head of the opportunity of endowed institutions and the opportunity of individual workers. Under the first head the equipment of colleges and research laboratories is passed in critical review, and suggestions are made as to the necessary limitations of such equipment and the provision which may be made for securing its fullest use, both for instruction and investigation. As to the opportunity of the individual, it is shown that breadth of foundation and a well-conceived and studiously followed plan of work, with system in

all of the steps taken, can hardly fail to lead to success in the long run. A considerable portion of the address is given to a consideration of the subject of publication, as viewed from the standpoint of the administrator of a research institution and the student seeking a medium for the publication of the results of his work.

THE additions to the Zoological Society's Gardens during the past week include a Rufous Rat Kangaroo (*Æpyprymnus rufescens*) from New South Wales, presented by Captain N. Allen; a —— Squirrel (*Sciurus*, sp. inc.) from Java, presented by Captain G. C. Candy, ; a Levaillant's Cynictis (*Cynictis levaillanti*) from South Africa, presented by Mr. Joseph Francis; eleven Harvest Mice (*Mus minutus*) from Surrey, presented by Captain Salvin; three Herring Gulls (*Larus argentatus*), British, presented by Mr. J. W. Wilkes; two Black-bellied Sand Grouse (*Pterocles arenarius*) from Spain, presented by Mr. Gerard S. Torrens; two Nicobar Pigeons (*Calænas nicobarica*) from the Indian Archipelago, a Canarian Pigeon (*Columba laurivora*) from the Canary Islands, deposited; three Varied Field Rats (*Isomys variegatus*), three Larger Egyptian Gerbilles (*Gerbillus pyramidum*), nine Lesser Egyptian Gerbilles (*Gerbillus ægyptius*), three Long-eared Hedgehogs (*Erinaceus auritus*), forty-six Egyptian Geckos (*Tarentola annularis*), five Fan-footed Geckos (*Ptyodactylus lobatus*), a Grey Monitor (*Varanus griseus*), five Horned Cerastes (*Cerastes cornutus*), six Square-marked Toads (*Bufo regularis*) from Egypt, received in exchange.

OUR ASTRONOMICAL COLUMN.

MOUNTAIN OBSERVATORIES.—The great increase in size of the apertures of instruments for use in astronomical research, has led astronomers to look further afield for spots on the earth's surface where the atmospheric conditions are most favourable for the work to be satisfactorily accomplished. The neighbourhood of large towns is now generally conceded to be no place for a big refractor or reflector, although occasionally a very fine night may be luckily secured. For the study of planetary details, and the taking of long-exposure photographs, and other kinds of work, a steady atmosphere is a necessary essential. In order that the stellar images may be still and devoid of that flickering and movement which is only of too common an occurrence, the atmosphere itself must be to a certain extent in stable equilibrium, and the layers at rest one above the other. There are not, however, many places where these conditions are fulfilled. In fact there are no such spots where perfect stillness reigns supreme, but some are better than others in this respect. The question then is, where are such localities for which the astronomer, armed with a powerful instrument, may make his stand? We may answer this question by saying that up to the present time very few have been found, although search is more or less continuously being made. In America we know that some observers are at work with their instruments of large power, in an atmosphere which is at times almost perfect. Not only is the air in that quiet state of equilibrium that is so necessary, but they are blessed with long spells of continuous fine weather. Any one who wishes to find out for himself what are the essentials to "good seeing," how far we have progressed in the construction of mountain observatories, and, further, where those already set up are situated, cannot do better than consult Prof. Holden's contribution to the Smithsonian Miscellaneous Collection. The writer there has massed together a great amount of material concerning those situated in America and Europe, and has also added greatly to the description of them by the insertion of numerous illustrations. We may, however, mention that meteorological stations at high or moderately high altitudes are also included; but these must, as we all know, be forerunners of those equipped for the special study of astronomy.

OBSERVATIONS OF SATURN.—In the study of planetary detail our atmosphere plays a most important *rôle*, and, as we have said in the preceding note, some places are more suitable for such observations than others. Some very interesting observations given in the *Astronomischen Nachrichten* (No. 3390) serve to show that the same observer, making similar observations at two different stations, not of course simultaneously, finds really marked differences in powers of seeing. Herr A. Anton Wonaszek records his visit to the Manora Observatory, where Herr L. Brunner is at work. The objects looked at were the planets Mercury, Venus, Mars and Saturn, and Herr Wonaszek expresses astonishment at the great amount of detail that can be observed in the pure air of Lussin. As regards Saturn, the markings looked at by both these observers were the dark and light spots situated on the disc. Both made independent drawings of these (illustrations of which are given in the *Astronomischen Nachrichten* referred to), with the result that in most respects they are very similar. Herr Wonaszek, however, finds out that Herr Brunner's eyes are capable of detecting more quickly the bright spots, while his own are more sensitive to those of a darker shade. With a 7-inch refractor situated at Kis-Kartal, he says that his numerous observations of Saturn do not show the great amount of detail that he recorded at Lussinpiccolo, although, by good atmospheric conditions, he is able to see a great deal. From the drawings which he gives, it is seen at a glance that the spots referred to above are seen at his observatory somewhat with difficulty, and are not so clearly defined as was the case at Lussinpiccolo. Both sets of observations, however, give one a good idea of these curious spots, which are not restricted alone to the equatorial regions, but occur towards the poles. From these drawings, however, no dark spot attains any great distance from the equator. The observations referred to above were made during the month of August last.

KARLSRUHE MERIDIAN OBSERVATIONS.—The fifth volume of the "Publication of the Grossherzoglichen Observatory of Karlsruhe" contains the observations made with the meridian circle, and includes the positions of all these stars down to the 8th magnitude in the zone $-0°$ to $-7°$, which were not observed in the preceding volume. The observations were made by Prof. Valentiner and Dr. Ristenpart, and number 8300. Volume iv. of the same publication contained 13,800 observations, so that the total number amounts now to 22,100, thus concluding the work in this zone. The programme was to observe each star six times, and this has been carried out with only a very few exceptions, the number of stars on the working list being 2700. The reduction of the observations was done throughout by Prof. Valentiner and Dr. Ristenpart.

At the completion of the work a thorough investigation of the division errors of the circle was made. This undertaking could not, as we are informed, be done earlier, as the *personnel* of the observatory was too limited in numbers.

The three sections into which the volume is divided are (1) observations with the meridian circle; (2) elements for the reduction of these observations; and (3) mean places of the southern stars observed in the years 1892-94, reduced to the epoch 1885·0.

In the preface Prof. Valentiner refers at some length to the late Ernst von Rebeur-Paschwitz, who was connected with the observatory from July 1884. Allusion is also made to the fact that this "Publication" is the last that will proceed from the Karlsruhe Observatory.

The new building that is being erected on the Königstuhl at Heidelberg will, no doubt, be soon ready for work; and being under better conditions in many respects, Prof. Valentiner will be able to continue his work with renewed zeal.

THE WESTERN AUSTRALIA GOVERNMENT OBSERVATORY.—The decision of the Government of Western Australia to erect an observatory at Perth, at a cost of about 5000*l.*, was announced in these columns nearly a year ago (vol. liii. p. 280). The *Daily Chronicle* now notes that the Government Astronomer, Mr. W. Ernest Cooke, during his recent stay in England, was engaged in the purchase and inspection of the necessary instruments. The two principal instruments will be an astrographic equatorial and transit circle, in addition to which the observatory will also probably be furnished with a cœlostat. Mr. Cooke proposes to devote his energies mainly to the observation of fundamental southern stars. He will, in addition, take charge of the meteorology of the colony. From each of the meteorological stations a report will be telegraphed daily to the observatory, and with the help of this and other information supplied by the Eastern Colonies, a daily weather map of the entire continent will be issued, together with forecasts of the coming weather.

OPENING OF NEW LABORATORIES AT UNIVERSITY COLLEGE, LIVERPOOL.

THE great interest which the manufacturers of Liverpool take in the University College of that city was again exemplified by the opening of the new William Gossage laboratories a few days ago, briefly referred to in our Educational Intelligence last week. Since the college was founded, it has had the ready and full support of the manufacturers and traders of Liverpool and the district around, the result being that today it is in the front rank of institutions for higher education. With well-equipped laboratories, and a strong professoriate, the college possesses exceptional opportunities for study and research; and the work accomplished in it has done much to advance the arts as well as the sciences. The teaching course, which extends over four years, not only aims at training students for manufacturing pursuits, but also to carry out independent investigations.

The first section of the chemical department of the college was opened in May 1886. But the main laboratories, the most important of all, were not at that time proceeded with, partly owing to lack of funds, and partly because a portion of the site, the whole of which was given by the Corporation of Liverpool, was not then vacant, and could not be transferred to the college until later. In the early years the advanced students were necessarily few in number, and there was sufficient accommodation for them as well as for much larger junior classes; but by the year 1893 the want of a complete laboratory for the whole of the special laboratory students was seriously felt.

In these circumstances Mr. F. H. Gossage and Mr. T. Sutton Timmis generously undertook jointly to build and fit up a further section of the building, including the largest of the main laboratories and rooms below, at a cost of 7000*l.*, and to present them to the college as a memorial of the late Mr. William Gossage. Other portions of the buildings are being erected by public subscription, the list being headed by donations of 1000*l.* each from Sir John T. Brunner, M.P., Mr. E. K. Muspratt, and Messrs. Lever Brothers.

