THURSDAY, FEBRUARY 4, 1897.

THE STUDY OF BACTERIOLOGY.

A Text-book of Bacteriology. By E. M. Crookshank, M.B. Fourth edition. Pp. xxx + 715. (London: H. K. Lewis, 1896.)

THE importance of bacteriology is undeniable; in fact, the study of the action of bacteria in health and in disease, inside and outside the animal body, has revealed so many new facts, it has already explained so many phenomena which formerly belonged to the realm of mystery and yet promises so much more, that we can easily understand why there was a danger, not even now totally removed, that, beguiled by this entrancing branch of science, pathologists would be led astray to regard bacteriology as the only portion of their subject worth taking up. We have at present a large number of "bacteriologists" in this country and abroad, many of whom are specialists who have entirely dissociated bacteriology from pathology, physiology, chemistry and botany. It requires comparatively little skill and study to be a "bacteriologist," and probably more incomplete and unsound work is published on bacteriology than in any other science. It is so easy to create a sensation with bacteria, especially where disease, or the prevention of disease, is concerned. Many bacteriologists, unfortunately, are quite satisfied in performing a few laboratory experiments without at the same time studying the disease itself, and they argue, only too often, from immature observations. They are ever criticising without being critical. In the study of disease, bacteriology cannot, and must not, be severed from pathology and clinical medicine or surgery. We insist on this, because recently an attempt has been made to have bacteriology recognised as a separate branch of the medical curriculum, with compulsory attendance and the inevitable examination at the end, without which there is no perfection. The principles of bacteriology must be, of course, taught with biology, pathology, clinical medicine and surgery, but the art and practice of bacteriology can only be taught by carefully-conducted courses extending over some weeks or months. If general compulsory classes were instituted, the student would acquire a smattering of practical bacteriology which is worse than useless, and this would encourage him in the idea that bacteriology is quite simple and mere child's play. Dr. Klein has warned us against the bacteriological cheap-jack.

"There seems to be an idea abroad, of which one hears only too often and sees its mischievous results continually, that for bacteriological and pathological studies and research all that is required is a platinum needle for inoculation, sterile nutrient gelatine in test-tubes (which can be easily bought by the dozen), a microscope with oil immersion, a microtome for sections (sections can be, of course, cut by any dexterous assistant), one or two aniline dyes (also easily bought ready made), and a book on bacteriology."

Thus writes Dr. Klein, and we agree with him that this is not bacteriological study; yet that might appear to be the ambition of those who advocate the introduction of compulsory courses in bacteriology. How many students who have been "signed up"—the signing up is an important factor in the scheme—would be competent to make a bacteriological diphtheria diagnosis? No more than would be competent to make a careful histological examination after a similar course in practical morbid histology. Let us leave the true science and art of bacteriology to the serious, and give them good laboratories, good instruction, and plenty of time and good books.

The student must derive much of his instruction from books, and, unfortunately, we possess but few good English books on bacteriology, and therefore we regret all the more that we cannot but express our disappointment with the new edition of Prof. Crookshank's work on bacteriology. We find that although the book is very bulky, that it contains but little information on points which require elucidation and discussion. Immunity is badly treated, and the process of immunity not discussed at all, and the principles of the antitoxins are touched upon in the most cursory manner, and there is no discussion whatever of the action of antitoxic or preventive serum and all the pathological questions involved. Although our knowledge of bacteriological chemistry is still very incomplete, we might have expected a full and critical account of what has been done. The chemistry of tetanus is not even brought up to date, but undue prominence is given by the author to his own researches on tuberculin, so that out of ten pages on the whole bacterial chemistry, three are devoted to his and Herroun's investigations, and the enzymes and ferments are passed over in eighteen short lines. The technical instructions are far too incomplete to be of any use, and had much better been left out, for practical bacteriology is best treated as a special subject. Coming to the pathological part of the book (Part ii.), we find that the whole subject is treated in 300 pages, of which about 100 pages treat of the diseases of animals. The utter lack of a sense of proportion is striking, and, as hinted above, the author's own work is always thrown into great relief. Thus, although actinomycosis occupies thirty-five pages, typhoid fever is rushed over in seven pages, if we make due allowances for the illustrations which fill five pages; cholera is skimmed in ten pages, with fifteen illustrations taking up about three pages; while to scarlet fever, with the notorious Hendon and the Wiltshire cows, twenty-two pages have been devoted, of which many are dreary reading full of controversial matter. Diphtheria has been deemed worthy of only five pages, tetanus of but two, and rabies of four. No important subject is clearly or carefully discussed, and the book is full of misleading and inaccurate statements. Thus we read, without any further explanation or criticism, on page 343: "Whether the typhoid bacillus is really peculiar to typhoid is much disputed. Bacilli very closely resembling it, if not actually identical, have been found under other conditions." The bacterium coli is not described, but passingly alluded to in a few lines which convey but little information, and the detection of the typhoid and colon bacillus in water is so incompletely explained as to be useless, and the import-

ance of the latter bacillus in analytical work is not considered at all. In fact, the whole chapter on typhoid fever, while omitting all that is wanted, contains nothing worth reading. Instead of reading page after page of diseases of deer, buffalo, boars, swine, fowls, horses, cows, ducks, grouse, mice, rats and other animals, the student would have preferred a serious discussion of the present position of the cholera or diphtheria question. The yeasts and moulds are also unsatisfactorily treated, and there again we cannot get away from cows, calves, fowls and mice, while man is of quite secondary importance. A few pages are devoted to the hæmatozoa, and here also the malaria parasite which occurs in man comes off badly, while the parasites of surra, of the common rat, and of fish are much more fully discussed. There is, of course, much regarding small-pox, cow-pox and other pox in the book, and also, for some reason or another, lengthy extracts from the final Report of the Vaccination Commission. All this is unsatisfactory reading, because the author does not write impartially on this matter.

In conclusion, we must say that the book, although well got-up, is not one which can be considered as worthy of English bacteriology. The best parts in the book are some of the illustrations of animal diseases; but even as a picture-book it is unsatisfactory, for some drawings are too diagrammatic and on an excessive scale. The absence of sound criticism, the lack of a just sense of proportion, and the want of a true appreciation of the problems of disease, and more especially of human disease, compel us to speak severely of the work, and to warn the student of bacteriology, who is needs surrounded by doubt and dogma, against placing his confidence in such a guide. A. A. KANTHACK.

PREHISTORIC MAN AND BEAST.

Prehistoric Man and Beast. By the Rev. H. N. Hutchinson, B.A., F.G.S. Pp. xxii + 298. (London: Smith, Elder, and Co., 1896.)

THE unscientific reader cannot fail to find much that is instructive in this work; it brings into a comparatively narrow compass information which could only otherwise be obtained by a wide course of reading, and it makes good its pretension to be fairly well abreast of the times.

There are many "good things" in it, generally distinguished by inverted commas. The author has the true instinct of a writer for the populace, and steadily pursues effect: to a striking passage he will succumb, even if it be a trifle meretricious, and it will be found inserted in its due place, with an apology if necessary. Witness the long extract giving "a rather fanciful picture" of palæolithic man" (pp. 34-36).

Naturally he has little sympathy with the technical details on which scientific results depend. "Every work dealing with prehistoric man contains," he says, "long and tedious descriptions of the famous skulls . . ." (p. 75). No doubt, yet we fancy there is more than one place in this work where a familiar knowledge of these details would have proved useful to the author. Again, on p. 22, we find "detailed evidence from sections in gravel-pits, &c. (*sic*), such as would be almost unintelligible, with the probable result that he would lay down the book at once." The detailed evidence was probably omitted in this case with judgment, but there are others in which some knowledge of "sections" would have greatly assisted the reader, and might possibly have saved the author from the following. "First of all stone was used. . . . *Hence* the stone age is the earliest." (The italics are ours.) On a question of fundamental importance, like the order of succession of the different prehistoric periods, the reader is likely to require evidence of a different nature to this.

The impatience for all that is technical savours of ingratitude when the author, speaking of those original investigators who have provided him with so much valuable material, remarks of them that they "have so obscured the romance by their 'dry-as-dust' descriptions and ponderous reports of their labours, that no ordinary reader would care to plod through a single chapter of their writings." Probably these writers were too solicitous about the truth to care much about the romance, which for the present may be left in the care of the author, who, let us hasten to add, is not always so censorious as these extracts might suggest; he praises the artist who has embellished his work with fancy pictures, and he praises Sir Henry Howorth, who generously returns the compliment.

It is a pity the book is not better illustrated; several sketchy drawings, spoken of as "restorations," occupy some ten plates, but of figures of real interest there are none. The ordinary reader would have welcomed reproductions of palæolithic drawings, and figures of ancient weapons; maps would have assisted him, and even geological sections might not have come amiss. Of the plates, some are worse than others. It will, perhaps, be fairest to choose the frontispiece for comment. It represents a palæolithic family receiving a call, at the photographed entrance of Wookey Hole, from three different kinds of wild beast. One, which we took to be a polar bear, we are informed is a machairodus; the next, a very stuffed-looking specimen, is a cave bear; and the third, a hyæna. The author recognises that a triple alliance of this kind is improbable; why, then, does he represent it? Because—and here we find the true popular writer—"it makes a more interesting picture," and "scientific accuracy should not be pushed too far." We let this pass, as well as the toy harpoon with which the cave man is defending his weeping wife and family, to ask if the author really supposes that palæolithic man is fairly represented by the tall, fair Caucasian with long straight nose, and orthognathous jaws, who does duty for him here.

It may be that this is, as the author claims for the illustrations, "a thoroughly artistic and vivid picture," though it is more than doubtful whether it "would well bear reproduction on a larger scale"; but we are in cordial agreement with him when he remarks that it is not a scientific, "mere scientific" diagram, and—we should prefer the diagram.

We are not quite sure whether the author has any really clear ideas of the bodily aspect of the people he wishes to portray. In speaking of the stage of culture of

palæolithic man, he makes use of Mr. Tylor's comparison with the aborigines of Tasmania; but on p. 36 we find the following: "In speaking of the probable mental and moral condition of man in the older stone age, we have, for want of further material, compared him with the aborigines of Australia, Tasmania, and New Zealand." Next time the author visits the British Museum, he will, perhaps, take a glance at the weapons and other implements of the Maoris that are exhibited there, and reconsider the evidence on which he regards these people as useful for purposes of comparison with men of the palæolithic age.

There is a great deal of foolish writing—there is no other term for it—in Chapter iv. headed "The Myth of the Great Ice-Sheet." The author concludes a tiresome tirade by admitting an ice-sheet, formed of confluent glaciers, which covered the greater part of the British Isles; he calls it a "modest local or British ice-sheet." With this conclusion in view, we might well have been spared the vapourings on "superstition," "bugbears," "myths," "nightmares," and the like—terms culled apparently from Sir Henry Howorth's vocabulary—as well as the somewhat spiteful gossip about Agassiz and Schimper. More modesty might have been expected from a popular writer; we shall not imitate Mr. Hutchinson's style, and say a mere popular writer—it would be rude—in discussing the views of some of the great geologists of the past. To speak of Ramsay, Agassiz, and Croll as having "gone mad over ice," as prostrating before it "not only their bodies, but their minds," and as having been beyond the reach of reason, is not becoming: still worse is the expression that Croll misled the public. Croll requires no defence from us, and we make no further comment.

The author appears as a reconciler of Genesis and science, with a somewhat inadequate acquaintance with Babylonian writings; the same deficiency appears in the ten pages devoted to the question of the origin of the zodiacal signs. He was warned of the doubtful nature of Mr. Peck's theory by Mr. Flinders Petrie, but introduces it with the usual plea—it may be wrong, but it is "interesting." There is an extensive literature on the origin of the zodiacal signs, and the probabilities all point to Babylonia as their birthplace.

As for the literary style of the book, it is well enough so long as the author keeps to digests, summaries, and simple descriptions; but where he gives us something of his own, the result is less pleasing. We could well have dispensed with several feeble witticisms, a parade of puerile suggestions, and a good deal of sentiment. As an instance of the author's undiluted style, we quote the following:—

"How delighted must Mr. Ruskin and all true followers of our great teacher and prophet be to learn that, after all, we shall not have to give up our fairies! And what an anti-climax must such a result appear to those hard, unsentimental scientific workers and thinkers who were wont to consider fairy tales as nothing but pure 'stuff and nonsense'! It must be somewhat humiliating to such—if there be any left—to reflect that they must no longer dare to despise fairies, but are compelled, in the sacred name of Science (with a *very* big S), to pay homage to them!"

W. J. SOLLAS.

OUR BOOK SHELF.

Getting Gold: a Practical Treatise for Prospectors, Miners, and Students. By J. C. F. Johnson, F.G.S., Member of the Aust. Inst. of Mining Engineers. Pp. xii + 204. (London: Charles Griffin and Co., Ltd., 1897.)

IN this book will be found much practical information on the mining and subsequent treatment of gold ores, particularly useful to the prospector setting out for Australia. It has often been said that the practical man does not write books, but there is here a complete refutation of the calumny. There are chapters on the "genesiology" of gold, which are hardly of practical value, on the treatment of ores by various processes, and on company formation. A useful section, too, is devoted to prospecting, in which the various difficulties of finding gold are clearly set forth. "Where it is, there it is," the author quotes, "and where it is, generally, there I ain't." The best part of the book, however, is undoubtedly under the heading of the "Rules of Thumb." Here the practical man shows what he can do. The recipes given are absolutely encyclopædic, and all more or less to the point. We are told how to make fire, how to find water, how to purify it and carry it, how to copy correspondence, to cross a flooded stream, and to build a house. One is lost in admiration at the wealth of knowledge displayed, and the mixture of "cuteness" and simplicity in the remarks.

The tables at the end of the book are less happy. A dozen or more mistakes occur in a short table of fusing and boiling points, and the elementary algebra seems unnecessary in the present state of primary education. Nevertheless, though not without faults, the book will be most useful to prospectors who have not been through a course of study at a School of Mines.