Mr. William Gossage, whose name is enshrined in the new laboratories, was one of the most fertile inventors of this century. His work was mainly chemical, and before his death in 1877 he possessed no less than sixty-three patented processes. In the early days of the soda industry, the hydrochloric acid gas, which is evolved from common salt for the production of sulphate of soda, was poured into the air in enormous volumes, to the destruction of vegetable and injury of animal life. In 1863 the Earl of Derby was instrumental in passing into law the Alkali Act which compels manufacturers to condense all except a very small fraction of the hydrochloric acid gas which they produce. It was William Gossage who rendered this legislation practicable by inventing the tall stone condensing towers which are so prominent a feature of the landscape in every Leblanc alkali works' district, and by means of which what was before worse than wasted is turned into a source of considerable profit to the manufacturers.

In 1838 he was engaged in experiments for the recovery of sulphur lost in the alkali waste of the Leblanc process, and also for the manufacture of soda from sodium sulphide. It was at this time that he demonstrated that calcium sulphide, and also sodium sulphide in solution, are decomposed by the action of dilute carbonic acid produced in lime kilns. In 1854 he produced silicate of soda or soluble glass by fusing sand with soda. He also utilised the red liquors from carbonate of soda manufacture, which were at that time an almost waste product, producing from them caustic soda, which was for years the only caustic soda made, and was employed to facilitate the manufacture of soap. He thus introduced what has now become a large and important industry in caustic alkali. In many other directions his inventive mind found occasional diversion, and of him it may be truly said that, although he was a successful manufacturer, he spent his mental energy and his means seeking out many inventions which benefited others rather than himself.

The new buildings, opened on December 12, include a large laboratory 60 feet by 32 feet, with benches fitted up for forty-four advanced students, an adjacent room provided with a new form of heated sand bath and other appliances for the service of the main laboratory, and, in the basement, an additional lecture room to seat seventy or eighty, a preparation room, and a gas analysis room. These five rooms, which are lined with ivory glazed bricks, constitute the "William Gossage" laboratories.

The other new buildings are a metallurgical laboratory, with furnaces and other equipment, an important addition to the research laboratory, a store for apparatus and chemicals, a dynamo room, electric-accumulator room and a heating chamber.

Beyond a number of minor improvements in the main laboratory, the benches do not essentially differ from those in some other similar laboratories except in one important respect, that the half-closed chambers placed in the middle of each bench have a really efficient draught which carries away all fumes from small operations without allowing any to escape into the room. This result is attained by carrying the whole ventilation of the room, which normally amounts to 125,000 cubic feet per hour, through these students' fume chambers and the larger chambers on either wall; the foul air passes from these hoods down to a wide subterranean channel ending at the base of a tall up-cast shaft, where a coke fire maintains a strong draught; by no other way can air escape from the laboratory, while a fan forces washed and warmed fresh air through flues and gratings in the walls into the room, so as to maintain a constant pressure during the working day.

The laboratories will be opened to students on January 7, 1897, and the committee will be glad to receive further donations to enable them to finish the buildings, and furnish the necessary equipment.

THE ANTHROPOLOGICAL HISTORY OF SOUTHERN RUSSIA.

IN continuing his ethnographic history of the region between the Dniester and the Caspian in the *Bulletins de la Société d'Anthropologie*, vii. (4 sér.), 1896, M. Zaborowski commences by criticising Sergi's assertion that "the first colonists of Southern Russia came from the Mediterranean." The enthusiastic Italian anthropologist recognised skulls of the type of his Mediterranean race from ancient graves in several parts of Russia, but Zaborowski contends that he has not paid sufficient attention to the dates of the finds, and that he has neglected the culture evidence. The author reserves the term Aryan to the tall blond dolichocephalic race, that is solely of European origin, which is not the case for the brown dolichocephalic Mediterranean race or the Celto-slavic type. Aryan languages are spoken in Europe where the brown brachycephals and dolichocephals have never penetrated, at least until our epoch; but there are no people with an Aryan language who have not come into contact with the fair race.

In the most ancient graves of the bronze age, Neolithic dolichocephals are still generally to be found, but before the Scythian epoch there was a mingling of brachycephals, perhaps partly through commercial relations and partly from women captured in war. The original home of the Scythians was to the east of the Caspian. The finds in the Scythian tombs exactly correspond to the description given by Herodotus of their neighbours, the allied Massagetes, except that iron is not quite unknown. The Thyssagetes, Tyregetes, Getes and Dacians, arose from the Scythians and Massagetes, descendants from the Getes and Dacians, still exist among the Roumanians, having harsh black hair and a yellow-brown complexion. In Scythia, Herodotus mentions the large nation of the indigenous, nomadic Budins, who "have remarkably blue eyes and red hair." These may be the ancestors of the Finns, at all events they formed a contrast to the Scythians, to whom Hippocrates attributed a short stature and a brown skin.

The Scythian period was terminated by the arrival of the Goths in the second century A.D. Strabo does not know of them, Tacitus mentions their occupying the shores of the Baltic between the Elbe and the Vistula. Later they came down the latter river to the Black Sea, and reached the lower Danube; at the commencement of the third century this enterprising and warlike nation touched the eastern borders of the Roman empire. The Goths were described as very large, of fine appearance, fair hair, milk-white skin, with great moral energy, modest, and very strong. They spoke a German dialect, and were even in possession of the primitive runic alphabet. The arrival of the Goths at the Black Sea is a return of the European blonds to a region where the brown Asiatic Scythians had reigned as masters for centuries.

M. Zaborowski evidently believes that the Aryan language arose about the Black Sea. He, with Broca and others, accepts the tradition that the Cymbri of Jutland were the descendants of

the Cimbrians of the Cimmerian Bosphorus, driven to the west of Europe by the Scythian invasion in the seventh century B.C. These Cymbrians had already had relations with the Greek world, for the Greeks had established colonies and introduced metals and the cultivation of the soil in Southern Russia before the arrival of the Scythians, and they may be regarded as the importers of the dialect from which the German languages arose. They were of the same race as the Neolithic blonds.

The Goths were driven away from the northern borders of the Black Sea by the Huns before the end of the fourth century; but though they remained during only two centuries, traces of their stay have been discovered.

The Alains, mentioned by authors in the first century A.D., were a blond people mixed with Medes, and possibly with the Scythian Massagetes. The Ossethes sprang from these Scythian Alains, who were driven into the Caucasus after the Gothic period by the pressure of the Huns. Thus the Ossethes are essentially Aryans and Europeans, despite the Iranian and Asiatic origin of their language, these originally blond Europeans, have been intimately mingled with Scythians, and later with other Caucasians, mostly browns and brachycephals. M. Kovalewsky states that among the Ossethes, when a bride enters for the first time her husband's house, she is greeted with "Prosperity! prosperity! nine boys and a girl with blue eyes." The latter wish could never arise amongst a brown population. In his work "Droit Coutumier Osséthien" (1893), Kovalewsky details numerous customs which, as Zaborowski points out, abundantly confirm the essentially European and Aryan origin of this nation; and the former author compares them with those of the Greeks of Homer, the Germans of Tacitus, and with the Romans, such, for example, as the cult of the hearth-fire, household arrangements, marriage ceremonies, and burial customs.

The Armenians, like the Ossethes, are a people with their original characters modified. They were also blond, at least in great part, and even now 11 per cent. are blonds according to Chantre.

In the Hindu Kush there are many traces of a fair race, and Zaborowski enters into a comparison of the Kafirs with the Ossethes, which tends to show that they are closely related.

THE HORN EXPEDITION TO CENTRAL AUSTRALIA.

THE Report on the work of the Horn Scientific Expedition to Central Australia has now been completed. It is published in four parts, the first of which is devoted to the narrative and summary of scientific results, while the three remaining parts deal respectively with zoology, geology and botany, and anthropology. The zoological results were reviewed in NATURE a short time ago (vol. liv. p. 241), and we propose to deal with the part on anthropology in a future issue. For the present we confine ourselves to summarising the knowledge gained of the geology and botany of the region explored, prefacing the synopsis with a statement of the inception and objects of the expedition, and of the region traversed, this introductory matter being based upon the Narrative.

Objects of the Expedition.

Mr. W. A. Horn, who defrayed the cost of the expedition to Central Australia, and through whose generosity the Report has been published, deserves the gratitude of men of science. The results which he has been the means of obtaining are most valuable contributions to the knowledge of the natural history of a little-known region; and by the accumulation of these facts, gained by direct observation, many perplexing questions will be elucidated. One of these questions is referred to by Mr. Horn in a brief introduction to the Narrative. For some time the opinion has been held that when the Australian continent was submerged the elevated portions of the McDonnell Range in Central Australia existed as an island, and that consequently older forms of life might be found in the more inaccessible parts. The scientific exploration of this belt of country was, therefore, much desired by men of science, and when Mr. Horn expressed his intention to organise and equip an exploring party, the scheme was received with great favour. In order to secure the services of the best men in Australia, the Premiers of the principal colonies were asked to nominate scientific representatives. As a result, Prof. Baldwin Spencer, Mr. J. Alexander Watt, Prof. Ralph Tate, and Dr. Edward Stirling joined the expedition, and Mr. C. A. Winnecke was chosen as surveyor and meteorologist.