Photo-Trichromatic Printing. By C. G. Zander. (Raithby, Lawrence, and Co., Ltd., 1896.)

THIS book is a model of neatness and printing, and harmonises well with the subject of which it treats. The author has not attempted an elaborate text-book on the optical sciences of chromatics and spectroscopy, but states in a straightforward and clear manner the outlines of the causes of colour phenomena and the effects of pigmentary mixtures and combinations. A perusal of the fifty pages shows that Mr. Zander has adopted a very happy arrangement for the sequence of the matter dealt with, making the book easy reading for even those who are not very familiar with the subject.

The first of the four parts into which the book is divided treats of chromatics and, more briefly, spectroscopy, the reader being introduced to the three fundamental colour sensations. In Part ii. pigment mixtures are discussed, and many a useful hint may be gathered here by those who wish to know the why and the wherefore of common every-day manipulations. The explanatory diagrams showing the absorption of two typical pigments and those of the resulting mixtures are all that could be desired. A useful *aide-mémoire* is the chromatic clock-dial, which is an ingenious idea for helping those who work with colours to remember which are the contrast or complementary colours, and how saddened colours or tints may be produced.

Three-colour work, or the production of any colour by the combination of the three primary colour sensations, is treated of in the third part.

The concluding section is devoted to the important question of photochromic printing inks, the author pointing out the chief essential qualities that they must possess for successful work.

We may say, in conclusion, that printers and artists have in these few pages a useful handy guide, which will give them an insight into the art of successful photochromic three-colour printing.

The Earth and its Story; a First Book of Geology. By Prof. Angelo Heilprin. Pp. 267. (Boston: Silver, Burdett, and Co. London: Gay and Bird, 1896.)

THIS is a most attractive little book of geology. It presents very clearly the general facts concerning the formation, structure and development of the earth; and notwithstanding its popular character, it contains a large amount of the more detailed information required by the elementary student of the subject.

Prof. Heilprin begins with the decay of rocks, and then describes the appearances and origins of the commoner rocks. The subsequent subject-matter follows this order: formation of mountains and valleys, snow and glaciers, underground waters, relation of the sea to the land, the earth in its interior, volcanoes, earthquakes, coral and coral islands, fossils, physiognomy of the land-surface, common and useful metals and minerals, building stones, soils and fertilisers, and common rock-forming minerals. It will be seen from this outline that the book is comprehensive enough to meet the needs of the average student; its form is also popular enough to attract a large number of lay readers.

The volume is most liberally illustrated, and the illustrations possess the immense advantage of being reproductions from photographs. There are sixty-four full-page plates, most of them containing two pictures, and all of them exhibiting striking objects or phenomena. We do not know of a better illustrated introductory text-book of geology than the one which Prof. Heilprin has given us. The book is more suitable for use in American colleges and high schools than in our own; but there ought to be a demand for it on this side of the Atlantic.

The Climate of Bournemouth in Relation to Disease, especially Phthisis. By A. Kinsey-Morgan, M.D., &c. Pp. 51. (Bristol: John Wright and Co., 1897.)

THE important part which climate plays in the etiology and cure of lung diseases is well recognised. In this essay Dr. Kinsey-Morgan shows the advantages which Bournemouth offers to consumptive patients, or to persons suffering from any form of chest disease. He differs from writers on continental health-resorts and sanatoria, inasmuch as he points out how hygiene and medical influences must supplement climatic conditions, and insists that wholesome sanitary surroundings are more important points to be considered than particular thermal or mineral waters.

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.*]

Carbon in Bright Line Stars.

IN an article "On the Question of Carbon in Bright-line Stars," in your issue of January 28, Prof. Lockyer makes the following statement in reference to our paper "On Wolf and Rayet's Bright-line Stars in Cygnus."

"As a result of their work, they make the following statement: 'Our observations appear to us, however, to be conclusive on the main subject of our inquiry, namely, that the bright blue band in the three Wolf-Rayet stars in Cygnus, and in DM 37° 3821, is not coincident with THE BLUE BAND OF THE BUNSEN FLAME.' The capitals are mine. It will be seen how carefully Vogel, in the case of comets, and myself, in the case of stars, had pointed out that it was not a question of the Bunsen flame!"

I am glad that the last words of the quotation from our paper were put in capitals, as they emphasise the assertions which we had to meet, namely, Prof. Lockyer's assertions in an article in NATURE (vol. xlviii. p 344):—

"In the Bakerian Lecture for 1888, I gave a complete discussion of the spectra of bright-lined stars, as far as the observations went, and the conclusion arrived at was that they were nothing more than swarms of meteorites, a little more condensed than those we know as nebulæ. The main argument in favour of this conclusion was the presence of the bright fluting of carbon which extends from 468 to 474."

Now, this bright fluting of carbon is that known as the blue band of the Bunsen flame. The variations of the position of maximum of brightness which may take place within it, were fully discussed in our paper, and do not affect the range of wave-length. Even the anomalous band photographed from a vacuum tube at South Kensington gives little help, for it is scarcely necessary to repeat that in two stars the bright band lies outside this region; and in the other, though the maximum falls near the more refrangible limit of the blue carbon band, a large part of it falls outside the carbon band.

But Prof. Lockyer himself puts beyond doubt that by his words, "the bright fluting of carbon," he did mean what we call "the blue band of the Bunsen flame," for he goes on to say (NATURE, *loc. cit.*):—

"Direct comparisons of the spectrum of all three stars in Cygnus, with the flame of a spirit-lamp, have been made by Mr. Fowler, and SHOWED AN ABSOLUTE COINCIDENCE OF THE BRIGHT BAND IN THE STARS WITH THE BLUE BAND OF THE CARBON SEEN IN THE FLAME. It was found quite easy to get the narrow spectrum of the star superposed upon the broader spectrum of the flame, so that both could be observed simultaneously."

The capitals are mine. Now, bright bands having an absolute coincidence with the blue band of carbon in the flame, could be no other than the blue band seen in the Bunsen flame. This was the assertion which we had to meet; an assertion stated to be supported by direct comparisons of the stars with a carbon flame. It was, therefore, necessary for us to make it clear that this assertion was incorrect; and to say, in words which could not be mistaken, that "the bright blue band in the three stars is not coincident with the blue band of the Bunsen flame."

I am not aware that Prof. Lockyer has withdrawn the observations made at South Kensington. They are certainly remarkable, indeed unique, in the annals of spectroscopic research, for Mr. Fowler saw the blue band of his flame to have ABSOLUTE COINCIDENCE with three different star bands, which, all three, differ from each other in wave-length.

If the blue band, differing in position in each star, were the blue carbon band, as Prof. Lockyer asserts it to be, we should certainly expect to find in the spectra of the stars indications of the other bands of the carbon spectrum, especially of the bright green band and of the orange band. Now, there *are* bright bands in these parts of the spectra of the stars: but we state in our paper, as the result of a very careful direct comparison of these bright places in the star-spectra with a carbon flame, that there is no connection whatever between the bright star bands and the carbon flutings. This important result has been fully confirmed by the recent measures of these bright star bands taken by Prof. Campbell. His measures of the bright places in the star spectra, *which are well seen upon the continuous spectrum*, show with certainty that they have not their origin in carbon. Prof. Lockyer says that "Prof. Campbell does not discuss the origins of the lines and bands which he has measured."

Prof. Campbell's words are:—

"It is now a question of identifying the lines and bands with the lines of known elements, and of assigning to these stars their true place along with other types of celestial objects. A most perplexing question! The hydrogen lines, Hα, Hβ, Hγ, Hδ, are present, but the other lines do not admit of certain identification. Prominent iron and other lines may coincide with a few of the star lines, and the line at 4480 suggests a magnesium origin; but there are not enough points of identity with well-known artificial or stellar spectra to enable us to draw any safe conclusions" (*Astronomy and Astro-Physics*, 1894, p. 472).

As Prof. Vogel's name is prominently brought forward in Prof. Lockyer's article, it may be well to say that Prof. Vogel has nowhere identified the blue bands in the Wolf-Rayet stars, of which he was the first to determine the wave-lengths with any approach to precision, with the blue radiation of carbon.

I should perhaps point out that, though Prof. Campbell does suggest magnesium, he is careful not to make any suggestion as to the presence of carbon. WILLIAM HUGGINS.

Upper Tulse Hill, S.W., January 30.

Symbols of Applied Algebra.

UNFORTUNATELY Mr. C. S. Jackson (p. 293) does not appear to believe that I mean what I say, nor does he definitely apprehend what I mean. It is possible, however, that he represents some other teachers, and, therefore, I must regretfully occupy your space with the elementary statements: (1) that absolute measure has nothing to do with "standard substances"; directly a standard substance is introduced the "measure" becomes relative; (2) that specific gravities are expressible in tons per cubic yard (weight or mass being understood in accordance with context and subject-matter), or in grammes per cubic inch, or even in dynes or poundals per cubic metre; and (3) that to consider a density as a mere number is erroneous.

January 31. OLIVER J. LODGE.

On Mass.

DESPITE the extraordinary letter of Mr. C. S. Jackson, which appears in your issue of December 31, 1896, I must say that if there is a term which teachers of rational mechanics should retain and emphasise, it is the term *mass*. Mass denotes the quantity of matter, or the amount of stuff, in a given body. It is a definite and invariable quantity, whether you have the body at latitude 0° or at latitude 90°; whether you conceive it transferred to the surface of Jupiter, or to the outermost ring of Saturn.

On the other hand, the weight of the said body is a variable quantity, being measurably greater in a high than in a low latitude. At the earth's centre, it vanishes; on the moon, it would be less than here in New York; whilst on Jupiter, it would be considerably greater.

The inevitable conclusion is that scientifically the *mass* of a given body is of more importance than such a variable quantity as its *weight*.

This holds even commercially, for when we buy a pound of sugar we are more concerned with the quantity of the saccharine material that we get than with its weight. The weight is taken, in any given place, as a convenient measure of the mass.

Mr. Jackson's equation

$$P/Q = f/a$$

is misleading; it is true only when the forces P and Q act on *equal masses*. To write such an equation without the above statement, is merely begging the whole question at issue.

It is to be hoped that teachers of rational mechanics will ever insist on the different ideas connoted by the terms *Mass* and *Weight*. M. F. O'REILLY.

Manhattan College, New York City, January 13.

Dynamical Units.

IF Prof. Perry's reply to my letter (on p. 126) is summed up in the charge that I think of "stuff" when I ought to be thinking of inertia, then the issue between us should reduce to very minute dimensions. It is, perhaps, unfortunate that in English the term mass may signify either "quantity of matter" or the inertia of that matter, but hardly so unfortunate as the fact that weight may denote either a quantity of matter or a force, an ambiguity to which we are all prone, though Prof. Perry makes light of it; for a definite amount of matter implies, at least, a definite amount of inertia, but not a definite weight, in the sense of force. If Prof. Perry thinks that with himself the word mass means simply inertia, then, substituting at the bottom of p. 49 in the current volume, I find that he says: "My unit of inertia is the *inertia* [the italics are mine] to which unit force gives an acceleration of 1 foot per second per second." I am free to confess that I cannot dissociate the conception of inertia from the idea of matter; but here we have abstraction indeed.

The main points to which I confined my remarks were the observation that with British standards the poundal is unique among units of force, and the showing that the alternative system of units advocated by Prof. Perry is artificial and inconvenient. Even if he makes such verbal alterations in my letter as may suit his craving for rigorous expression, the objections to his proposals will still hold. But I do not know for certain what alterations he demands. In the case of a student who is commencing the study of dynamics by observing the effect of forces applied to bodies moving smoothly on the flat, would he tell him at the outset that it is not a number of pounds of iron or other stuff that he is moving about, though he may think so, but an amount m of inertia? Surely he would not. Or is it that he objects to my statement that his system involves the conception of one piece of matter (the standard pound) whose weight (under conditions) is the unit of force, and also of another lump of matter of 32·18 lbs. whose inertia is the unit of inertia? Well, if he says that no such conception presents itself to him I will not insist. I am not familiar with his psychological processes, but such images arose in my mind on reading his exposition of the system, and I think the same would (and ought to) occur in the case of a student on first trying to understand it. And it is for the beginner that Prof. Perry is so solicitous: an advanced student may be left to choose his own system, and will get on in spite of all systems.

In seeking to justify his preference, Prof. Perry, dexterously using the figure paraleipsis, extracts such support as he can get from existing legal definitions of the pound. We have had our law-abiding instincts appealed to in this connection before; but the law is a broken reed to rely on. The legal standard pound was originally established almost entirely with a view to facilitate the accurate weighing of Prof. Perry's conventional or metaphysical ideas—in other words, quantities of stuff of various kinds. Its environment did not signify, as its weight, in the sense for which modern physicists try to reserve the term, was quite a secondary matter. The standard pound was adopted for the sake of something which it and all its true copies, of whatever material they may be made, possess, or appear to possess, in themselves; and this thing they possess, or are associated with to the same extent wherever they may exist in the known universe: and it is not their weight, in the modern sense. It is their mass, in the sense of, or as measured by, their quantity of inertia. Prof. Perry is welcome to whatever comfort he can obtain from the wording of Weights and Measures Acts.

However, we have the thing—the standard pound. No one denies that its weight, when it is placed in vacuo near London, furnishes us with an excellent practical unit of force. But this is not good enough to secure the banishment of the poundal and the dynamical system associated with it. I do not quite gather where Prof. Perry himself considers the "huggermugger" comes in with regard to this unit; but if I understand his letter aright, something perilously near to this appears to have crept in among his observations on the subject.