The objects of the expedition as set down in the articles under which the members started were:—The scientific examination of the country from Oodnadatta to the McDonnell Range; the collection of specimens illustrative of the fauna, flora, and geological structure and mineralogical resources of that region, and the illustration by photography of any remarkable natural features of the country traversed; the securing of photographs of the aborigines in their primitive state, the collection of information as to their manners, customs, and language, and the reproduction of their mural paintings. The expedition started in May 1894, and returned in August of the same year, burdened with the records and the photographic spoil of the region which the members went out to see.

The McDonnell Ranges.

The McDonnell Ranges are in the very centre of Australia, they are barren and rugged in the extreme, rise to an altitude of nearly 5000 feet above sea-level, while the country surrounding them has an altitude of about 2000 feet, sloping away on every side towards the coast, 1000 miles distant. The mountains are at the head of the river Finke, and for this region, including the valley of the Finke, the name of Larapintine has been adopted from the native name of the Finke, "Larapinta." It was over this area that most of the explorations were conducted.

The general editor of the Report on the work of the expedition is Prof. Baldwin Spencer, who is also the author of the Narrative. Without entering into too many details, Prof. Spencer summarises, in a more or less popular form, in this part of the report, the work accomplished, and gives a good idea of the nature of the country through which the expedition passed.

Nature of the Country traversed.

It is usual to speak of the whole interior of Australia as a desert or Eremian country, but Prof. Spencer shows that this name as applied to the whole area is very misleading. It is true that over wide areas extending especially over the western half of the interior there spead out sandhills and flats covered with Mulga scrub or "Porcupine" grass, which may justly be described as desert, but in addition to this there is a vast track of country watered by streams which at varying intervals of time are swollen with heavy floods which spread out over wide tracts, and for a time transform the whole country into a land covered with a luxuriant growth of vegetation. To this part of the continent the name of the Australian Steppes has been applied. The Lower Steppes extend over the area occupied by the great Cretaceous formation with its alternating stony or gibber plains, loamy flats, and low-lying terraced hills capped with Desert Limestone. At Lake Eyre the land is 39 feet below sea-level, and gradually rises to a height of 1000 feet at its northern limit. What are termed the Higher Steppes are characterised by high ridges of Ordovician and Pre-Cambrian rocks which stretch across the centre of the continent from east to west for some 400 miles. The average elevation of these Higher Steppes may be taken as about 2000 feet, and above them the higher peaks of the ridges rise for some 2500 feet more.

Prof. Spencer devotes two chapters in his Narrative to the country belonging to the Lower Steppes, two to the Higher Steppes, and one to the Desert Region. The gibber plains to which he refers consist of flat surfaces covered with a layer of purple-brown stones, varying in size from an inch to perhaps a foot in diameter, and all made smooth by the constant wearing away of wind-borne sand-grains. Judging from the description, and the views which illustrate it, nothing could be more desolate than a gibber plain when everything is bare and dry. Throughout this district the low flat-topped desert hills have a thin capping of hard chalcedonised sandstone, and it is by the disintegration of this rock that the gibbers or stones have been produced. The stony gibber plains merge constantly into loamy plains covered with poor scrub, but on which the gibbers are wanting. It is suggested that these loamy plains occupy areas on which the Upper Cretaceous rocks are not capped with the hard chalcedonised Desert Sandstone, and where, therefore, no gibbers have been formed.

Colours of Animals.

Some interesting remarks are made by Prof. Spencer on the subject of protective colouration. Prof. Spencer has collected animals in Central Australia, both in the dry season and in the

wet season, and his study of the fauna leads him to the following conclusions.

(1) That in the dry season, when food is scarce and the sum total of activities is at its lowest point, the various animals, such as frogs and lizards, are dull-coloured, but that this dull colouration has not of necessity (as in the case of *Amphibolorus barbatus*) any definite relation to the environment, though it is often in general accord with it. (2) That in the rainy season, when food is plentiful and the sum total of the activities is at the highest point, various animals are highly coloured, but that this often brilliant colouration has nothing to do either with choice of partners (reaching its climax after pairing has taken place) or with protective colouration—sometimes even it renders the animal more conspicuous.

Limits of space prevent us from summarising any other points of interest from Prof. Spencer's most attractive Narrative. For a more detailed notice of the zoological collections and conclusions, we must refer our readers to the review which appeared in these columns last July (vol. liv. p. 241). We must mention, however, that the narrative is illustrated by eleven plates (splendidly reproduced from photographs) and seven figures in the text. Among the objects and views depicted upon the plates is a striking natural pillar of sandstone—Chamber Pillar—rising solitary among the sandhills; Ayers' Rock—a huge dome-shaped monolith, brilliant Venetian red in colour, and one of the most striking objects in Central Australia; several wonderful gorges among the McDonnell Range and Mount Olga. These picturesque views add to the interest of a well-written narrative.

General Geological Features.

We come now to the part of the Report referring to the geological and botanical results of the expedition, and here again we think that the valuable work accomplished will be best made known by summarising the leading features. The first section of the third volume opens with a general outline of he physical geography of Central Australia, by Prof. Ralph Tate and Mr. J. A. Watt. The subject is dealt with under seven heads, viz. mountains, rivers, gorges and gaps, lakes, claypans, stony plains, and sandhills. The same authors contribute a description of the geological features of the portion of Central Australia examined by them, embracing the country lying between Oodnadatta on the south, and the McDonnell Ranges on the north.

Under headings bearing the names of the geological systems to which the different series of rocks are assigned, an account is given of the general geological features, the extent, thickness, mineralogical composition, petrological characters, and fossiliferous contents of the various rocks. Beginning with the Pre-Cambrian system, the conclusions of previous observers as to the age of the rocks of the McDonnell Ranges, which exhibit a high degree of metamorphism, are summarised. These rocks have been described as Archæan and Azoic, but the authors conclude from the fact that a very strong unconformity separates the rocks from the Lower Silurian Group, that they must be either Cambrian or Pre-Cambrian, and reasons are given for favouring the latter alternative. The evidence obtained points to much of the metamorphic group having had an eruptive origin, whereas the Cambrian rocks of Australia, so far as at present known, are entirely sedimentary. In the region examined (from Oodnadatta to the McDonnell Ranges) Cambrian rocks are held not to be represented. Almost all the strata lying between Mount Burrell Cattle Station on the south, and the McDonnell Ranges on the north, are included by the authors in the Ordovician system.

The superstructure of the lowest levels around Lake Eyre have long been known to be argillaceous, and to contain marine fossils, as at Mount Margaret, Primrose Springs, and Dalhousie. The fauna was at first referred to the Jurassic period, but has in late years been recognised as contemporaneous with that of the Rolling Downs series, regarded as Upper Cretaceous, of Queensland. It has generally been held that the source of supply of the natural artesian wells on the west side of Lake Eyre was derived from tropical rains in Queensland absorbed by Cretaceous outcrops, and that the issue of these waters was along the line of junction of the Cretaceous water-bearing beds with the Palæozoic rocks on the west margin of Lake Eyre. But the now-ascertained far-northerly extension of the Cretaceous rocks, and the replacement of the prevailing argillaceous condition by sandy strata towards the northern boundary make it probable that the source is, after all, of local origin. Thus, the Finke River from Henbury to Crown Point flows approximately along the junction of the Cretaceous arenaceous beds and the impervious Ordovician limestones; so also do the Goyder and Lilla Creeks, particularly towards their sources. Moreover, the Cretaceous beds have in the main a slight southerly inclination. It is, therefore, highly probable that they do absorb some of the flood-waters of those river-channels, and conduct them to considerable depths in the depressed area margining Lake Eyre; whilst in no instance do the subterranean waters issue at the surface at a level so high as that of their conjectural intake. The phenomenon of extinct mound-springs, as at Dalhousie, may be explained by the circumstance of a diminished supply; in other words, that the level of saturation has fallen below the level of discharge as a consequence of the desiccation of the climate since Pliocene times.

A hard flinty quartzite or chalcedonised sandstone, varying up to fifty feet in thickness, forms the topmost bed of the Rolling Down series, and is referred to as the Desert Sandstone. The Rolling Down series is held to be akin to the European Upper Cretaceous, and the Desert Sandstone is designated Supra-Cretaceous, the palæontological difference between the two being very slight. The Desert Sandstone of Central Australia, on account of its attachment to the Upper Cretaceous, and by the occurrence of marine Mollusca of Cretaceous age (at Lake Frome well-sinkings), is regarded as coeval with the Desert Sandstone of Queensland, which, by its intercalated marine sediments, is proved to be Cretaceous; though separated unconformably from the Rolling Down series (Upper Cretaceous). The phytiferous beds, which underlie marine Eocene in Victoria and South Australia, and are conformable with them, are considered as Pre-Eocene.

As to the origin of the silicification of the Desert Sandstone, in the first place, the obsidian bombs and agates which occur on the Desert Sandstone plateaus and their slopes could not have been transported there by water, unless in the form of ice (an hypothesis incompatible with the coordinate features). The origin of the Desert Sandstone breccia was certainly not due to fracture of the original bed by failure of support arising from denuding action, but might have been caused by a lava-flow or the deposition of highly-heated volcanic ashes when saturated with water. The obsidian bombs demand volcanic action, and agates are not infrequently associated with volcanic ejectamenta; whilst the silicates of the ash-beds or lava under chemical action would furnish silicated waters as a source of the chalcedonising action on the underlying rock-surfaces. The development of agates within the volcanic material was only another phase of siliceous precipitation. Of this supposititious volcanic formation all that remains are the agates and the obsidian bombs. The theory may seem wild, because of the widespread silicification, and the absence over its area of any traces of actual volcanic outbursts; nevertheless, it is held that no other explanation accounting for the several phenomena appears admissible.