In his letter (NATURE, vol. lv. p. 176) he affects to ignore the fact that the standard pound really furnishes us with a standard *something* that is constant—its inertia. He uses such phrases as "Assuming . . . that the weight and inertia of a certain body measured under the same circumstances at the same place are always the same"; and again: "Now here are your standards" (*i.e.* of weight and inertia) "in one piece of metal and its environment, and in your instruments." How ingenious is the suggestion that its inertia suffers from the same incurable disease that afflicts its weight, viz. that it is a function not of the body only, but also of its more or less unknown and uncontrollable environment. If it should ever be shown, as he seems to think may occur, that for a given body its inertia—the ratio of force to acceleration produced—is not to be regarded as an absolute constant, then not only the poundal, but a good many more of our dynamical ideas will have to be thoroughly overhauled.

Furthermore, he cannot mean what he appears to say, that he really considers the weight of a body, its attraction by and for the earth, to be the most fundamental property of matter, though from the stress he lays on the importance of his system one might almost suppose that it is so, and, moreover, that it is the weight at London which possesses this distinction. If he means that he regards the gravitational field of force associated with every particle of matter (ether-stress, if you will) as the most fundamental property of matter, I understand him, while not quite agreeing with him. Still, he can found a mechanical system on that basis, free from the objections applying to his present system; but it will have no 32·18, and I am afraid practical men will not receive it with gratitude.

As emphatically pointed out by Prof. Lodge, the interest the question is pre-eminently educational. Prof. Perry agree that to an expert, so far as his own personal work is concerned the units he works in are generally of no great consequence. Such a one can use, say, the Birmingham wire-gauge or the Baumé hydrometer with much more facility than an ordinary person could use more rational devices. And so far as actual

practical calculations go, Prof. Perry, in getting out in foot-pounds the energy of rotation of a fly-wheel, or in making a conversion into horse-power from C.G.S. units, merely does his division by g (arithmetically or symbolically) at an early stage, where a "poundalist" would probably divide at the end. But with the elementary student it is different; a misconception at the start may stick to him for years unnoticed. Perhaps an occasional bath among all sorts of difficulties in which he is told to sink or swim, such as Prof. Perry advocates, may have a stimulating effect. But let us consider. Prof. Perry's main complaint was that so many are overwhelmed by the poundal. (Oddly enough, he does not seem to mind the dyne, which is on all-fours with it; in fact he has nothing to say against the work of the B.A. Units Committee, beyond a grumble at the fact that they acquiesced in the formula $4\pi r^2$ as representing the surface of a sphere.) Now, for instance, will a student not be puzzled as to the reason why this new system should bear to the English standards a relation so utterly unlike that which the C.G.S. system bears to the French standards? And it seems to me that there must be students who might manage to keep afloat in presence of the poundal to whom Prof. Perry's definition, that "the unit force is that which would give to a body of 32·18 times the inertia of the standard object kept in London an acceleration of 1 foot per second per second"—invented out of pure kindness for them—may prove a very millstone round their necks. And they will be no better off if he raises the talismanic number to 32·19, as apparently he would now do.

May I conclude by suggesting to Prof. Perry, by way of a small return for the many useful things which I have learnt from him during the past twenty years and more, that an appreciative toleration of rule-of-thumb methods is one thing, but it is another thing to glorify and perpetuate them.

Ashurst Wood, January 12. M. J. JACKSON.

Durham Science Degrees.

I AM surprised to see the letter of your anonymous correspondent "X." in your issue of January 28.

All the six gentlemen referred to, hold important positions on the teaching staff of this college.

They were recommended by the Council of the college to the Senate of the University as deserving such a degree as would make them members of the Convocation of the University.

"X." insinuates that these gentlemen had no qualification for this honour.

The truth is, that one of them is M.Sc. of Victoria University, three of them are B.Sc. of Scotch Universities; the remaining two are the Senior Lecturers in their respective departments, where they have taught graduates of the University for twelve and thirteen years respectively. HENRY PALIN GURNEY.

The Durham College of Science, Newcastle-upon-Tyne, January 29.

PHOTOGRAPHY IN COLOURS.

THE announcement has been made during the past week of the discovery of a true process of photography in colours. It is too early now to discuss the matter in its many interesting bearings, since the process so far remains more or less secret, but the following communications will indicate how the question at present stands.

The first is a *communiqué* received from Sir H. Trueman Wood, the Secretary of the Society of Arts.

I am anxious to make, through the medium of the Society of Arts *Journal*, at all events a preliminary announcement of a very remarkable process for producing photographs in colours which was brought to my notice the other day. To say that it enables photographs to be produced in natural colours would not, perhaps, be precisely true, since colouring media are employed; but the result of the process is a photograph in colours of nature—a faithful reproduction in colour of the object photographed—and so, for all practical purposes, it may be said that the long-sought object of photographic research, photography in colour, has actually been obtained.

The inventor is M. Villedieu-Chassagne, of Paris, who has developed a process originally suggested by Dr. Adrian Dansac, and the following is his method:—(It must be premised that he keeps secret, at all events for the present, the nature of the four solutions he employs.) A negative is taken on a gelatine plate prepared by treatment with one of his solutions. This is developed and fixed in the ordinary manner. It shows no trace of colour. From it a print is taken on glass or paper, the plate or paper being specially prepared by treatment with the same solution. The transparency or the paper print in no way differs, to all appearance, from an ordinary positive, and shows no trace of colour by transmitted or by reflected light. It is then washed over successively with three coloured solutions, blue, green, and red, and it takes up the appropriate colours in appropriate parts, these three colours giving, by their various combinations, all varieties of hue. How it is that this power of selective absorption is given to the components of the photographic image (principally, of course, metallic silver) is, it appears to me, the interesting question connected with the process. The action is certainly previously unknown, and it will, as certainly, repay scientific investigation.

As I declined to be convinced by mere inspection of the finished results, M. Chassagne was good enough to demonstrate the whole process for my benefit, and by the kindness of Prof. Thomson, of King's College, the demonstration was allowed to take place in the laboratory of King's College on two mornings last week. Prof. Thomson and Mr. Herbert Jackson, of King's College, were present on both occasions, and Captain Abney on the second. I must not speak for those gentlemen, but I believe they were as much impressed as I was myself by the remarkable nature of the process and its results.

That such results should be obtained by such a process seemed *à priori* in the highest degree improbable, but obtained they certainly were.

The photographs taken by ourselves were poor, the light (on the morning of Wednesday, 20th) being extremely bad. Nevertheless, the positives (made by one of ourselves on the following day) showed with perfect distinctness, when treated as above described, the colours of a bunch of flowers I had bought at Covent Garden, on my way to King's College, and of various other test objects.

Our own experiments were confined to gelatine films, but M. Chassagne treated with complete success some paper positives he had brought from Paris. These looked like ordinary silver prints toned with gold, but I omitted to ask about the toning.

Further experiments and independent investigation (for which M. Chassagne has kindly promised me the materials) will, no doubt, throw further light on the nature of the process; but I cannot believe that any investigation will throw doubt on its genuine character, for it was carried out under test conditions last week, the sole reservation being the nature of the materials employed.

I hope that a fuller account of the method may shortly be presented to the Society in the form of a paper; but in the meantime it appeared to me that members of the Society would be interested by having placed before them the first information about so remarkable and promising an invention. H. TRUEMAN WOOD.

Captain Abney, who was present at the experiments referred to above, writes as follows:—

The process of colour photography, which I had the pleasure of seeing demonstrated at King's College

some ten days ago, through the kindness of Sir H. T. Wood, is a very remarkable one. I was present as a sceptic, and came away partially convinced. The process may be described in a very few lines. In the first place a negative is taken on a gelatine plate, which has been specially prepared. It is developed and fixed in the ordinary way, and appears like any other negative taken on a good density-giving plate. A transparency (a positive) is taken on a similar plate from this negative, or a silver print taken on specially prepared albumenised paper, on either of which the colour process is worked. The colouring is of a very simple nature. There are three dyes—a crimson-red, a grass-green, and a very good blue, all in solution, and probably mixed with some other ingredient besides water. There is what we may call a mordant in the shape of a colourless liquid containing, I should say, albumen and salt.

This last liquid is brushed copiously over the face of the positive on the silver print, and the blue dye applied a little at a time. If the light is good (and it was stated that the colouring must take place in good daylight), the blue dye rapidly takes hold of those portions of the surface which represent in monochrome blues in the original. For instance, a china vase will take the blue tint, and the face or hands a faint amount of the same colour. The green dye is applied in the same manner, and the greens in the original make their appearance in the positive, and so with the red. Finally the print or positive presents a picture in colours, underlying which is the dark brown silver image. It appears as if the image took up selectively these three colours; but why it takes them up, it is hard to see. I have by me a portrait done in the manner described, and the negative has evidently been retouched with the pencil. It is hard to understand why a pencil mark should be the cause of selective absorption of the colours. That the success of the process does not depend upon the inventor's intervention is quite evident, for negatives were taken by Sir H. T. Wood, quite independently, on prepared plates given him for the purpose, and from these he made positives. These last, when treated with the colouring matter, gave the correct colours of the original. Still I am somewhat sceptical—I believe it is my failing to be so—and I shall not be satisfied till I get the plates that have been promised me by the inventor (M. Chassagne), and taken negatives of certain test objects which will be unknown to the inventor. If he can reproduce their colours without depending on the different amounts of deposit caused by the red, the green, and the blue, and which he will be obliged to do in the negatives I submit to him, then I shall be satisfied. Some few years ago a powder process was seen by Mr. C. V. Boys, in which three coloured powders were selected by the surface of paper prepared with some glutinous substance and bichromate of potash, and which remained more or less tacky after exposure to light. These three powders, a red, a green, and a blue, I believe, if applied in a certain order, adhered to the print, and gave approximately correct results of colour. Whether this new process now described depends on any similar grounds, it is hard to say at present; but for the older process no special negative was required.

The point that strikes me in the newer one is the possibility of producing from a negative a print which exhibits the peculiar selective power claimed for it. Were it the negative which took up the colour, one might understand the matter better. To me at present the process is a mystery; but if it does all that it is claimed for it, it must be a great success commercially. At present the details are a secret; but I am given to understand that the seal of secrecy will be withdrawn before long, as a patent is applied for. We shall then be able to ascertain on what principles the process is worked.

W. DE W. ABNEY.

BRITISH ASSOCIATION MEETING IN TORONTO.

I.—LOCAL ARRANGEMENTS.

THE various special Local Committees, organised to make preparations for the British Association meeting, to take place in Toronto this year, have now, after a year's work, to report very satisfactory progress in the arrangements for the occasion. In the case of some of the Committees, their work may be considered as finished. The special Committee on Finance, for instance, has secured promises of financial aid to the extent of 5700*l.* from the Governments of the Dominion of Canada and the Province of Ontario, and from the Toronto City Council. This sum will, it is believed, be fully sufficient for all the expenses of the meeting, which, owing to the special circumstances of the occasion, must be larger than those of any meeting in Great Britain.

The Committee on Rooms also has, for the present, finished its labours. According to its report, which has been adopted by the Local Executive Committee, the reception room, general offices, and the rooms for the sectional meetings are all to be in the various lecture-rooms and laboratories of the University of Toronto and of the School of Practical Science. As the buildings of the University and School are in the centre of the city, and within less than five minutes' walk from the electric car line which communicates with all parts of the city, the selection offers every convenience in the way of conveyance. The rooms selected are large and well adapted for the purposes assigned, and all are within a short distance of each other. Sections A and H (Mathematical and Physical Science and Anthropology) will occupy lecture-rooms in the main building of the University, Sections D, I and K (Zoology, Physiology and Botany) are allotted rooms in the Biological building, Section B (Chemistry) will be placed in the Chemical building, Section E (Geography) in the general reading-room of the University library, while Sections C, F and G (Geology, Economics and Mechanical Science) are to be given large rooms in the University Y.M.C.A. building, Students' Union building, and in the School of Practical Science respectively. The only building to be used by the Association, and not situated on the University grounds, is Massey Hall, in which will be delivered the President's address and the evening lectures. It is capable of seating 4000 persons, and has splendid acoustic properties.

One of the conversaziones will be held in the main building of the University; the other will, it is expected, be given in the new buildings of the Provincial Legislature. A number of gentlemen have kindly offered to give garden parties, while the Faculties of Trinity College and Victoria College have arranged to hold receptions. The various Clubs in the city will be open to the members of the Association.

The arrangements for conveyance are not yet completed, but the concessions already made by the Steamship and Railway Companies may be announced. The Canadian Steamship Companies, the Allan, Dominion and Beaver Lines (Liverpool and Londonderry to Quebec and Montreal) have granted to members of the Association considerable reductions in rates for single and return tickets, and the Anchor Line (Glasgow and New York) offer reasonable rates for single or return first-class tickets. A copy of a circular giving information in regard to Atlantic steamship rates will be sent to each member of the Association in a few weeks. It may be well to note that berths are to be applied for early in the season; for the choice, if made late in June or July, may not be a large one. The Canadian Pacific and Grand Trunk Railway Companies have decided that round

(return) trip first-class tickets over their lines may be obtained by members for the single fare, and that for single trips between points on their lines in Canada east of Port Arthur (on Lake Superior) only half rates (¾d. per mile) will be charged. The Canadian Pacific Railway Company will also give free tickets for trips over the branch roads of the main line in the North-west and British Columbia, and will arrange a special excursion to the Pacific Coast, to take place after the meeting, for a number of members and guests of the British Association.

Additional excursions to other parts of Canada have been provided for. Niagara Falls may be reached from Toronto in three hours by the large fine steamers of the Ontario Navigation Company, which ascend the Niagara River to a point connected with the Falls by two electric car lines. This excursion may be made on any day, and an opportunity will be offered to visitors to spend the time from Saturday to Monday at the Falls. It is expected also that members will have the privilege of inspecting the means employed of "harnessing Niagara." Another excursion, to the beautiful Muskoka Lake region, Ontario's summer resort, four hours (by rail) distant from Toronto, is offered. The members may leave Toronto at 3 p.m. on Saturday, August 21, and return early Monday morning. There will be, on an afternoon during the meeting, an excursion to the Ontario Agricultural College and Farm, in the neighbourhood of the town of Guelph. The Committee on Excursions is providing also for a number of special excursions to Nova Scotia, Kingston, and the Thousand Islands, Montreal, Ottawa, the Upper Lakes, to cover from five days to three weeks. The town authorities of Sudbury are preparing for an excursion of members to that district, in which are to be found the richest nickel mines in the world. Parties interested in mining also will, by special excursions, visit the Western Ontario gold mines, and the gold mines of British Columbia, which at present are attracting much attention.