Excepting the silt deposits of the present water-ways and the widespread sand-plains, the only Tertiary deposits of any significance are those which indicate a former water-flow of vaster volumes than at present. These signs are chiefly in the form of gravels, more or less consolidated, through which the present water-channels have cut their way, or in the form of terraces margining the valley-plains through which now flow relatively diminutive creeks. These facts demonstrate that high pluvial conditions once prevailed; and, in consequence, perennial flows in the river-channels of this region were maintained, which, discharging into Lake Eyre, and supplemented by an Artesian supply in and around it, produced an inland sea of fresh water, inhabited by alligators (*Pallimnarchus pollens*) and turtles, and on its marshy margin dwelt *Diprotodon* and its fossil associates. Inferentially the date of formation of these gravels and river-terraces is coeval with the existence of *Diprotodon*, whose extinction was due to those physical causes which destroyed its habitats, and gave Central Australia its present rigorously dry climate. The marsupial life of this period, on comparison with that which replaced it, indicates a high antiquity in the number of extinct genera, and the very high percentage of extinct species.

Gold in the McDonnell Ranges.

The highly metamorphic character of the Pre-Cambrian rocks of the McDonnell Ranges, their greatly disturbed state, their extensive development, and, lastly, the presence of numerous

intrusive masses varying much in composition, are all circumstances favourable to the development of mineral deposits in them. Gold is the only mineral that has been found in payable quantities in these ranges, and that only in a very limited area of about fifty square miles, situated seventy to eighty miles E.N.E. of Alice Springs, on the Arltunga or Paddy's Hole goldfield. Although, as just stated, gold in payable quantities has been found on the above-mentioned goldfield, yet alluvial gold in small quantities has been found also near Winnecke's Depôt, Bald Hill, and in some of the gullies in the Georgina Range.

The most important auriferous quartz reefs have a prevailing due north and south trend, and their gold contents show a remarkable uniformity. The country-rock includes metamorphic gneisses and mica schists, intruded by eruptive dykes. Where not absolutely vertical the underlay is almost without exception to the west, and varies from 5° to 10°. The outcrops of these reefs, which are not, as a rule, traceable for any great distance, vary in width from four inches to two feet six inches, while at the bottom of trenches and shafts the width varies from three inches up to four feet six inches. Taking the average of ten reefs, the width at the surface was found to be twelve inches, while at an average depth of twenty-one feet it was fifteen inches. Gold is contained not only in the veinstone, but occasionally and in a less degree in the selvage also, on one or both sides of the reef. In nearly all the reefs the gold is associated with gossary quartz, some of the best results being obtained from a spongy siliceous matrix, which crumbles easily when subjected to pressure.

The lithological specimens gathered during the Horn Expedition included examples of a number of interesting rocks. The microscopical structure of some of the eruptive, and a few of the most typical of the metamorphic varieties, are briefly described by Mr. W. F. Smeeth and Mr. J. A. Watt, their paper being illustrated by four plates. The Palæontology of the expedition forms the subject of a separate contribution by Prof. Ralph Tate, who also deals with the botany.

Origin of the Flora.

The route traversed by the main body of the expedition practically circumscribes what has been termed the Larapintine region. The Larapintine flora is fully described, Prof. Tate taking in turn the general physiography and boundaries of the region, botanical characteristics, origin of the flora, previous explorations, enumeration of the flowering plants and vascular cryptogams, and diagnosis of new genus and species. The flora of the central "Eremian region" is briefly described in a separate paper.

The distribution of the constituent elements of the Larapintine flora and their exoteric relationships, taken in conjunction with the physiographic changes that have taken place within the area, lead to the conclusions that:—

(1) The Larapintine table-land was isolated, except perhaps in a northerly direction, during the deposition of the marine sediments constituting the Rolling Downs system (Upper Cretaceous).

(2) The marine submergence was replaced by a lacustrine area during the deposition of the Desert Sandstone (Supra-Cretaceous).

(3) A cosmopolitan flora prevailed at this period, which continued into Paleocene times.

(4) The area occupied by the lacustrine area of the Desert Sandstone period was somewhat reduced, yet high pluvial conditions continued into Pliocene times.

(5) In Post-Pliocene times a high state of desiccation was reached, which has continued till to-day. The cosmopolitan flora became largely extinct, and its place occupied by an Oriental immigration, more especially over the previously-submerged areas.

A short description, by Mr. J. H. Maiden, of the vegetable exudations collected during the expedition, concludes the volume.

We have had to content ourselves with a sketch of the work of the expedition and of the conclusions arrived at from the knowledge gained. This abridgment will suffice, however, to show the value of the results obtained in geology and botany; and we need only point to the volumes themselves as monuments to Mr. Horn's generosity, and to the industry of the members of the expedition organised by him.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE Paris University Council has resolved to consider the institution of a degree which foreign students might take away with them as a proof of their studies and acquirements in Paris.

THE officers for the Oxford University Junior Scientific Club for next term will be as follows:—President: A. W. Brown (Christ Church). Treasurer: A. E. Boycott (Oriel). Editor: A. R. Wilson (Wadham). Chemical Secretary: W. P. Billinghurst (St. John's). Biological Secretary: J. E. H. Sawyer (Christ Church). Committee: R. A. Buddicom (Keble); E. H. Hunt (Balliol); D. Meinertzhagen (New Coll.).

AT the inauguration of the Lyons University, the Rector, M. Compayre, announced a donation to the university of 4000*l.* from M. Auguste Falcouz, a Lyons banker. The *British Medical Journal* states that the interest of this sum is to be disposed of as follows:—Every two years a prize of 40*l.* sterling will be given to the students of each of the four faculties—literature, science, law, and medicine—who write the best essay on a current subject. The subject of the essay will be chosen by the Council of the Lyons University a year in advance. Every two years instruments for the science and medical faculties will also be bought. When fifty years have elapsed, the Lyons University will have entire control over the capital in order to be able to meet the demands of scientific progress.

DR. G. H. BRYAN, F.R.S., has been appointed professor of pure and applied mathematics in the University College of North Wales, at Bangor. Dr. Bryan graduated at Cambridge in 1886 as Fifth Wrangler. In 1888 he was Smith's Prizeman, his essay being published by the Royal Society; he was then elected Fellow of Peterhouse. In 1895 he became Fellow of the Royal Society, and received the degree of Doctor of Science of Cambridge University. Dr Bryan has been appointed one of the examiners for Part II. of the Mathematical Tripos (1897). He is the author of a valuable report to the British Association on the "Present State of our Knowledge of Thermodynamics," and of several other important papers on mathematics and mathematical physics.

MAGDALEN COLLEGE, Oxford, has just elected Mr. R. W. T. Günther to an official fellowship as tutor in natural science. Mr. Günther, who is the son of Dr. Albert Günther, F.R.S., so well and long known in the scientific world, has had a distinguished career at Oxford. He was elected to a demyship in natural science at Magdalen in 1888, from University College School. He took a first class in morphology in 1892, was appointed University student of biology at Naples in 1893, and Royal Geographical student in 1895, and has been first lecturer and then tutor at Magdalen since 1894. He has made several contributions to Prof. Ray Lankester's very interesting "Linacre Reports," and he read a paper at the British Association meeting last summer. It may be noted that Magdalen has already this term elected a demy and an exhibitioner in biology, the former coming from the Charterhouse, the latter being a pupil of Prof. Weldon at University College.

THE following are among recent announcements:—Dr. Surmont to be professor of hygiene at Lille; Dr. P. V. Lichtenfels to be full professor of mathematics in the Polytechnic Institute at Graz; Dr. Edler to be associate professor of agriculture in the University of Jena; Dr. E. Pringsheim to a professorship of physics in Berlin University; and Dr. Karl Friedheim to a professorship of chemistry; Dr. Kalischer to be professor of physics at the Technical High School of Berlin-Charlottenburg; Dr. Autenrieth, privat-docent of medical chemistry at Freiburg i.B., to be provisional successor to Prof. Baumanns; Dr. J. Kurschak to be associate professor of mathematics at the Technical High School in Budapest; Dr. Anton Pestalozzi to be assistant in the Zürich Botanical Museum; Prof. Blass to be full professor of geology at Innsbruck. Dr. Szadeczky has been invited to become associate professor of geology at Klausenburg; and Prof. Allé, professor of mathematics in the German Technical High School at Prague, has been called to the Technical High School at Vienna.

THE conference of headmasters was opened at Rugby on Tuesday, and was largely attended. After a long discussion a resolution declaring the organisation of secondary education to be a matter of pressing necessity, with which the Government should be urged to deal in the next Session of Parliament, was carried, with a rider expressing the desire of the conference to

co-operate with other educational bodies. In moving "That the new regulations for Woolwich examinations will not be satisfactory unless the number of subjects a candidate can take up is diminished by at least one, and that a heavy one, below the present number," the Rev. Dr. James said the Army curriculum afforded no education at all. It was, from the literary point of view, a failure, and from the scientific point of view was poor and inadequate. The incessant and irritating changes were a grave detriment to the intellectual development of the candidates. The result of these changes was especially felt in the department of science, and it was made impossible to give a really valuable scientific training. Under the old system nine was the maximum number of subjects. Now a boy was to be allowed to take up ten subjects, and the amount of mathematics in Class I. had been very largely increased, while a third alternative subject had been added which was beyond the reading required by the scholarship standard for mathematics at the Universities. Dr. James's resolution fell through, but the following were adopted in its place:—(1) That the new regulations for Woolwich examinations involve a disastrous increase of the burden of a curriculum which is already too heavy for candidates of the required age. (2) That it is not desirable that any such changes as are proposed should be made in regulations which have been only recently established, and which have enabled Woolwich and Sandhurst candidates to be generally prepared together, and that the committee be instructed to urge the views of the conference on the military authorities.