The special Committee on Publication is preparing a hand-book of the Dominion, which will give an account of its resources, and of its geological, climatic and other features. It is expected that copies of this hand-book will be ready for distribution amongst the members before they start for Canada.

The Local Committee has decided to invite a number of distinguished continental (European) scientific men, and it is believed that not a few of these will accept the invitation. A very large number, also, of prominent American scientific men have expressed their intention of attending the meeting. The American Association for the Advancement of Science meets on August 9, at Detroit, 240 miles from Toronto, in order to allow its members to be present at the meeting of the British Association. The Society of American Naturalists, the American Psychological Association—both very important and strong organisations—have accepted for their members invitations to join the British Association and attend its meetings. It is confidently believed that the Toronto meeting will have very largely an international character, and that the numbers in attendance will be very great.

The people of the Dominion in general, and of Toronto especially, are determined that the coming meeting shall not fall one whit in interest behind any meeting held in the British Isles. As the time approaches, the interest in it daily increases. Canadians realise also that it is a rare opportunity to show what their country is in grandeur, in extent, and in resources; and they will leave nothing undone which will make the meeting a success from every point of view. It must also be said that for the British man of science the occasion is the opportunity of a life-time.

A. B. MACALLUM.

NEW FOREIGN MEMBERS OF THE ROYAL SOCIETY.

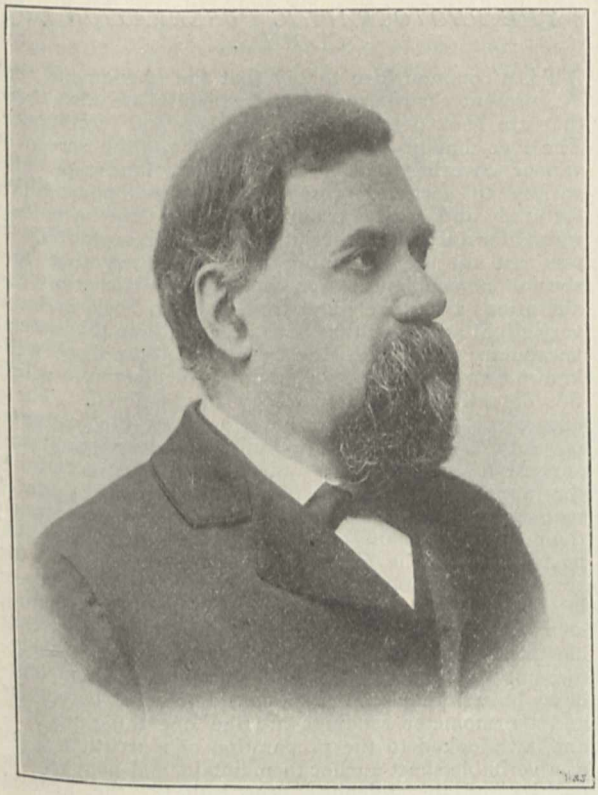
WE are able to give this week portraits of the recently elected foreign members of the Royal Society—Giovanni V. Schiaparelli, the Astronomer and Director of the Royal Brera Observatory in Milan; Prof. Albert Heim, the geologist, Professor of Geology in the Hochschule and Polytechnische Schule of Zürich; Prof. Gabriel Lippmann, Professor of Physics in the University of Paris, and a Director of the Physics Laboratory of the Sorbonne École des Hautes Études; and Prof. Gösta Mittag-Leffler, Professor of Pure Mathematics in the Hochschule, and Director of the Mathematische Seminar at Stockholm.

Prof. Giovanni V. Schiaparelli is best known for his researches in meteoric and cometary astronomy, and for his acute observation of planetary characteristics. He is the author of numerous papers in the Milan *Rendiconti*, the *Journal de Physique*, the *Annalen der Physik*, in the *Comptes rendus*, in *Les Mondes*, and elsewhere In 1867 his papers, "Intorno al corso ed all' origine probabile delle stelle meteoriche," "Sur la relation qui existe entre les comètes et les étoiles filantes" (*Astronomische Nachrichten*), and "Sur l'origine des étoiles filantes de Novembre" appeared. Later came "Sul calcolo di Laplace intorno alla probabilità delle orbite cometarie iperboliche," and "Nuovi fatti e nuove teorie sulla repulsione nelle comete"; and more recently "Osservazioni astronomiche e fisiche sull' asse di rotazione e sulla topografia del Pianeta Marte," "Observations de la tache polaire australe de Mars pendant l'opposition de 1879," and a number of other papers on this planet. His observations of Mercury and Venus, which led him to conclude that the period of rotation of each of these planets is the same as that of revolution around the sun, are also noteworthy contributions to astronomy.

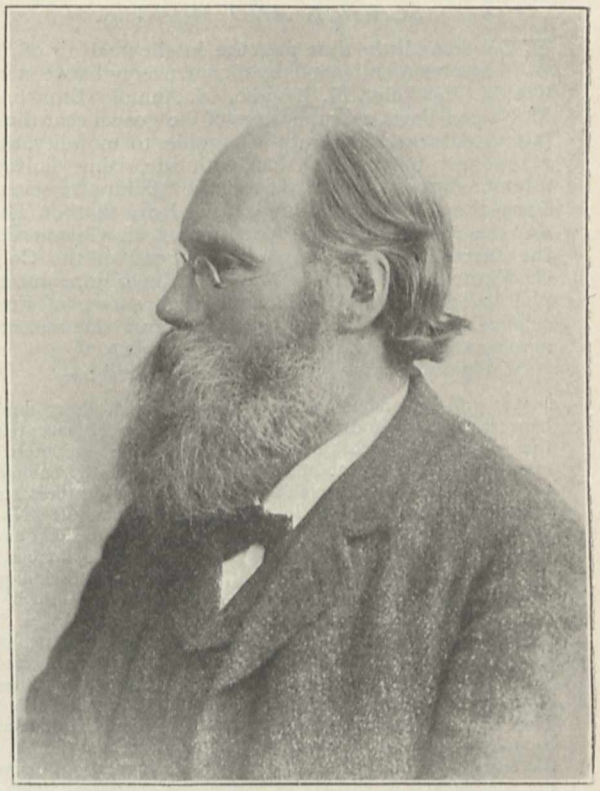
Prof. Heim is well-known for his work in reference to glacial action and to mountain structure. Among his more important published works are his "Handbuch der Gletscher Kunde," published in 1884, and his "Untersuchungen über den Mechanismus der Gebirgsbildung," besides a number of occasional contributions to scientific literature, including various papers on Glaciers, printed in the *Annales Phys. Chem.*, in the *Sehweizer. Naturf. Gesellschaft Verhandlungen*, &c., in the Zurich *Vierteljahrschrift*, &c., also "Les tremblements de terre et leur étude scientifique," in the *Archives Sci. Phys. Nat.*

Prof. Lippmann is well known to men of science by his important observations respecting electro-capillary phenomena, leading to his invention of the capillary electrometer; and by his recent researches upon colour photography, in which he has attained the optical solution of a problem at one time considered insoluble. By photographic processes he has produced brilliant pictures, not only of the spectrum and simple coloured subjects, but also of landscapes and figures. Among his other published works are numerous contributions to the *Journal de Physique*, the *Revue Scientifique*, the *Comptes rendus*, &c., on the relations between electrical and capillary phenomena, on units of electrical force, on experimental determinations of the ohm, and kindred subjects.

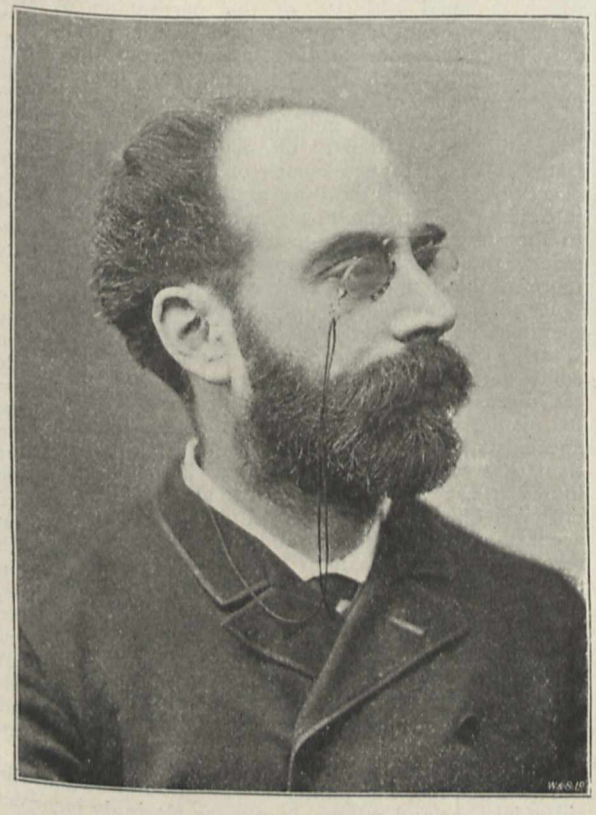
Prof. Gösta Mittag-Leffler, whose name is familiar as the founder and editor of the *Acta Mathematica*, is distinguished for his researches in the theory of functions and in other regions of pure mathematics. His published papers are numerous, and have appeared principally in the Stockholm *Ofversigt*, in the *Acta Societae Scientiarum*, Helsingfors, and in the Paris *Comptes rendus*. Among the more important may be mentioned a series of papers in the *Ofversigt*, "Om den analytiska framstellningen af funktioner utaf rationel karakter," "Funktionsteoretiska Studier" in the *Helsingfors Acta*. "Sur la theorie des fonctions uniformes d'une variable" in the Paris *Comptes rendus*, &c.



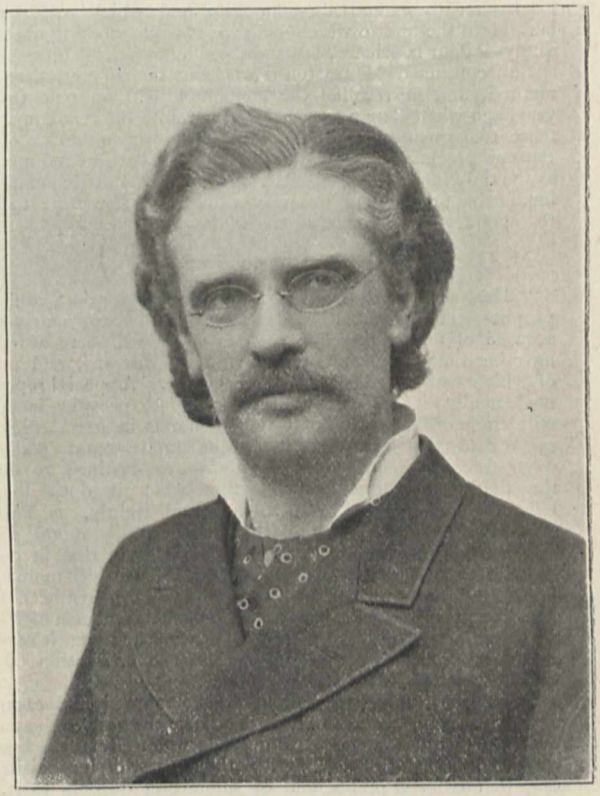
GIOVANNI SCHIAPARELLI (*Milan*).



ALBERT HEIM (*Zürich*).



GABRIEL LIPPMANN (*Paris*).



GOSTA MITTAG-LEFFLER (*Stockholm*).

THE NEW FOREIGN MEMBERS OF THE ROYAL SOCIETY.

SCIENCE AND MORALS.

FOR some little time past the intellectual air of Paris has been enlivened by a controversy between men like M. Berthelot, M. Lavisse, M. Anatole France, and M. Gaston Paris, as supporters of the gospel that the disinterested search for truth is a guide to morality, and a reactionary party which has, with surprising dialectics, attempted to sustain a plea of the "failure of science." From the *Times* of Friday last, we learn that on Thursday the reception at the Academy of M. Gaston Paris, the successor of M. Renan as the head of the Collége de France, and one of those who have done most in philological studies to maintain the renown of French science, was the occasion of a signal demonstration against the reactionary, unscientific spirit.

M. Gaston Paris is reported to have said :—

"It will be understood that science, which every day enhances, enlarges, and renders more precise our conception of the world, and which transforms, at the same time more and more effectively, the conditions of our existence by submitting to our laws the matter which was crushing us, inspires an enthusiasm almost religious in those enamoured of it. No one had this cult more deeply rooted in his soul than M. Pasteur. No one claimed more insistently for science the honour and the place to which it has a right, or became more indignant with the stupid misunderstanding which refuses to it the means of action of which it stands in need. In a brief piece of writing, entitled 'Le Budget de la Science,' published in 1868, he adjured his fellow-citizens to take more interest in 'those sacred abodes known under the expressive name of laboratories. Ask that they should be multiplied and adorned. They are the temples of the future. It is there that humanity becomes greater and stronger and better.' He had the joy and the supreme honour to see rise under his invocation, owing to the munificence of the entire nation, the most magnificent of these temples of the future. There he reposes to-day in his glory, and about his tomb has been formed, like an order of the new times, a militant, truly spiritual band which fights under his banner to extend his conquests, and which will remain faithful to the motto which he gave it while working unremittingly—'Pour la science, la patrie, et l'humanité.'"

But, continued M. Gaston Paris, science had more than one method, and he recalled the memorable sitting some twenty years ago when Renan received Pasteur into the Academy, and these two great men exchanged words never to be forgotten, Pasteur proclaiming the grandeur of the experimental method as the only infallible instrument of discovery, and Renan claiming for historic and philosophic criticism the share due to it in the conquest and defence of truth.

M. Gaston Paris went on to say :—

"This science of which Pasteur was the priest and the prophet, this science to which we owe so many marvels, is accused of not having kept certain promises, some of which have been made by representations that it disowns, and others of which can only be realised with time. A special reproach made against it is that it is not yet ready to provide humanity with the moral direction of which it stands in need. Science might reply that it does not extend its empire so far, and that other forces which it does not deny are destined to do in the field of sentiment and action what it does in the field of knowledge. But it can, and rightly, as Pasteur affirmed, lay claim to its large share in this moral direction itself. If, unfortunately, it is not certain that in pointing out in the social instinct the true basis of morals, it assures to this instinct predominance over selfish instincts, it is certain that in drawing tighter the bands that bind men together, in undermining the barriers which still separate them, it renders easier and indicates as nearer at hand the civilisation of the world as a whole. . . .

"Science, in the circles where it is honoured and comprehended, does not restrict to men of science themselves the moral benefit which it confers. It diffuses in wider circles the love of truth and the habit of seeking it without bias, of recognising it only by unalloyed proofs, and of submitting docilely to it. I think that no loftier or more fruitful virtue can be inculcated in a nation."

THE PHOTOGRAPHIC OBSERVATION OF CLOUDS.

IT is a commonplace to say that the phenomena that present themselves most frequently are also those that are least observed with accuracy and intelligence. The ever-changing aspect of our sky, and the screen of vapour covering that adds charm to landscape and variety to scenery, present numberless opportunities for study and critical examination, but they have long waited for adequate description and representation. It was not till the beginning of this century that any special nomenclature was invented to describe the alterations that take place from hour to hour, and the very slight additions that have been made to this special vocabulary since Luke Howard proposed the three well-known terms of description, show the neglect from which this department of meteorology has suffered. These terms, too, though they have become the common property of all nations, are limited to description, and suggest nothing of the physical causes that determine the appearances he so happily described. Indeed, meteorology in his day was not in a position to push the inquiry with hope of success, and it may even still be urged that the explanations offered to account for some of the recognised types of cloud formation are largely speculative. This neglect of a very charming study has been brought about, not only by the fact that clouds are of ordinary every-day occurrence, and therefore not worth noting, but students of practical meteorology have perhaps too much considered that barometer and thermometer readings are the one thing needful, and have looked to the preparation of a weather chart as a veritable sheet-anchor to maintain and support the position of the science. For hitherto the general character of cloud observation among even painstaking meteorologists has been lamentably insufficient. A rough personal estimate of the percentage of area covered by cloud is frequently all that is given, with very little reference to the distance from the zenith at which these clouds are seen, and consequently neglecting the effects of foreshortening. Altitude, density, direction of motion, character of formation have all been regarded as of small consequence, but it is to be hoped that an epoch of more useful and more exact observation is dawning and possibly we may run into the other extreme, now that attention is being called to the subject, and devote too much time to the consideration of these fleeting appearances, and accumulate more results than can be effectively studied.

It might have been anticipated that artists, who maintain so constantly that they reproduce precisely what they see, would have given us pictures of clouds in some degree approaching to accuracy, and have made the discussion of their forms and characteristics easier for men of science. But as a rule the study of these specialists has scarcely been more exact or painstaking than that of the ordinary public, who, from the causes hinted at, are especially unfitted to apply that wholesome criticism which might have resulted in promoting more accurate representation. We believe there is a case on record in which a painter represented a rainbow with the colours reversed. This was unwise, because a rainbow being a rarer phenomenon than ordinary clouds, it has attracted more attention from the public, and the error was noticed. But faults as egregious too often accompany artistic production of clouds, and pass without censure or remark. Painters may make rain fall from a thin strip of cloud, or from impossible cumulus, and escape without ridicule. But these are freaks it is no longer safe to indulge in.

The artist, too, who paints by sunlight and without the aid of brushes and colours, is often as glaringly incorrect as his more respected and ambitious brother. We have

heard in the past, we know not with what truth, of artfully-placed pieces of cotton-wool on the printing frame, and of other devices, which, by judicious handling, have been made to give an appearance remotely resembling that of natural clouds, and that competent judges have been deceived by these means. A great authority on photographic reproduction has laid it down as a rule that the same "sky" should not be printed on more than one picture; and that such advice should be considered necessary, shows the length to which ingenious fraud has been carried in this matter. And yet it might be thought that if accurate reproduction of cloud-forms was attempted anywhere, it would be found in photographs of landscape. Some of the reasons for its non-appearance, very well known to practical photographers, have recently been discussed in NATURE (No. 1367), and valuable suggestions made to overcome these difficulties. The photographer does not always wish to reproduce the actual state of the sky at the time his photograph was taken. He thinks he can produce a better artistic effect by employing clouds of his own manufacture; but, apart from this, there is an inherent difficulty in obtaining a satisfactory negative of the lighter forms of cirrus and cirro-cumulus. The blue colour of the sky has practically the same chemical action on the sensitised plate as that exercised by the white colour of these fleecy clouds, and the contrast on which the photographer relies for his effects is wanting. The rules of procedure there given have resulted in some excellent representations, of which specimens will be found in the recently issued International Cloud Atlas, a work that may possibly revolutionise our methods of cloud observation.

Although the processes of photography have been sadly abused, it is undoubtedly to the employment of the camera, scientifically used, that we must look for the best results. Every day sees these results accumulating, and, as a necessary consequence, the introduction of greater uniformity in the classification and nomenclature of cloud observations. Also, greater and more frequent use suggests numerous devices to the expert, by which he may win more trustworthy pictures of the lighter forms.

It is now possible to reproduce very light cirro-cumulus clouds, and though some of the delicacy of the original may be lost in the method of printing, sufficient detail remains to enable one to judge of the success that attends the processes that Prof. Riggenbach, of Basle, and others have successfully advocated. Prof. Riggenbach avails himself of the fact that, while the light from a cloud is only slightly polarised, the light from the blue sky is much more so, especially at points which are 90° from the sun. By employing a Nicol prism, therefore, the skylight may be darkened to a very considerable extent, while the fleecy filaments of the cloud will come out with greater sharpness and distinctness. A dark mirror may be employed instead of the Nicol prism, and a still simpler means is to use the still surface of a lake as a polarising mirror. When clouds have an altitude of about 37°, and differ in azimuth from the sun by about 90°, they can be photographed in this way with ease and truthfulness. Another method which secures admirable results, though it may not be at the disposal of every one, is to photograph the clouds directly, at a considerable elevation above the sea-level. Here, on the top of a mountain summit, the sky appears much darker than in the plain, caused probably by the absence of scattered light from dust particles, which are more numerous in the lower strata. The observer, too, has the additional advantage of lessening the distance between himself and the cloud.

FIG. 1.—Cloud, photographed at an altitude of 2500 m.

photographed. Our first illustration (Fig. 1) shows the appearance of a cumulus cloud as seen from the top of the Santis Mount at a height of 2500 m. At this elevation a yellow glass placed in front of the lens is all the protection needed. The other picture (Fig. 2) shows that excellent results can be obtained at the sea-level with proper chemical treatment of the negative. These pictures were taken by Prof. Riggenbach, who kindly permits their reproduction, and both appeal to us by their evident fidelity.[1]

But it must not for a moment be supposed that the object sought is to secure pretty pictures, or even accurate pictures. In clouds we have portions of the atmosphere which, from natural causes, have become temporarily visible, and as clouds exist at practically all heights above the surface, their study must reveal to us something of the behaviour of the atmosphere at otherwise inaccessible points. Wind and currents of the atmosphere, to say nothing of the vertical displacement of large masses of the air, must betray themselves by the motion of the clouds, if the cloud movements are interpreted correctly; and the connection between wind and "weather" is so intimate, that the possibility of predicting the one depends in a large measure upon our knowledge of the other. The definite knowledge of the height of a cloud, and the means of accurately determining its distance becomes, therefore, a problem of the highest importance in meteorology, and it is one in which, fortunately, photography can render efficient assistance. If two simultaneous instantaneous photographs of the same cloud be secured at stations, distant possibly half a mile apart from each other, the height of the cloud can be determined by trigonometry. This process has been carried out systematically at various observatories. Two observers, a suitable distance apart, and in connection with each other by telephone, select a cloud by arrangement to which each points a camera, and the simultaneous exposure is effected by one of the operators releasing the shutters of both cameras at the same instant. Considerable impetus has been given to inquiries of this nature, not only by the possibility of greater accuracy being secured to the photographs when improved methods have been employed, but by the action of the International Meteorological Congress, who, mainly at the instance of M. Hildebrandsson, have arranged a scheme by which observers in all countries are invited to take part in a common investigation, which has for its aim the determination of the altitudes and the motions of different kinds of cloud. Theodolites can also be used advantageously in this work. This scheme, which was originally contemplated to be in force for one year from May 1896, will soon be completed, and will add materially to our knowledge of the motions of the clouds, and, by inference, of the motion of the atmosphere. The observation of the behaviour of a kite, when at a considerable elevation it plays in some measure the part of a cloud, can be made, in skilful hands, to reveal the direction of atmospheric currents at generally inaccessible heights. This method, which is being actively prosecuted under the auspices of the Weather Meteorological Bureau of America, has the advantage that the height of the kite is always approximately known, and is free from eddies and currents likely to be produced by irregularities on the earth's surface. Moreover, if the object of cloud observation be not so much the methods of formation as the study of air currents, kite-flying is likely to afford on

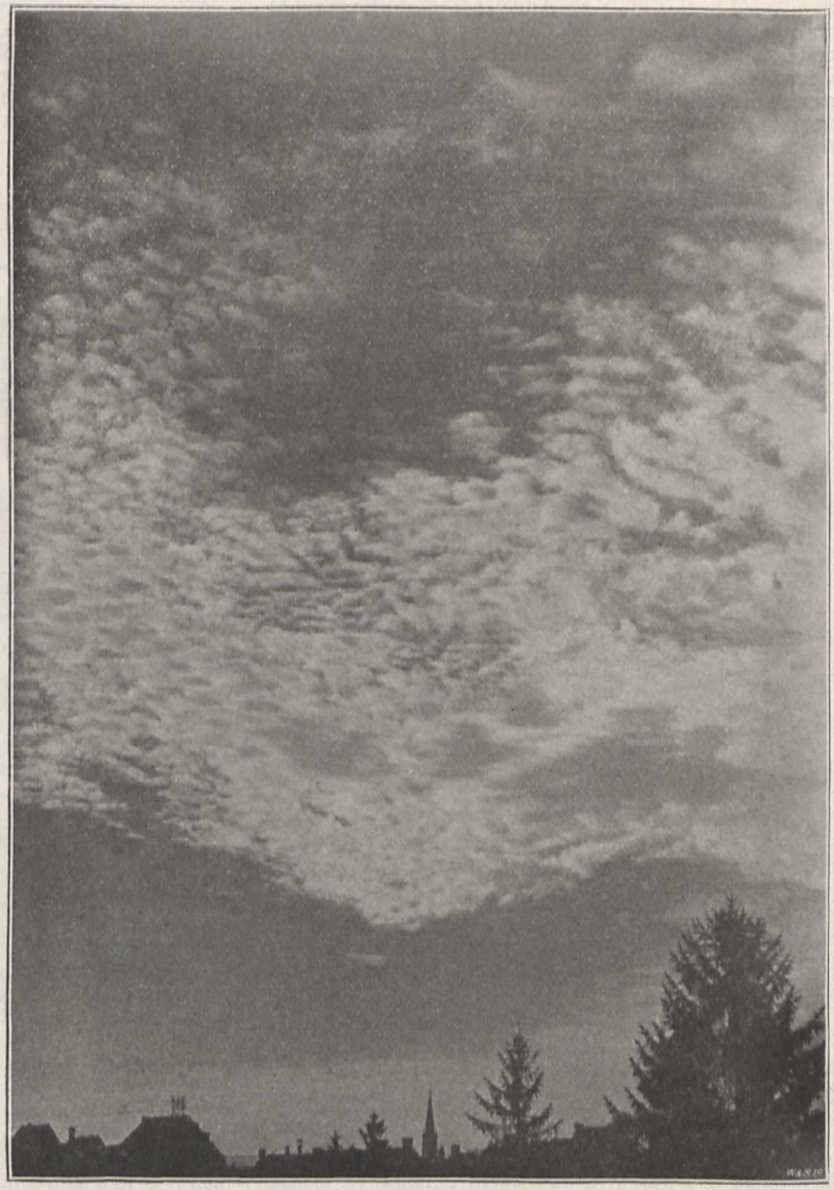


FIG. 2.—Clouds, photographed at low-level station

[1] M. Plumandon, of the Puy de Dôme Observatory, has also sent us some excellent specimens of his work, but the photographs arrived too late to be reproduced.

some grounds more accurate information, because a cloud produced under peculiar circumstances, such as a mountain-cloud cap, for example, may appear stationary under even a strong current of wind.

As an instance of another welcome result that attends cloud photography, we might refer to the confirmation it affords of recent mathematical investigation concerning the origin of cloud. Herr von Helmholtz has demonstrated that when one current of air passes over another of different density or different temperature, waves must arise at the two surfaces in contact, similar to those produced on water under the action of wind. These atmospheric waves are, however, of quite different dimensions to the ordinary water-wave. The distance between two contiguous crests in the atmosphere is incomparably larger than the similar wave-length in water, and, indeed, may be reckoned in kilometres. Air waves become visible when sufficient moisture is present, and the wave-crests can be seen in the form of clouds presenting the appearance of parallel billows, and for which the name of "Wogen wolken" has been suggested. In this form they have been repeatedly photographed. A well-known example that has been frequently reproduced, has been taken from the Lick Observatory. From other elevated stations, where the conditions have been favourable, pictures of these nebulous waves have been secured, proving the justness of the views held by Helmholtz. A mass of alto-stratus cloud will frequently show that a subsequent stage of the process of formation has been reached. When the regular parallel billows produced between strata of air have met other currents having different velocities and densities, the result is to break up the regular form into more or less lozenge-shaped pieces, of which the appearance is very familiar, and the methods and terms of description equally numerous. To do away with these vague terms of description, and to substitute others which may have closer reference to the physical structure, and perhaps indicate something of the relative heights of clouds, is one result for which we may look from the more satisfactory application of photography to cloud phenomena.