SCIENTIFIC SERIALS.

American Journal of Science, December.—*Archelon Ischyros*, a new gigantic Cryptodire Testudinate from the Fort Pierre Cretaceous of South Dakota, by G. R. Wieland. This testudinate is closely allied to the genus Protostega. All the large bones were found in place, and the skeleton was almost complete. The ribs, which average 1 m. in length, are remarkable for their distal increase in thickness. The cervical centra are very heavy and strong bodies, and indicate a neck of enormous strength. The humerus measures ·65 m., the ulna ·33 m., and the femur ·46 m. The total length is about 11 feet 4 inches, and the spread of the massive forearms 16 or 20 feet, this being the most striking feature of the animal. The skeleton was found embedded at the side of a small ravine near the South Fork of the Cheyenne River.—A method for the separation of aluminium from iron, by F. A. Gooch and F. S. Havens. The method is based upon the different solubilities of aluminium and ferric chlorides in strong hydrochloric acid. To test the method, measured portions of the standardised solution of aluminium chloride were evaporated nearly to dryness in a platinum dish, a measured amount of ferric chloride was added in a very little water, a mixture of equal proportions of ether and strong hydrochloric acid was introduced, the liquid was saturated at 15° with gaseous hydrochloric acid, more ether was added to secure complete miscibility, and more gas passed to perfect saturation. The aluminium chloride was collected upon asbestos in a perforated crucible, washed with a mixture of ether and aqueous HCl thoroughly saturated with the gaseous acid, dried at 150° C. for half an hour, covered with pure mercuric oxide, and ignited, gently at first, and finally over the blast. The error was less than 1 per cent.—Chemical composition of Hawaiian soils and of the rocks from which they have been derived, by A. B. Lyons. The relation in chemical composition of soils to the rocks from which they are derived can be most advantageously studied in a volcanic country, where disintegration of the rock is rapid and is attended with great chemical changes. In the Hawaiian soil there is observed a loss of more than half the silica, 77 per cent. of the manganese, 93 per cent. of the lime, 91 per cent. of the magnesia, and about 50 per cent. of the phosphoric acid. It is especially interesting to note that while the rotted lava has lost nearly all its calcium and potassium, the soil retains a considerable proportion of both these elements, probably owing to the influence of plants and molluscous animals.—The Jurassic formation on the Atlantic coast, by O. C. Marsh. Adduces reasons why certain fresh-water formations in New Jersey and elsewhere along the Altantic coast should be regarded as Jurassic instead of Cretaceous.

Bulletin of the American Mathematical Society, vol. iii No. 2, November.—The number opens with a report of the Buffalo Colloquium, a meeting which was held as auxiliary to the summer meeting of the Society. It lasted a week, and the plan of it was that two courses of lectures should be given, consisting in each case of six one to two-hour lectures. Prof. Bôcher's subject was linear differential equations and their applications, and Prof. Pierpont's the Galois theory of equations. Outlines of the lectures are given. The result was so satisfactory that at the close of the Colloquium a motion was adopted recommending to the Council that arrangements be made for a similar gathering in connection with the next summer meeting of the Society.—A geometrical method for the treatment of uniform convergence and certain double limits, by Prof. Osgood, was read, as previously noted, at the summer meeting. It is a very thorough paper and fully illustrated. The geometrical representation of functions by curves and surfaces is, the author states, of twofold importance; for not only does it represent to the eye, by means of a concrete picture, relations which would otherwise appear only in abstract arithmetic form, but this picture in its turn makes evident new facts, and points out at the same time the curve that the arithmetic proof of the theories thus suggested would naturally take.—Prof. Bôcher reviews Heffter's einleitung in die Theorie der linearen Differentialgleichungen mit einer unabhängigen variabeln.—From the notes we learn that Profs. Klein and J. J. Thomson addressed the Society on October 17.

Symons's Monthly Meteorological Magazine, December.—Weather in the last century. Early records of the weather being somewhat rare, it was thought that summaries of the one in question were worthy of publication. The register was kept at Richmond by Mr. George Smith, a Proctor to Queen Anne, and contains a record of daily observations, made without instruments, from April 1713 to June 1745. The original document is preserved in the library of the Royal Meteorological Society.—The scientific use of kites, by W. L. Moore, Chief of the U.S. Weather Bureau. The question discussed is simply, why kites are better than captive or unmanned balloons for exploring the upper air. The advantages over captive balloons are manifest. Prof. Moore has made out a strong case in favour of kites, but thinks that balloon observations should not be neglected.—*Barometri descriptio*, by J. Addison, 1672–1719. Attention has been called by Mr. Inwards, late President of the Royal Meteorological Society, to a poem under this title which is contained in *Tickell's Addison*, vol. vi. p. 427. The poem is reprinted in the current number of the *Magazine*, and the editor would be glad of a reference to any good translation that may exist.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 10.—"The Chemical and Physiological Reactions of certain Synthesised Proteid-like Substances. Preliminary Communication." By Dr. John W. Pickering.

From the observations recorded in this paper it appears that if certain derivatives of proteids, and other substances of allied chemical constitution, are heated together in sealed tubes with an excess of either phosphorus pentachloride or pentoxide, a series of colloidal substances are formed which, when freed from the contaminating phosphoric acid, and dissolved in concentrated ammonia, give opalescent solutions that, on evaporation down *in vacuo*, yield substances closely resembling in physical, chemical, and physiological properties certain proteids.

These colloidal substances, although they differ from one another in minor details, are usually distinguished by the following characteristics:—

(1) They are soluble in warm water, forming opalescent lævorotatory solutions.

(2) The resulting solutions yield the principal colour reactions hitherto deemed diagnostic of proteids.

(3) In the absence of salts, solutions of these colloids do not coagulate on heating. In the presence of a trace of a neutral salt they coagulate on heating at temperatures very similar to proteid solutions.

(4) Fractional heat coagulation shows the colloidal solutions are a mixture of different substances.

(5) The different constituents of the colloidal solution exhibit different physiological action.

(6) In the presence of an excess of neutral salts, or of salts of the heavy metals, the colloidal solutions behave in a manner similar to proteid solutions.

(7) When introduced into the circulation of pigmented

rabbits, dogs, and cats, certain of these substances (viz. the colloids designated A, B, C, α and β) produce intravascular coagulation of the blood in a manner similar to a nucleo-proteid. They also hasten the coagulability of the blood withdrawn from the carotid, and will, when slowly injected intravenously in minute quantities into dogs, produce a retardation of the coagulability of the intravascular blood, *e.g.* a "negative phase."

(8) Apparently these colloidal substances are owing to both their physical and chemical properties and their physiological behaviour, the nearest synthesised bodies at present known to proteids.

"An Attempt to determine the Adiabatic Relations of Ethyl Oxide." By Dr. E. P. Perman, Prof. W. Ramsay, F.R.S., and J. Rose-Innes, M.A., B.Sc.

Geological Society, December 2.—Dr. Henry Hicks, F.R.S., President, in the chair.—The Secretary announced that Mr. Frank Owen had presented to the Society a photographic portrait of his late grandfather, Sir Richard Owen.—Another possible cause of the glacial epoch, by Prof. Edward Hull, F.R.S. In the introductory portion of the paper the author gave an account of the submarine topography of the area east of North America, and summarised Dr. J. W. Spencer's work upon a submerged Antillean continent; he then dealt with the effects which would be produced upon the Gulf Stream by the uprising of this continent in the glacial period, and maintains that, as the current could not pass into the Gulf of Mexico (being debarred by a coast of high continental land), it would flow directly northwards into the North Atlantic, and thereby be deprived of about 10° (Fahr.) of heat: the effects of which may be practically illustrated by supposing the isothermal line of 32° to take the place of that of 42° in the northern hemisphere. He argued that the increased snowfall which would thus be caused over certain areas would tend to intensify the cold through all the adjoining tracts. To the effects produced in this way must be added those due to the elevation of the land of Eastern North America and to an elevation of North-western Europe, which was supposed to have occurred at the end of Pliocene times. These elevations would intensify the glaciation caused by the difference of direction taken by the Gulf Stream. In the discussion which followed, the Rev. Edwin Hill inquired what were the grounds for the estimated reduction of temperature, and asked for a comparison between the Gulf Stream in such conditions and the present North Pacific current. Dr. Blanford agreed with him in feeling doubtful whether a change in the configuration of the American coast would prevent a warm current from still impinging upon the shores of North-western Europe, and expressed the opinion that the main cause of the glacial epoch was still unknown.—On the affinities of the Echinothuridæ, and on *Pedinothuria* and *Elikodiadema*, two new subgenera of Echinoidea, by Dr. J. W. Gregory. The author summarised and discussed the literature bearing upon the Echinothuridæ, and brought forward arguments to prove that the family is a member of the order Diademoidea, and is derived from the Pedinidæ, members of which are found in earlier rocks than the Corallian, which contains the oldest member of the Echinothuridæ, namely, *Pelanechinus*. He maintained that the extreme flexibility and loose articulation of the plates of the living genera *Asthenosoma* and *Phormosoma* was due to the diminished calcification of the plates, and that these recent genera were extremely specialised forms, and not primitive—the apparently primitive features of the family being secondarily acquired, not primæval.—On *Echinocystis* and *Palæodiscus*, two Silurian genera of Echinoidea, by Dr. J. W. Gregory. The author gave a history of the genera *Echinocystis*, Salter, and *Palæodiscus*, Wyv. Thoms., redescribed their structures, and discussed their affinities. He concluded that *Echinocystis* was an echinid and not a cystid; and that *Palæodiscus* was an echinid and not an asterid.

Linnean Society, December 3.—Mr. C. B. Clarke, F.R.S., Vice-President, in the chair.—Mr. R. Morton Middleton exhibited and made remarks on specimens of *Acer dasycarpum* strangulated by *Aristolochia tomentosa*. He also exhibited examples of *Helix Cumberlandiana*, an extremely local land mollusc from the carboniferous limestone of Tennessee, his remarks being confirmed by Mr. W. Stearm, an American conchologist, who was present as a visitor.—Mr. E. M. Holmes exhibited specimens of *Liebmannia major*, a seaweed not hitherto detected in Britain, and, so far as is known, recorded only from Finisterre. The specimens were collected at Lossiemouth in August 1896. He also showed *Bonnemaisonia hamifera*, collected in May last by Mr. E. George, and in August last by himself. In 1895 living specimens of this seaweed, a native of Japan, were found at Falmouth by the late Mr. T. H. Buffham, and during the present year other examples had been found at Shanklin, Isle of Wight, showing that the plant had apparently become naturalised. The Rev. George Henslow gave the substance of a paper entitled, "Does Natural Selection play any part in the origin of Species among Plants?" After defining a species from the systematists' point of view, the author showed, by examples, that many specific characters in plants might be useful, indifferent, useless or injurious; and that they were the direct result of a responsive action especially to the physical environment. The *origination* of varietal characters, he thought, should be considered as quite distinct from "the survival of the fittest" and "the struggle for life" which determine the *distribution* of species in time and space. The individual differences of plants were held to be (as a rule) inadequate to produce variations of any systematic value, unless the plant migrated, and dimensions *per se* could have no "destructive" capacities whatever. Darwin's and Wallace's conditions for natural selection, viz. large populations and infertility between parents and offspring, had, he considered, no connection with the origination of variations, while the latter did not exist. On the contrary, species with large populations were (as a rule) invariable, while others might vary greatly, but only when in different soils, &c. Instead of "changed conditions of life" happening to any plant without migration, it was the latter which brought them about; instead of a struggle being required with the parent stock or other plants, it was the avoidance of the deteriorating effects of struggling which was most beneficial, and new varieties arise best when there was no struggle at all.

Anthropological Institute, December 8.—Mr. E. W. Brabrook, President, in the chair.—Prof. E. B. Tylor read a paper by Mr. Horatio Hale on four historical Huron wampum-belts, which he exhibited, adding remarks of his own on the employment of wampum in a mnemonic system. After a short account of the state of the Indian confederacies at the time of the arrival of the earliest discoverers, in the course of which the mention of the chief Hiawatha caused Prof. Tylor to contrast the accuracy of Fenimore Cooper as a painter of Indian life with the poetical license of Longfellow, attention was directed to the use of wampum as currency, and to the laborious method of drilling the hard shell to form the beads. Specimens of the two shells employed in the manufacture were exhibited. Dr. Tylor then passed to the symbolic use of wampum-belts as historical records, illustrating his remarks by a number of lantern slides. From these it was explained how the Iroquois belt might be distinguished from others by the occurrence of diagonal bands of beads, contrasting in colour with those forming the ground. These bands are derived from the diagonal rafters of the peculiar "long-houses" of the Iroquois. Other well-known conventional symbols, representing hearts, houses, lands, the "peace path," &c., were also illustrated. One of the belts exhibited was itself an historical record of some interest to Europeans, as it depicts a proposal of conversion to Christianity made by the early Jesuit missionaries to the Indians, the message being effected by working into a wampum-belt a symbolic group consisting of the lamb, the dove, and several crosses. The investigations made by Mr. Hale seem to show that the "Penn Belt," which is now in New England, is not a record of the famous scene depicted by Benjamin West, but of a more obscure treaty concluded with Iroquois chiefs. The intrinsic evidence afforded by the belt convinces Mr. Hale that it was made by Iroquois. In this way anthropology has been able to correct history. Dr. Tylor exhibited lantern slides of West's picture, and of one of Lafitau's plates, the latter giving a far more accurate idea of the ceremonious ratification of an Indian treaty than the former. He also exhibited a slide illustrating the use of wampum-belts as records in modern times, exemplified by the annual meeting of chiefs, at which all the belts are carefully gone over, in order that events of tribal importance may be kept green. A short discussion followed.

Mathematical Society, December 10.—Prof. Elliott, F.R.S., President, in the chair.—Major MacMahon, R.A., F.R.S., stated a result arrived at in a note by Prof. Sylvester, F.R.S., on a discovery in the theory of denumeration. In connection with this communication the President announced that

Prof. Sylvester had put his "Outline of Lectures on the Partitions of Numbers," which he read at King's College, London, in 1859, and which had never been published, at the disposal of the Council, and that that body had arranged to print them as a companion to the ex-President's valedictory address.—Mr. Burbury, F.R.S., communicated a paper on the stationary motion of a system of equal elastic spheres of finite diameter.—Mr. Hough read a paper on the influence of viscosity on waves and currents.—Mr. Macfarlane Gray gave a description of his multiplying apparatus. Messrs. C. V. Boys, F.R.S., and T. I. Dewar, Prof. Greenhill, F.R.S., and other gentlemen, joined in a discussion of points connected with the subject.—Lieut.-Colonel Cunningham, R.E., gave an account of results arrived at in his paper on the connection of quadratic forms.—The following papers were communicated by their titles, viz. : Concerning the abstract groups of order K ! and ½K ! holoedically isomorphic with the symmetric and the alternating substitution groups on K letters, by Prof. E. H. Moore.—On a series of cotrinodal quartics, by Messrs. H. M. Taylor and W. H. Blythe.—On finite variations, by Mr. E. P. Culverwell.

Zoological Society, December 15.—Lieut.-Colonel H. H. Godwin-Austen, F.R.S., Vice-President, in the chair.—The Secretary read a report on the additions that had been made to the Society's menagerie during the month of November 1896.—Mr. Sclater exhibited two bound volumes of original drawings by Joseph Wolf and Waterhouse Hawkins, belonging to the Knowsley library, which had been kindly lent to him for examination by the Earl of Derby. They represented various animals that had been living in the Knowsley menagerie, 1844-48.—Mr. W. Bateson exhibited and made remarks on some pigeons with very well-marked webs between the toes.—Prof. Newton sent for exhibition the type-specimen of *Heterorhynchus olivaceus* of Lafresnaye, kindly entrusted to him by Prof. Hyatt, Curator of the Museum of the Boston Natural History Society. This extinct species, now referred to *Hemignathus lucidus* of Lichtenstein, was peculiar to Oahu, one of the Sandwich Islands, and the present appeared to be the only full-plumaged male specimen ever seen in this country.—Dr. G. Herbert Fowler read a paper entitled "Contributions to our Knowledge of the Plankton of the Færoe Channel," which contained an account of the first results arrived at from his examination of the marine fauna of this channel during a voyage in it, in July and August last, in H.M.S. *Research* (Captain Moore).—The Secretary read a paper by Mr. Oldfield Thomas, entitled "On the Genera of Rodents, being an attempt to bring up to date the current arrangement of the Order." Taking as a basis Alston's paper on the Rodents, published in 1876, the main object of the present communication was to place in their proper positions the many genera described since that author's times. In regard to the larger groups, Alston arrangement had been followed as far as possible ; but among other things it had been thought better to elevate the subfamily Bathyerginæ into a family, to make two families of the Hystricidæ, one for the Old-World and one for the New-World porcupines, and to give to the subfamilies Geomyinæ and Heterominæ full family rank. All the recent genera of the order were enumerated, to the number of 158, as compared with 100 in Alston's list.—Dr. J. W. Gregory gave a description of *Lysechinus*, a new genus of Plesiocidarids from the Tyrolese Trias.—A second paper by Dr. J. W. Gregory related to the classification of the Palæozoic Ophiurids.—A communication was read from the Rev. O. Pickard Cambridge, F.R.S., containing descriptions of four new or little known spiders (Araneidea) from Ceylon, Borneo, and South America.—A communication from Dr. Robert O. Cunningham related to the occurrence of a pair of supernumerary bones in the skull of a Lemur, and to a peculiarity which he had noted in the skull of a young Orang.—A communication was read from Dr. Alph. Dubois, in which he gave the description of a new African Trogan from Lake Tanganyika, proposed to be named *Hapaloderma rufiventris*.

EDINBURGH.