NOTES.

AT last Thursday's meeting of the Royal Society, the following words of congratulation were addressed to Lord Lister, the President, by Sir John Evans:—"As Treasurer and as one of the older of the Fellows of this Society, I beg to offer you on their behalf and my own our most hearty congratulations on the high yet well-merited honour that Her Majesty has been graciously pleased to confer upon you by elevating you to the Peerage. We have great satisfaction in feeling that, while this distinction is a fitting recognition of the value of your life-long labours in invoking the aid of science to the relief of suffering humanity, it comes at a time when this Society has the honour and pleasure of looking up to you as its President. If anything could add to that satisfaction, it is the fact that with your new dignity you are still able to retain the name of Lister, for the name of Lister, among the inhabitants of all the civilised countries of the globe, is 'familiar in their mouths as household words.'"

WE understand that Lady Prestwich is collecting material for a biography of the late Sir Joseph Prestwich, and will be grateful to friends if they will forward to her any letters they possess, addressing to Shoreham, near Sevenoaks. These will be at once copied and carefully returned.

A GERMAN antarctic meteorological station will be established shortly in Victoria Land, under the direction of Dr. Rudolph Mewes. The station will be in connection with the German South Polar expedition, and will have for its object the determination of meteorological conditions during the antarctic winter.

DR. NANSEN will lecture upon his Arctic expedition, at the Royal Albert Hall, on Monday next, at 9 p.m. A Reuter dispatch from Christiania says that during his visit to Great Britain Dr. Nansen will deliver forty-seven lectures. The explorer will then go to Germany, and at the end of March will be present at a great demonstration of the Geographical Society in Berlin, organised in his honour. On leaving Berlin Dr. Nansen will go to St. Petersburg, where he will have an official reception. Subsequently he will visit Paris in response to an intimation conveyed to him by the French Consul-General in Christiania, and will again be the object of an official reception. Early in October next, accompanied by his wife, Dr. Nansen will leave for New York, in order to deliver a course of fifty lectures in various cities of the United States.

IT may be remembered that a sum of money was raised, and placed in the hands of the Royal Society, to found a scholarship in honour of Joule. The Council of the Society resolved that the scholarship should be awarded alternately in England and in other countries, for the purpose of encouraging young investigators to walk in the steps of Joule. In accordance with this decision, the Royal Society asked the Paris Academy of Sciences to nominate a candidate for the award this year; and we learn from *La Nature*, that the Committee appointed to consider the claims of young French physicists have selected M. Jean Perrin, of the École-normale, for that distinction.

DR. CLEGHORN, Sanitary Commissioner for Bombay, is the special Indian medical expert selected by the Indian Government to attend the International Conference, to be held in Venice on February 10, to consider what means Europe should take to control the bubonic plague, should that disease advance towards the confines of Europe. Dr. Thorne Thorne, principal medical officer of health to the Local Government Board, has accepted the appointment of British Technical Commissioner at the same Conference.

THE honour in which Pasteur's name is held throughout the world is shown by the fact, announced in the *British Medical Journal*, that the subscriptions in France and other countries for a statue to the great investigator now amounts to more than £10,000. M. Paul Dubois has been selected as the sculptor, and the site for the statue will probably be the space between the Rue de Médicis and the Luxembourg Gardens. More than £20,000 has already been spent in the erection of statues of Pasteur in various parts of France. As an instance of the high regard in which he is held outside that country, it may be mentioned that the municipality of Mexico has given the name of Pasteur to the gardens situated in front of the National School of Medicine in that city.

WHEN the regulations for the muzzling of dogs in London and adjoining counties came into force at the beginning of last year, it was pointed out in these columns that rabies could not be stamped out by leaving local authorities to deal with it. The welfare of adjacent districts is so closely involved, that to place in the hands of different County Councils the power to enforce regulations for preventing the spread of disease, which knows not county boundaries, is absurd on the face of it. The only way to effectually cope with the evil is for some central authority, as, for instance, the Board of Agriculture, to compel joint action on the part of authorities having control over the areas where rabies exist. A muzzling and registration order so enforced for a couple of years would, in all probability, bring about the disappearance of the disease from our island. The report, just issued, of the Departmental Committee of the Board of Agriculture, appointed at the end of last April, "to inquire also and report upon the working of the laws relating to dogs," bear out this opinion. Statistics are quoted to support the con-

clusion that the powers of muzzling as exercised since 1882 by local authorities are inadequate to eradicate rabies, and only result in temporary and local checks to its spread. It is pointed out that the Board of Agriculture should have regard to the country as a whole, and should impose muzzling over considerable areas, irrespective of the boundaries of boroughs and counties; that the Board should impose it, in fact, where it is really required, and leave the rest of the country free. With the extirpation of rabies the necessity of muzzling will have disappeared, but the Committee think it expedient that more efficient means should be devised for the due licensing of dogs, and for their subsequent regulation. As to the question of a compulsory system of registration of dogs, it is considered that the matter should be entrusted to the Board of Agriculture, not to local authorities. With regard to the importation of dogs, the Committee consider that, without resorting to the extreme remedy of absolute prohibition, it would be possible for the Board of Agriculture to arrange, in concert with the Customs authorities, a system under which a sufficiently effective supervision may be secured over dogs landed in this country. In Norway, Denmark, and Sweden a system of quarantine is insisted upon; and in New South Wales, we believe, a dog has to undergo about six months' quarantine before it is allowed to enter the country, a heavy fine being imposed on the person causing this quarantine to be averted. If something of this kind were enforced in our own country, rabies would be as little known here as it is there. The first thing to be done, is to stamp out the disease by combined action; it would then be a comparatively easy matter to prevent its re-introduction.

AN eminent surgeon, who rendered distinguished services to the medical profession and to humanity, has just passed away in the person of Sir Spencer Wells. In 1882–83 Sir Spencer Wells was President of the Royal College of Surgeons. He received the honorary degree of M.D. from several universities, and was a member of many learned societies at home and abroad.

DR. AGAMENNONE, who has studied so successfully the earthquakes of Turkey and the south-east of Europe during the last two years, has not renewed his engagement with the Ottoman Government, and will shortly resume his work in Italy in connection with the Central Office of Meteorology and Geodynamics at Rome.

THE President of the Board of Trade has appointed a Committee, consisting of Major F. A. Marindin, R.E., C.M.G. (chairman), Earl Russell, Sir Douglas Galton, K.C.B., F.R.S., Sir Charles Scotter, and Dr. John Scott Haldane, to inquire into the existing system of ventilation of tunnels on the Metropolitan Railway, and report whether any, and, if so, what steps can be taken to add to its efficiency in the interest of the public.

ON Friday, January 22, Prof. Guido Cora delivered an address, at the Alpine Club in Turin, on Dr. Nansen's Polar expedition of 1893–96. This was, we understand, the first special meeting of a scientific society held to discuss the results obtained by Nansen in his recent journey.

PROF. W. E. AYRTON, F.R.S., will lecture at the Imperial Institute, next Monday, on "Sixty Years of Submarine Telegraphy." The lecture will be illustrated with historical and modern apparatus showing the development of submarine telegraphy, oil paintings of the chief pioneers, lantern slides showing the operations of making and laying a cable, experiments on the velocity of electric waves in a submarine cable, and in other ways will be made interesting. Mr. W. H. Preece, C.B., F.R.S., will occupy the chair.

ON Thursday next (February 11), Dr. J. W. Gregory will deliver the first of a course of three lectures at the Royal Institution, on "The Problems of Arctic Geology"; and on Saturday (February 13) Mr. Walter Frewen Lord will begin a course of three lectures on "The Growth of the Mediterranean Route to the East." The Friday evening discourse (on February 12) will be delivered by Prof. John Milne, F.R.S., his subject being "Recent Advances in Seismology." That on February 19 will be by Mr. G. Johnstone Stoney, who will lecture on "The Approaching Return of the Great Swarm of November Meteors."

THE twenty-fourth annual dinner of the old students of the Royal School of Mines was held on Tuesday, January 26, at the Criterion Restaurant, and was attended by over 120 Associates and others who have been connected with the School. The chair was taken by Dr. T. K. Rose, of the Royal Mint, and he was supported by a number of past and present Professors at the School of Mines and Royal College of Science. In proposing the toast of prosperity to the mining and metallurgical industries, Dr. Rose dealt with the great advances in gold production and the influence of the cyanide process, and then referred to the recent progress of investigation of the inner nature of metals. The recently published register of old students was also mentioned as an event of the year.

DR. ARTHUR WILLEY, who worked out the later development of Amphioxus when he was a pupil of Prof. Ray Lankester at University College, London, has just made a most important discovery. He has succeeded in obtaining the ripe eggs of the Pearly Nautilus, and is now at work on the development of that most interesting animal. Two and a half years ago Dr. Willey gave up a teaching post in Columbia College, New York, and accepted the Balfour Studentship of the University of Cambridge, in order to proceed to the coast of New Guinea and neighbouring islands in quest of the embryological history of the pearly nautilus. He has had great numbers of live nautilus, but, in spite of all efforts, had, till December 5 last, failed to obtain the eggs. Specimens which he was keeping in a large cage, sunk in the sea at a suitable spot in the Loyalty Islands, were found by him on that day to have spawned. Dr. Willey's indomitable perseverance and devotion to his task have thus been at last crowned by success. Dr. Willey has been assisted in his arduous and dangerous enterprise—amongst the savage people of those remote islands—by grants of money from the Government Grant Fund administered by the Royal Society.

THE first number of vol. vi. of the *Atti dei Lincei* contains no less than three papers on phenomena associated with Röntgen rays. In the first of these, Prof. Villari considers the relation between the dissociation produced in gases by these rays, in virtue of which such gases discharge electrified bodies, and the molecular association produced by the transformation of oxygen into ozone by means of the electric spark. In one series of experiments a current of air was first traversed by Röntgen rays and then allowed to pass through an ozonator before falling on a charged electroscope, and it was found that the ozonator deprived the air of its power of discharging the electroscope. Prof. Villari's paper is illustrated by figures showing the patterns obtained when the surface of the ozonator is sprinkled with a mixture of sulphur and red lead.

THE second paper is a note, by Prof. A. Róiti, on the apparent deflection of Röntgen rays behind opaque obstacles. Prof. Róiti has obtained closely analogous effects with ordinary light by observing the shadows of opaque objects made by an incandescent gas-burner. A note, by Prof. Stefano Capranica, forms a sequel to his previous investigations on the biological action of the rays. Moles were inoculated with the virus of enteritis, and were subjected to the action of the rays. The symptoms were identical with those shown by animals protected from the rays, and the moles died in either case in about the same time; showing that the rays possess no influence, either for good or bad, on animals infested by pathogenic bacilli.

A. DE HEMPTINNE publishes, in the December number of the *Zeitschrift für physikalische Chemie*, an account of an attempt to detect some action of the Röntgen rays on chemical processes. His results confirm those already obtained by Prof. Dixon and Mr. H. B. Baker, and others. The conductivity of electrolytes in aqueous solution, the hydrolysis of etherial salts by acids, and the combination of chlorine with hydrogen and carbon monoxide were studied; no effect could be detected. Solutions of silver nitrate in alcohol, and of mercuric chloride and ammonium oxalate in water, which are decomposed by light, gave only minute and uncertain traces of change when exposed to the Röntgen rays.

A WRITER in the current number of *Blackwood's Magazine* gives a prospective account of a trans-Pacific cable. It is interesting to find that the coral reefs, which, in the opinion of the late Sir John Pender, constituted the chief difficulty in the way of the scheme, are not a serious obstacle. Modern soundings have shown the reefs to lie in well-defined groups, and it happens that the ocean expanses between them contain wide and uniform depressions, particularly suitable for a cable. The article points out that the most favoured route is from Vancouver to Fanning Island; Fanning Island to Fiji; Fiji to Norfolk Island; and from Norfolk Island in two sections—one to New Zealand, and the other to Australia. Fanning Island is of coral formation, and is about ten miles long by four miles wide; it is the nearest British possession to Vancouver on the Australian route. The article gives an account of the history of the Pacific cable scheme, and states its financial aspect.

THE current number of the *Comptes rendus* contains a description of an absolute electrometer intended for measuring small electromotive forces (about 1 volt), designed by MM. Pérot et Fabry. The instrument consists of an attracted disc electrometer, in which the necessary sensitiveness is obtained by greatly reducing the distance between the plates. The attracting disc consists of the plane end of a glass cylinder about 6 cm. in diameter and 1 cm. high, this height being large compared with the distance betweeen the two discs. The attracted disc consists of a thin circular disc of glass about 7 cm. in diameter, and which is virtually an infinite plane. These discs are lightly silvered, and their parallelism adjusted, and their distance measured by being traversed normally by a beam of monochromatic light, which forms interference bands between the light which has passed directly through the thin silver coating and that which has been reflected an even number of times at the silvered surfaces. The electrical attraction is measured by comparing the deformation produced in three springs, which carry the movable disc by the electrical forces, with that produced by a known weight when placed on the movable disc. The authors have obtained 0·0048467 as the mean value of the electromotive force of a Clark cell at 0° in electrostatic measure, and, taking the electromotive force in electromagnetic units as $1{\cdot}4535 \times 10^8$, the value of v, the ratio of the units obtained is

$$v = 2{\cdot}9989 \times 10^{10}.$$

The authors think that in this determination, which they regard as simply a preliminary one, the mean error between the different measurements is 1 in 1000.