Royal Society, December 7.—The first ordinary meeting of the Society was held, at which Prof. M'Kendrick gave the opening address. He remarked that the number of ordinary Fellows of the Society was now 513, twenty-five having been elected during the past year. Referring to the jubilee of Lord Kelvin, he said the celebrations were unique in their kind, and marked the climax, though not the end of a great career. It was now fifty years since Lord Kelvin became a member of this Society, and during that time he had contributed seventy-two papers, including his famous memoirs on thermodynamics, on the dissipation of energy, and on vortex motion. Prof. M'Kendrick then read short obituary notices of Fellows who had died during the recess. By request of the Council, he then gave an account of recent investigations of his own. He began with some remarks on the structural and physiological nervous unit. He showed that these units in brain structure—neurons, as they were called—were not, as was at one time believed, linked together. There was contiguity of their fine terminations, but not continuity of structure. He next described how it was possible by an arrangement consisting of a variable resistance transmitter, and an induction coil, to stimulate the sensory nerves of the skin electrically, so that some of the elements in music—rhythm and intensity—might be perceived, and even enjoyed by those who had become deaf. Lastly he exhibited his improved phonographic recorder, by which the curves on the cylinder could be amplified so that the form of each might be studied, and made some remarks on the character of these curves.—Papers by Mr. G. R. M. Murray on the reproduction of some marine diatoms, and by Dr. Thomas Muir on the eliminant of a set of quaternary quadrics, on the resolution of circulants into rational factors, and on the eliminant of $f(x) = 0, f(1/x) = 0$, were held as read.

DUBLIN.

Royal Dublin Society, November 18.—Prof. A. C. Haddon in the chair.—The following papers were presented :—Note on Irish annelids in the Museum of Science and Art, Dublin, by Prof. W. C. M'Intosh ; new species of dragon-flies in the Dublin Science and Art Museum, by Mr. George H. Carpenter ; on Fresnel's wave-surface, and the surfaces relative thereto, by William Booth, Principal of Hoogly College, Bengal (communicated by Mr. Thomas Preston).—Prof. W. J. Sollas, F.R.S., gave an account of a journey in the interior of Fiji, illustrated by numerous photographs.

NEW YORK.

National Academy of Sciences, November 17 and 18.—Prof. Ogden N. Rood read a paper on flicker photometers. He called attention to a paper published by him in the *American Journal of Science* for September 1893, on a photometric method which is independent of colour, illustrating its use by determinations of the luminosity of discs of variously coloured paper. In his communication to the Academy, he described five forms of photometer based on the flicker principle. The idea underlying the action of these instruments is identical with that which obtained in his experiments with coloured discs, viz. the rapid distribution of two illuminated surfaces alternately for each other, the flicker disappearing when the two surfaces had equal brightness. The photometric measurements made with this new style of photometer are quite accurate and independent of colour.—Prof. Edward D. Cope read a paper on the geographical distribution of batrachia and reptilia in the Medicolumbian region.—Prof. A. E. Verrill read a paper on the evolution and phylogeny of the gasteropod molluscs, illustrated by beautiful diagrams. He advances the view that the Ophisthobranch molluscs were evolved from Pteropods, and are a type of higher order than the Prosobranchs, notwithstanding that they are hermaphrodites. Their sexual organs are much more complicated, and the loss or thinness of the shell gives greater scope for the development and arrangement of internal organs than can be attained by the Prosobranchs with their hard shells. The Ophisthobranchs furnish the most conspicuous examples in the animal kingdom of protection by mimicry, having lost their hard shell as a means of protection, though they still retain it in the early stages of life. The adults, however, either mimic seaweeds, on which they live, or sponges, hydroids, or corals, known to be poisonous to fishes, the chief enemies of the molluscs. Some beautiful examples were shown of molluscs, living in the Sargasso Sea, which imitate the seaweed, and even the parasitic life upon it. In the discussion, Prof. Cope maintained the correctness of the old theory that the Prosobranchs were the more advanced and higher.—Prof. Othniel C. Marsh read a paper on the Jurassic formation on the Atlantic coast. This formation has long been supposed to be lacking in America ; but Prof. Marsh found it in 1868, near Lake Como in Wyoming, and has now traced it also on the Atlantic coast.—Prof. Alfred M. Mayer read a paper on the equation of the forces acting in the flotation of discs and rings of metal

on water and on other liquids, giving several formulæ. The surface tension of pure water is sufficient to bear up discs or rings of metal for three days in localities free from dust, but the slightest impurity in water destroys the surface tension; even dipping the finger into it, or pouring vapour of ether upon it. Could the water be kept absolutely free from dust, it seems probable that it would retain its surface tension indefinitely. The surface tension of mercury is about ten times as great as that of water, but it overflows the metal, and is not convenient to experiment with. The kind of metal used in these experiments is quite immaterial.—Prof. Simon Newcomb read two papers, one on the physical causes of the variations of latitude. These causes are accumulation of ice and snow, and the alternate northerly and southerly motion of the earth's atmosphere from and towards the poles for a period of three months in one direction, and three months in the other direction in each year. His second paper was on solar motion as a gauge of stellar distances. He finds that the stars observed have an apparent drift southward of about 2″ a year, indicating that the solar system is moving at that rate in the direction of Alpha Lyræ. His observations show, also, that the stars of smaller magnitudes are not so remote from the earth as their magnitude would indicate, the increase of distance being about one-fifth for each decrease in stellar magnitude. This seems to warrant the inference, he thinks that the visible universe has a definite limit in space.—Prof. C. S. Hastings read a paper on a new type of telescope free from secondary colour. He finds it possible, by proper arrangement of silicate glasses, to eliminate secondary colour entirely, and also to reduce the length of the telescope tube one half, obviously giving a great advantage in the construction of large telescopes where the weight of the object-glasses has to be supported at a great distance from the point of support.—Prof. Ira Remsen read two papers: one on the hydrolysis of acid amides; the other on the isomeric chlorides of paranitro-orthosulphobenzoic acid.—Prof. C. S. Peirce read two papers: one on a graphical method of logic; the other on mathematical infinity.

PARIS.

Academy of Sciences, December 14.—M. A. Cornu in the chair.—On a new form of the equations to the problem of three bodies, by M. H. Poincaré.—On a class of transcendental functions, by M. Émile Picard.—The theory of the confluence of lymphatics and the development of the lymphatic ganglions, by M. L. Ranvier.—The application of the Röntgen rays to pulmonary tuberculosis, by M. C. H. Bouchard. The continuation of the study of one of the cases of pleurisy previously described shewed an opacity at the summit of the lung, appearing to result from a condensation of the pulmonary tissue, and this was confirmed by percussion and auscultation. In all the cases of tuberculosis examined with the aid of the fluorescent screen, the number of pulmonary lesions has been clearly made out, and in all diseases of the thorax the application of this method forms a valuable aid to diagnosis.—On the third scientific campaign of the *Princess Alice*, by S. A. Albert I., Prince of Monaco. This communication is chiefly occupied with the results of deep-sea soundings in the neighbourhood of the Azores, and in the Mediterranean.—A new double image micrometer, particularly suitable for the measurement of small diameters, by M. G. Bigourdan.—On Taylor's series, by M. Émile Borel.—On a linear partial differential equation of the second order, by M. J. Le Roux.—On the quadratic integrals of the equations of dynamics, by M. G. di Pirro.—On the longitudinal tension of the kathode rays, by M. Colard. Starting with the hypotheses that the ray consists of the transport of negatively charged molecules, and that the electric field is negligible in the space considered, the conclusion is drawn that the behaviour of a kathode ray in a magnetic field is similar to that of a perfectly flexible conductor carrying the same current.—On some errors admitted as facts in electromagnetism, by M. Vaschy. In the case of the movement of a magnet under the influence of a current of constant intensity, the usual calculation of their relative energy neglects the heat evolved by the current. Other examples are given of similar cases.—On selenic anhydride, by M. René Metzner. A comparison of the thermochemical data of sulphuric and selenic acids; the formation of selenic anhydride from selenious anhydride and oxygen is an endothermic reaction.—Analysis of copper by the electrolytic method: estimations of arsenic, antimony, sulphur, and foreign metals, by M. A. Hollard. A continuation of a previous paper on the same subject.—On the antimonio-tungstic combinations, by M. L. A. Hallopeau.—Researches on the sulphides of cobalt and nickel, by M. G. Chesneau. The solubility of cobalt sulphide in sodium polysulphide increases rapidly with the excess of sulphur present. The sulphide of cobalt obtained in this way approximated to the composition $CO_3.S_7$. Nickel gives with the same reagent a black polysulphide of perhaps analogous composition, differing from the cobalt salt in being soluble with difficulty in sodium polysulphide, and more soluble in the monosulphide.—New method for the estimation of glycerol, by MM. F. Bordas and Sig. de Raczkowski.—On 1 : 3 di-bromo-propylene, by M. R. Lespieau. This substance ($CHBr : CH.CH_2.Br$) is obtained by the action of phosphoric anhydride upon symmetrical dibromhydrin.—On the decolorisation in wines, by M. J. Laborde. Under the action of the oxydase present in a culture of *Botrytis cinerea*, a wine was completely decolorised in four hours. This oxydase is destroyed by heat, hence the best method of preventing the spontaneous decolorisation of wines is to raise the wine to a temperature sufficiently high to destroy the ferment.—Coagulating and toxic properties of the liver, by MM. Mairet and Vires. By the action of heat upon the extracts a precipitate is formed, possessing coagulating properties; the filtrate contains the toxic principles.—Replacement of the amibocytes and phagocytic organ in the *Paludina vivipara*, by M. L. Cuénot.—On the development of Annelids, by M. Auguste Michel.—Contributions to the study of the *Rouget*, by M. S. Jourdain. The disease known as "rouget," "bête rouge," &c., is due to the attack of an acarus (*Trombidion*), in a larval hexapodal form.—On the formation of non-nitrogenous food stores in the nut and almond, by M. Leclerc du Sablon.—Action of some substances on the germination of the spores of black rot, by MM. L. Ravaz and G. Gouirand.—On an apparatus designed to show that the quantity of dissolved gas in sea-water at great depths is independent of the pressure, by M. Jules Richard. A description, with diagrams, of the apparatus used in the deep-sea soundings on the last voyage of the *Princess Alice*.—On the influence of certain living organisms on the quantities of oxygen and carbonic acid dissolved in sea-water, by M. Marten Knudsen. The observations on the amount of dissolved oxygen in the superficial layers made by Dittmar, in the *Challenger* Expedition, and later by Tornoë, show great variations, the quantities found being in some cases greater than that calculated from the law of solubility of gases. These results were attributed by Dittmar to errors of observations, but similar results having been obtained during the expeditions of the *Ingolf* to Greenland, although by a different method from those adopted by other observers, led to the discovery that this excess was due to the presence of a great number of living copepods.—On a red rain that fell at Bizerte (Tunis), by M. Ginestous. The colouring matter was of a mineral nature, which from its composition would appear to consist of the débris of a granulitic pegmatite.—The cooling of the globe, the primordial cause of evolution, by M. R. Quinton.

NEW SOUTH WALES.

Linnean Society, October 28.—Mr. Henry Deane, President, in the chair.—The President formally announced the death, on the 10th inst., of Baron von Mueller, who was one of the first two honorary members of the Society to be elected (January 22, 1876).—On the motion of Mr. J. H. Maiden it was resolved that (1) the members of this Society desire to express the profound regret with which the tidings of the decease of Baron von Mueller have been received; and at the same time to place on record their high appreciation of the Baron's life-work, which has in so eminent a degree contributed to the advanced state of our knowledge of the flora of Australia. (2) A copy of this resolution be forwarded to the surviving sister of the late Baron, with an expression of the Society's sympathy in her bereavement.—The President read a letter from the Royal Society of Tasmania, offering to co-operate in any movement to raise some appropriate memorial of the late Baron von Mueller.—The following papers were read:—Australian *Termitidæ* (Part ii.), by Walter W. Froggatt. The author discusses the classification of the family, and proposes its subdivision into four subfamilies based upon the characters of the neuration of the wings.—Note on the occurrence of Palæozoic *Radiolaria* in New South Wales, by Prof. David. With the exception of the opal rocks, which contain numerous spherical casts, possibly of

radiolaria, all radiolarian rocks at present known in New South Wales are of Palæozoic age, and occur on two geological horizons, namely, Carboniferous (? or Devonian), as in the red jaspers of Barraba and Bingera, and the claystones and cherts, &c., of Tamworth; and Devonian or Silurian as at Jenolan Caves, in which locality the radiolaria are best preserved where the rocks are in contact with eruptive dykes. The author is led to the conclusion that these radiolarian rocks are not necessarily of deep-sea origin. In Palæozoic times in New South Wales the development of radiolaria both vertical and horizontally was very extensive.—Note on traces of *Radiolaria* in pre-Cambrian rocks near Adelaide, by Prof. David and Walter Howchin. The recent microscopic examination of calcareous and cherty rocks of undoubtedly pre-Cambrian age from South Australia has shown that these rocks, not previously known to be ossiliferous, contain abundant remains of radiolaria.

AMSTERDAM.

Royal Academy of Sciences, October 31.—Prof. van de Sande Bakhuyzen in the chair.—Prof. W. Kapteyn on the construction of a curve of the third order, its real foci, its satellite-point and a tangent being given.—Prof. van der Waals demonstrated that the value of b in the equation of fluids which, when they are in a state of great rarefaction, is equal to four times the molecular volume, decreases with diminishing volume. The formula

$$b = 4m\left\{1 - \epsilon_1\left(\frac{4m}{V}\right) + \epsilon_2\left(\frac{4m}{V}\right)^2 \&c.\right\}$$

represents the variation of b with the volume. Of the coefficients ϵ_1, ϵ_2, &c., only the first has been calculated, and has been found equal to $\frac{1}{88}$.—Prof. Weber communicated the conclusions drawn from 254 determinations of the absolute and the relative weight of the brains of mammals. A hippopotamus amphibius of 1755 kilogr. had brains weighing only 582 gr. Consequently the ratio is 1 : 3105. This is the most unfavourable one hitherto fixed by weighing. Only the relative weight of the brains of the large cetacea presents a more unfavourable ratio, which, however, is founded on estimation. In many respects the hippopotamus has preserved the character presented by the brains of the tertiary mammals.—Prof. Franchimont on the fusing point of organic bodies. The speaker drew attention to the variation of the fusing point taking place when hydrogen atoms are replaced by other elements or groups of atoms, and took it that the latter, though they become united with the same atom, do not occupy the same place, so that a change in the form of the molecule is brought about, which influences the fusing point. This change of form counteracts in some cases the effect of the increase of the molecular weight, which consists in a rise of the melting point, and seems to be brought about principally by the CH_3 group, which, when in contact with oxygen, nitrogen, or carbon, can cause the fusing point to fall. To such a change of form the speaker also wished to ascribe the phenomenon observed by himself and Zincke in 1872, viz. a variation of the fusing point in terms of an homologous series with an even and an odd number of C atoms alternately. The speaker had met with this phenomenon in other cases also.—Prof. Engelmann treated of myogenic self-regulation of the action of the heart, and presented a paper on the subject for publication in the Academy's *Proceedings*.—Prof. Lorentz presented a paper to be published in the Academy's *Proceedings*, entitled "a universal theorem concerning the motion of a viscous fluid with friction, and a few consequences deduced from it."—Prof. Kamerlingh Onnes communicated two papers: (*a*) by Dr. Zeeman, on the influence of a magnetisation on the nature of the light emitted by a substance. Pursuing a hint given by Faraday, several experiments were tried. The principal was this: the light of the electric arc, being sent through a heated tube containing sodium vapour, is analysed by a Rowland's grating. The tube is placed between the poles of an electro-magnet. When acted on by the magnet, a slight broadening of the two sodium lines is seen, tending to show that forced vibrations are produced in the atoms by the action of magnetism; (*b*) by Dr. J. Verschaffelt, on capillary ascent between two concentric cylindrical tubes, being measurements carried out in the Leyden Physical Laboratory. In a previous communication Mr. Verschaffelt, to calculate the capillary ascent of liquid carbonic acid, made use of an hypothesis, viz. that the meridian section of the surface of the liquid was an ellipse. The writer has put this manner of calculation to the test of observation. For this purpose, however, he has not used liquid carbonic acid, but methyl chloride, and has found a satisfactory correspondence to exist between the value deduced from observation and that arrived at by calculation.—Mr. Jan de Vries presented, on behalf of Prof. L. Gegenbauer, of Vienna, a paper entitled "Zwei allgemeine Sätze über Sturm'sche Ketten."

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (mathematico-physical section, Part 3) contains the following memoirs recently communicated to the Society.

August 1.—Charles A. Noble (San Francisco): Solution of the boundary equation for a plane contour composed of segments of continuous curvature and without salient angles. R. Fricke (Brunswick): On a simple group of 360 operations. W. Voigt: An attempt to determine the true specific electric moment of a tourmaline.

October 24.—J. Orth: (1) On the formation of fibrin on serous and mucous membranes; (2) Researches conducted in the Göttingen Pathological Institute. W. Voigt: (1) A new method of investigating the thermal conductivity of crystals; (2) On the position of the absorption-brushes in biaxial pleochroic crystals. The formal communications (Part 2) include the address voted to Lord Kelvin upon his recent jubilee, and that to Prof. Wilhelm Hittorf, of Münster, on his *doctorjubiläum*.

BOOKS AND SERIALS RECEIVED.

BOOKS.—A Treatise on Ore Deposits: J. A. Phillips, 2nd edition, by Prof. Louis (Macmillan).—Mensuration for Beginners: F. H. Stevens (Macmillan).—Applied Bacteriology: T. H. Pearmain and C. G. Moor (Baillière).—The Story of Forest and Stream: J. Rodway (Newnes).—Scritti intorno alla Teoria Molecolare ed Atomica ed Alla Notazione Chimica: S. Cannizzaro (Palermo).—The Lepidoptera of the British Islands: C. G. Barrett, Vol. 3 (L. Reeve).—This Wonderful Universe: A. Giberne (S.P.C.K.).—Elementary Meteorology: Dr. F. Waldo (New York, American Book Company).—Observations and Researches made at the Hong Kong Observatory, 1895: W. Doberck (Hong Kong).—La Structure du Protoplasma et les Théories sur l'Hérédité, &c.: Prof. Y. Delage (Paris, Reinwald).—Traité de Zoologie Concrète, Tome 1: La Cellule et les Protozoaires: Prof. Y. Delage and E. Hérouard (Paris, Reinwald).

SERIALS.—Good Words. January (Isbister).—Sunday Magazine, January (Isbister).—American Naturalist, December (Philadelphia).—Himmel und Erde, December (Berlin).

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