A PAPER upon the subject of vertical earth-air electric currents was presented to the Philosophical Society of Washington by Dr. L. A. Bauer on January 9. Vertical earth-air electric currents were first revealed by Dr. Adolf Schmidt, of Gotha. In his mathematical analysis of the earth's magnetic field—the most carefully executed analysis up to date—he reached the following conclusion: The earth's total magnetic force consists of three parts, viz. (1) the greatest part; this is to be referred to causes *within* the earth's crust, and possesses a potential. (2) The smallest part, about 1/40 of the entire force; this is due to causes *outside* of the earth's crust, and likewise possesses a potential. (3) A somewhat larger part than the preceding; this does not possess a potential, and, in consequence, points to the existence of vertical electric currents. These currents amount, on the average, for the earth's entire surface to one-sixth of an ampere per square kilometre. The existence of such currents is indicated by the non-vanishing of the line integral of the earth's horizontal magnetic force resolved along a closed curve of the earth's surface. Gauss carried out this test in a special case, and finding the integral practically zero, he assumed that the entire force is due to a potential. More recently Prof. Rücker applied the same test. He found "no evidence in favour of the existence of vertical currents" over a region of the earth—the British Isles—which had been very minutely surveyed. The results of some preliminary investigations being confirmatory of Schmidt's conclusion, Dr. Bauer determined to carry out the test in a thoroughly systematic manner, viz. to take as the closed curves parallels of latitude. The results obtained confirm those of Dr. Schmidt's more elaborate investigation. Summing-up, Dr. Bauer finds that:—"There are vertical electric currents which pass from the air into the earth, and back again into the air. Between 60° N. and 60° S. the average current intensity per square kilometre is about one-tenth of an ampere."

AT Governor's Island, a few days ago, Lieut. Hugh D. Wise, of the United States Army, made a very successful ascent by kites. He used four kites, a modification of the Hargrave invention, and weighing about 16 pounds each. The kites were attached to a windlass running out a ½-inch manilla cord connected with an iron ring drawn up fifty feet above the ground. From the ring the kites ran up on two 1-inch cords. Two kites, one above the other, were attached to each of the latter cords. To the ring was also attached a tackle and block, running a heavy rope to the ground. On this rope Lieut. Wise was drawn up, and remained for a considerable time at a height of about 42 feet, surveying the environment on all sides with his field-glass. The wind was blowing fifteen miles an hour, and the pull of the kites was about 400 pounds.

A SHORT but interesting account of the earthquake of last December 17, founded partly on newspaper descriptions and partly on the notes of observers, is given in Symons's *Meteorological Magazine* for January. The first of the two maps, which illustrate the paper, shows many of the places where the shock was felt and where structural damage occurred. The writer remarks that the area affected was apparently 350 miles in diameter, and contained about 100,000 square miles; and that the part within which damage was produced, which is nearly central with regard to the former, is about 130 miles from north to south, and of a maximum breadth of 40 miles, thus containing nearly 4000 square miles, or about ten times the corresponding area of the Essex earthquake of 1884. He believes that there is evidence that the shock was one of a series which can be traced back for more than six centuries, and gives small sketch-maps showing the approximate boundaries of the shocks of the years 1248, 1574, 1705, 1863, 1868, and 1896. Taking the initial time of the recent disturbance as 5.32 a.m., and Hereford as the centre, the more careful time records appear to show that the velocity of the earth-wave may have been about 30 miles a minute. The paper concludes with a list of the minor shocks, a series of records of the luminous phenomena, which, it is suggested, prove only that a local thunderstorm occurred at about the same time as the shock, and some references to the sound which accompanied the earthquake.

DURING the last few years, one of the principal sources of income of cold-storage companies in the United States has been

derived from the storage of furs, rugs, and valuable woollen goods during the summer months to prevent damage by the larvæ of clothes moths, clothes beetles, and allied insects. This development raised the question as to the exact or approximate temperature at which furs and similar goods should be kept in order to maintain in a state of inactivity any destructive insects which they might contain. The matter was referred to Dr. L. O. Howard, entomologist to the U.S. Department of Agriculture, but he was unable to furnish the necessary information, or to find any facts bearing upon the subject. A series of experiments were, therefore, begun, and the results are described in the *Proceedings* of the Eighth Annual Meeting of the Association of Economic Entomologists, received a few days ago. The insects subjected to experiment were the common clothes moth, the black carpet beetle, the leather beetle, the dark meal-worm, and a cabinet beetle. The results seem to show definitely that it is perfectly safe to keep materials infested by any of the insects mentioned at a temperature of 40° to 42° F. during the summer months, and that the cold-storage companies, which have been keeping the goods at temperatures of 12° to 20°, have been wasting energy in producing a temperature about 20° lower than is required. A number of valuable papers on economic entomology will be found in the *Bulletin* (No. 6 of the U.S. Department of Agriculture) in which Mr. Howard's paper appears.

EMBRYOLOGICAL research is now flourishing in the University of Tōkyō, Japan. Part 1, vol. x. of the *Journal* of the College of Science in that University, consists of an elaborate memoir, by Prof. K. Mitsukuri, on the "Fate of the Blastopore, the Relations of the Primitive Streak, &c., in Chelonia." The text is in English, and there are eleven plates containing numerous figures, both of surface views of embryos and of sections. The memoir is appropriately dedicated to the memory of the late F. M. Balfour, of whom the author is one of the distinguished pupils. The embryos studied were those of three species of turtle common in Japan, those of two of them having been obtained in abundance with great facility at a turtle farm. The observations throw a great deal of light on the nature of the primitive streak, and on the formation of the posterior end of the embryo, and the general result is to confirm and elaborate in detail the interpretation of reptilian development in its early stages, which is explained in Balfour's "Comparative Embryology." New suggestions, however, are made concerning the relations between the mode of development and the evolution of yolk in the various classes of vertebrates.

THE development of the renal and generative organs in dog-fishes is one of the most important subjects in vertebrate morphology, and has occupied much of the attention of several eminent investigators. Prof. Carl Rabl has studied the matter in great detail during the past few years, and in the current number of the *Morphologisches Jahrbuch*, edited by Gegenbaur, gives a new description of the history of these organs in the embryo, and reconsiders various questions concerning their evolution.

THE horary values of the magnetic elements at Copenhagen, during the years 1893–94, are given in the "Annales de l'Observatoire magnétique de Copenhague," prepared by Dr. Adam Paulsen, Director of the Denmark Meteorological Institute, and just published.

MESSRS. LONGMANS, GREEN, AND CO. have published, as a pamphlet of twenty-four pages, the first part of "Exercises in Practical Physiology," dealing with elementary physiological chemistry. Prof. A. D. Waller, F.R.S., and Mr. W. Legge Symes are the authors; and the exercises they give should be of great assistance in laboratories of physiological chemistry.

A COURSE of six short lectures and demonstrations on fish and fisheries, free to the public, is now going on at University College, Liverpool. Prof. Herdman opened the course with an account of the present position of our fishing industries, and the advantages to be gained from biological investigations. Mr. R. A. Dawson followed with a lecture on the need and object of Sea Fishery Committees, and on the different methods of fishing in the Lancashire Sea Fisheries District. Some methods of fishing, and of fish culture in other European countries, were described by Mr. R. L. Ascroft on Monday evening. The three ensuing Monday evenings in this month will be devoted to fish parasites, and some constituents of the food of fishes, by Mr. Isaac C. Thompson; the habits and life-history of crabs and lobsters, by Mr. Andrew Scott; and the bacteriology of fish, and the connection of fish with disease, by Prof. Boyce. The Lancashire Sea Fisheries Committee is fortunate in being able to arrange a course of lectures so very serviceable to all who are interested in the fishing industry of the district.

SOMEWHAT remarkable results have been obtained by Messrs. T. Paul and B. Krönig in an investigation into the behaviour of bacteria towards chemical reagents, which appears in the December number of the *Zeitschrift für physikalische Chemie*. A definite number of organisms are exposed to the action of a solution of the disinfectant for a definite time; after complete removal of the disinfectant, the number of organisms still capable of development is determined. The spores of the anthrax bacillus were used in the greater part of the experiments. It is found that the different salts of a metal possessing a specific poisonous character—mercury, for example—are not by any means equally deadly. Under otherwise similar circumstances, those salts which are electrolytically dissociated to the greatest extent are most active. For example, a solution of mercuric chloride contains very many more mercury ions than one of mercuric cyanide of the same concentration, and the latter salt is very much less deadly than the former. The addition of sodium chloride to a solution of mercuric chloride diminishes its disinfecting power to a very marked extent; in this case, also, the number of mercury ions is diminished by the presence of the salt. This is of practical importance, because the addition of salt to mercuric chloride solutions is often recommended in order to increase its solubility. Similar results are obtained with silver salts; such salts as the nitrate, chlorate, and benzene sulphonate, which are dissociated into their ions to a considerable and approximately equal extent in aqueous solution, have nearly the same disinfecting action, while the addition of sodium thiosulphate or of potassium cyanide, with which the silver ions combine to form complex ions, practically destroys the disinfecting action altogether. The disinfecting power of solutions of bases or of acids depends, on the whole, on the strength of the base or acid—that is, on its degree of electrolytic dissociation. Although in all these cases the influence of the dissociation is plainly apparent, the specific action of the anion and of the undissociated molecule is by no means to be neglected. Hydrofluoric acid, for example, though a comparatively weak acid, has a more powerful action than acids like nitric or hydrochloric. Of practical interest is the fact that silver nitrate has a maximum disinfecting power when dissolved in 50 per cent. alcohol, while with mercuric chloride the maximum occurs at 25 per cent. Solutions of these salts in absolute alcohol are practically without effect on anthrax spores.

THE additions to the Zoological Society's Gardens during the past week include a Bonnet Monkey (*Macacus sinicus*, ♀) from India, presented by Miss E. Blanche Joyce; a White-backed Piping-Crow (*Gymnorhina leuconota*) from Australia, presented by Mr. H. Brame; a Kinkajou (*Cercoleptes caudivolvulus*) from South America, deposited; a Black Lemur (*Lemur macaco*, ♀) from Madagascar, purchased.

OUR ASTRONOMICAL COLUMN.

TABLES FOR FINDING LATITUDE VARIATIONS.—Prof. S. C. Chandler, gives in the *Astronomical Journal* (No. 392), tables for finding the variations of latitude for the present year, these being a continuation of those published in an earlier number of the same journal (No. 193). The formulæ used in the computation were derived entirely from observations made previous to 1894·0, so that, as is suggested, a good opportunity is given of comparing the theoretical with the observational places obtained since that date. Such a comparison made by him shows that only an average difference without regard to sign of ±0″·041 is indicated, a quantity sensibly not greater than the uncertainty of the observed points themselves. This satisfactory conclusion shows us then that predictions of the movements of the pole may, with no reasonable doubt, be made for several years beforehand. From an investigation, which Prof. Chandler has in hand, he informs us that a discussion of the whole series of observations from 1889 to 1896·5, demonstrates that the radius of the 428-day revolution has been diminishing in accordance with the law given by him (Equation 52, *Astr. Journ.*, 322), but at a slightly greater rate. He further adds that a comparison of the observations at Kasan in 1895 and 1896, in conjunction with those made in Central Europe, confirms the fact of the "remarkable eccentricity of the annual ellipse which was developed from the previous European and American observations."

THE TRIFID NEBULA.—Prof. Pickering, in the Harvard College Observatory Circular (No. 15), gives a brief account of the performance of the Bruce photographic telescope which is now erected at Arequipa. This instrument was generously given by Miss Catherine Bruce, as it had been suggested that a telescope of 60 cm. aperture and 343·8 cm. focal length would give most probably excellent photographic results. Since it was set up, it has been in constant use by Prof. Bailey, and a plate accompanies the Circular to serve to illustrate the work already accomplished. The original negative was taken last year, on June 11, with an exposure of three hours, on a plate 14 × 17 in. The region covered extends in R.A. from 17h. 40m. to 18h. 10m., and in declination from −20·8° to −26·5°. The two nebulæ on that part shown in the figure are the Trifid Nebula N.G.C. 6514 and N.G.C. 6523. It is stated that photogravures of two regions have been prepared, and a limited distribution, mainly to observatories, is being made of them. It is also proposed to issue maps of other portions of the sky, such as the Magellanic Clouds. It was originally intended to map the entire sky, but it is now thought better to furnish contact prints on glass from the original negatives to such astronomers as will make use of them.

Excellent results have already been obtained with objective prisms, and these, as we are informed, will be communicated in a future Circular.

THE PERIOD OF SIRIUS' COMPANION.—In this column for November 19, we gave the measures made by Prof. Aitken of the companion of Sirius, and pointed out that the position angle differed from that reported by Dr. See. In the current number of the *Astr. Nach.* (No. 3400), Herr H. J. Zwiers communicates a short note, in which he has taken the mean of the new measures made at the Lick Observatory—namely:

1896·8235 ... Position angle 189·28° ... Probable error ± 0·67°
Distance ... 3·74″ ... ,, ,, ± 0·12″

and compares this place with that given by the computation of the orbit (*Astr. Nach.*, 3336), which is

Postion angle 185·99°
Distance ... 4·05″

The difference, observation minus calculation, gives for the two measures: position angle + 3·29° and distance −0·31″, showing that the computed place is sufficiently near until more observations have been obtained. Prof. Auwer's suggestion that the period may be a little longer than 49·4 years is thus endorsed, while Herr Zwiers' period of 51·10 years gives a somewhat too slow a movement.

HEAT RAYS OF GREAT WAVE-LENGTH.—It is well known that the spectrum we see when observing an ordinary red-hot poker through a prism is only a fractional part of a much more extensive one. In addition to the common light waves there are several other kinds, such as electrical, heat, &c., all of which may form part of the spectrum in its entirety, and the attempt has often been made to increase our knowledge over the broad region between the electrical and light waves. This may be done by either reducing the wave-lengths of electrical oscillations, or by the discovery and measurement of longer heat waves. In the pamphlet we have before us, a reprint from the *Physical Review* (vol. iv. No. 22), Messrs. H. Rubens and E. F. Nichols have just completed a very interesting investigation of the infra-red waves of great wave-length. The new theories of dispersion have suggested a method by means of which homogeneous rays of great wave-length may be obtained, and in sufficient quantity to make the determination of their properties and wave-length possible: this can be done, further, without the intervention of either a prism or grating. The authors make "reflection" the basis of their investigation, and in the instrument they devised they have chosen three reflectors of the same substance as the light source used. The bolometer employed was one of platinum, after the design of Lummer and Kurlbaum, the absorbing layer being a coating of platinum black, deposited electrically.

The two substances studied were quartz and fluorite. In the case of the former, the mean wave-length of the observed rays gave in the first and third orders 0·00887 mm. and 0·00882 mm. respectively. The agreement between the two values lies well within the limit of probable error. For fluorite the maximum energy in the diffraction spectrum of the first order corresponded to a wave-length of 0·0244 mm., the mean from other series varying from 0·024 mm. to 0·025 mm.

The authors remark that if these values be compared with those computed from the Kettler-Helmholtz dispersion formula for the middle of the absorption bands, in each case the observed value for quartz is 10 per cent., and for fluorite 20 per cent. less than the computed. As inaccuracies may arise from the computed values, and there may be errors in the experimental values, such as, for instance, a variation in the absorption of platinum black with the wave-length, yet "one is justified in regarding the agreement between the observed and computed wave-lengths as close enough to confirm the utility of the theories involved."

The rays corresponding to the infra-red absorption band in fluorite lie thus almost exactly midway between the shortest ultra-violet rays of Schumann (λ = 0·0001 mm.) and the 6 mm. electrical waves of Lebeden, reckoning the interval according to octaves, as is customary in acoustics.

The authors hope, moreover, to be able to refine the present method of observation, and study waves of greater wave-length; and, by means of an improved radiometer, obtain a much higher degree of sensitiveness.

THE VALUE OF PATHOLOGICAL RESEARCH.[1]

ON the occasion of the jubilee of Queen's College, Belfast, last month, the new physiological and pathological laboratories were formally opened by the Lord Lieutenant. On the following day an address of welcome and congratulation was presented by the North of Ireland Branch of the British Medical Association and the Ulster Medical Society to Lord Lister, who, after receiving it, spoke as follows:—

It gave me very great pleasure to witness the opening of the physiological and pathological laboratories yesterday by His Excellency the Lord Lieutenant. Such an establishment is calculated to be of enormous advantage to the North of Ireland. The benefits which it will confer will be of various kinds. In the first place it will be of very great assistance to the medical practitioner in forming his diagnosis of the disease of the patient he has to treat. In these days the knowledge of pathology has made immense advances; and, at the same time, along with those advances in pathological knowledge, there has arisen increased complexity in the methods of examining pathological objects. Section cutting, staining, microscopic examination—these are matters of the utmost moment; and yet for the general practitioner there may be neither the apparatus nor the time requisite for that kind of investigation. It will, therefore, be of great advantage to the practitioner, when he has removed or in any way obtained a portion of a morbid growth, to send it to a central institution, and have absolutely definite informa-

[1] An address delivered January 20, in connection with the opening of the new physiological and pathological laboratories in Queen's College, Belfast, during the celebration of the jubilee of the College, by Lord Lister, P.R.S.

tion as to the precise nature of the disease with which he has to deal. Then, as regards the bacteriological department—there, again, diagnosis will be greatly facilitated. You are most of you aware that the diagnosis of diphtheria can now be made by bacteriological examination. It is of the utmost importance in the treatment of a case of diphtheria that its nature should be distinctly defined; that it should be known with certainty whether it is true diphtheria or a disease which closely simulates it, and may deceive the most experienced practitioner, and yet have none of the deadly characteristics of true diphtheria. Now for the future any medical man in the North of Ireland will only have to send, in a suitable tube, which will be provided by the institution, a little of the false membrane in the case with which he is dealing, and in a very short time he will have sent to him a bacteriologically made diagnosis of whether it is a case of true diphtheria or not. Again, with reference to what is more immediately connected with the objects of this College, such an institute will be of very great help in the training of students in their education for the medical profession. In it the student will have the opportunity of practically studying the various forms of morbid growths and the diseases which are of the nature of microbes. These are days when the subjects of medical examination are becoming more and more complex, and the student is too much tempted to get up his knowledge in a superficial way, cramming to satisfy the examiner, rather than to obtain thorough-going practical information. That is more especially the case when the student is not examined by his own teachers, under whom he might work with some confidence that his labour would not be thrown away with reference to that really subordinate, but in his eyes vastly important, matter of the passing of his examination. May I venture to interpose a remark on that point, and to express the hope that the time is not very far distant when the great northern metropolis of Ireland will have its own university, a true teaching and graduating university on the same lines as most of the German universities and the Scotch? But passing from that, independently altogether of the difficulty a student may have in preparing for examination by strangers, the great complexity of the subjects of medical education makes it extremely important that there should be afforded ample opportunities of practical study. The bacteriological department will be of peculiar value in the education of the student. It will in the first place convince him of the reality of the microscopic foes with which we have at the present day so largely to deal—the microbes, which are the cause of so large a proportion of human disease. He will not only read that such things are, and when he gets into practice perhaps forget that they exist, but he will know them as acquaintances. He will see the evidence not only of their existence, but also of their effects. The bacteriological training will besides be of special advantage in teaching the student accurate observation and also dexterity of manipulation—both most important matters in a medical man's practice. If a student is told to prepare a culture of a particular microbe in a state of purity, in order to do that he must be very sharp indeed in his observations, and very clever, too, in his manipulations; and if he fails, the fact will very soon declare itself. There will be an impure culture, and instead of having only the one microbe he wished to cultivate, with its well-known special characteristics, it will be seen that he has allowed others to get in at the same time. His own imperfections will thus declare themselves; but he will persevere, and go on and on until he becomes perfectly competent to produce a pure culture. This will be of great importance in his education. There is another aspect of a pathological institute which I feel some delicacy in alluding to, because there are some people who take strange views with regard to these matters—exaggerated views. There are people who do not object to eating a mutton-chop—people who do not even object to shooting a pheasant with the considerable chance that it may be only wounded and may have to die after lingering in pain, unable to obtain its proper nutriment—and yet who consider it something monstrous to introduce under the skin of a guinea-pig a little inoculation of some microbe to ascertain its action. Those seem to me to be most inconsistent views. With regard to all matters in which we are concerned in this world, everything depends upon the motive. A murderer may cut a man's throat to kill him; any one of you medical students may have to cut a man's throat to save his life. The father who chastises his son for the sake of the good of his morals is a most humane man: a father who should beat his son for the mere sake of inflicting pain upon him would be an inhuman monster. And so it is with the necessary experiments upon lower animals. If they were made, as some people seem to assume, for the mere sport of the thing, they would be indeed to be deprecated and decried; but if they are made with the wholly noble object of not only increasing human knowledge, but also diminishing human suffering, then I hold that such investigations are deserving of all praise. Those little know who lightly speak on these matters how much self-denial is required in the prosecution of such researches when they are conducted, as indeed they always are, so far as I am aware, with the object of establishing new truth. The exercise of a little charity might lead those who speak of us as inhuman to reflect that possibly we may be as humane as themselves. The profession to which I have the great honour to belong is, I firmly believe, on the average, the most humane of all professions. The medical student may be sometimes a rough diamond; but when he comes to have personal charge of patients, and to have the life and health of a fellow-creature depending upon his individual care, he becomes a changed man, and from that day forth his life becomes a constant exercise of beneficence. With that beneficence there is associated benevolence: and, in that practical way, our profession becomes the most benevolent of all. If our detractors knew this, common sense would enable them to see that our profession would not be unanimously in favour of these researches if they were the iniquitous things which they are sometimes represented to be. I was reading the other day a very interesting account of Pasteur's work on rabies, written by one who was associated with him from an early period (M. Duclaux). It had been established that the introduction of a portion of the brain of a mad dog under the skin of a healthy animal was liable to cause rabies, and Pasteur had reason to believe that it was principally in the nervous centres that the poison accumulated. He felt a very strong desire to introduce some of the poison into the brain of an animal; but he was a peculiarly humane man. He never could shoot an animal for sport. He was more humane than the great majority of human beings; and for a long time he could not bring himself to make the experiment of trephining an animal's skull, and introducing some of the poison of rabies into the brain. He was exceedingly desirous of doing it to establish the pathology of the disease, but he shrank from it. On one occasion, when he was absent from home, one of his assistants did the experiment, and when Pasteur came back he told him that he had done so. "Oh!" said Pasteur, "the poor creature! His brain has been touched. I am afraid he will be affected with paralysis." The assistant went into a neighbouring room and brought in the animal, which was a dog. It came in frisking about and investigating everything in a perfectly natural manner; and Pasteur was exceedingly pleased, and though he did not like dogs, yet he lavished his affection upon that particular animal and petted it; and from that time forth he felt his scruples need no longer exist. The truth is that the pain inflicted by this process of trephining is exceedingly slight, and yet the operation is sometimes described as being a hideously painful one. That is a mistake. In point of fact the operation is always done now under anæsthetics, so that the animal does not feel it at all; but even without that the operation is not seriously painful. I look forward to the time when there will be an institute in connection with this College, where investigations of the kind to which I have referred can be carried on, and where pathological knowledge of the first importance may be promoted. Think also of the practical advantages of an institution where the materials can be provided for the treatment of diseases on the principles which have been recently established. It appears to be now placed beyond doubt that that dreadful disease diphtheria may by the antitoxic treatment be reduced in mortality from about 30 per cent. to about 5 per cent. if the proper material is promptly used. It is exceedingly important that in a city like Belfast the supply of such material should be within easy reach of the practitioner—that he should not be compelled to send to London for the requisite serum, and thus lose much valuable time. Every hour that is lost in the treatment of a case of this nature is a very serious loss indeed. But it is by no means only in diphtheria that such an institute is likely to confer benefits of this kind. In the case of the streptococcus, which is the cause of erysipelas and kindred disorders, including that very terrible disease, puerperal fever, there are very promising indications that the use of antitoxic serum will

rescue patients from otherwise hopeless conditions. Let any one picture to himself the case of a young wife after her first confinement afflicted with this dreadful puerperal fever, and doomed under ordinary treatment to certain death. The practitioner makes an injection of this serum under the skin, with the result that the lady rapidly recovers, and in a few days is perfectly well. Let any man conceive such a case as this, and all objections to the investigations necessary to bring about such a state of things must vanish into thin air. So soon as our poor selves are directly concerned our objections disappear. If a tiger threatened to attack a camp, who would care much about what kind of a trap was set for it, or what suffering the trap caused the animal, so long as it was caught? When the matter affects only the welfare of others, including generations yet unborn, the good done does not appeal to the individual, and the objector sees only the horrors of modern scientific investigation; of which horrors, however, he quickly loses the sense as soon as he becomes personally concerned.

On the occasion of the funeral of that illustrious investigator to whom I have before referred, I visited the Institut Pasteur, and there was shown preparations of the microbe of the plague discovered at Hong Kong in 1894 by M. Yersin. And I was told by M. Roux, that Yersin, whom he knew intimately as formerly his colleague, had lately been treating in China several cases of that fearful disease with serum prepared at the Institut Pasteur on the same lines as that used for diphtheria. Cultures of the plague bacillus had been taken to Paris, and at the Institut, under the most rigorous precautions, the serum had been prepared. At the Institut they did not think they had succeeded in producing a very powerful serum, judging from its action on animals; but in the human subject it seems to have proved most potent. M. Yersin obtained serum sufficient for the treatment of twenty-six cases of the plague. The mortality from the disease at the time was above 80 per cent. The first case which he treated was that of a young man, in whom a "bubo," characteristic of the disease, was present, and the patient, already delirious, was completely despaired of. A little of the serum was introduced, and, to M. Yersin's absolute amazement, on the following day the young man was well, the bubo having almost entirely disappeared. And, moreover, of the twenty-six cases in which M. Yersin used the serum, twenty-four recovered; while in the remaining two Yersin felt that he was called in so late that their cases were hopeless. I would not have referred to these facts did I not know that the person from whom they were obtained was absolutely trustworthy. We cannot tell how soon the plague may visit these shores. We know that in one of our great dependencies—Bombay—it is already prevalent in a very severe form, and has already cost many lives. We know that a ship may carry the disease; that rats are liable to contract it, and that a rat making its escape from a ship coming from Bombay, say, to the Thames or to Belfast Lough, may carry the plague ashore, and that the taint may be communicated to human beings, with dreadful results. I would not say that there are not slums in the city of Belfast which might harbour the plague. So you can easily recognise how vastly important it would be to have means at hand whereby, in the simple way I have described, the disease may be combated. I have, I think, said enough to show the vast importance of an institute of such a character, and I look forward to the time when you will have such an establishment thoroughly equipped for its beneficent work.

There is another department in connection with medical education in this city about which I cannot speak in the same terms of praise as I can with reference to the new laboratories, and that is the hospital. No doubt the Royal Hospital, which I had the honour of visiting for the first time yesterday, is a fine institution; but it is altogether inadequate to the requirements of this great and rapidly-growing city. It is inadequate, whether for affording means of clinical instruction to students or for dealing with the diseases of your large and increasing population. But I am glad to know that there is a prospect of better things before long. I understand that it has been not merely contemplated, but determined, to build a large new hospital provided the requisite funds can be obtained; and I have been informed that within six weeks of the initiation of the movement more than half the necessary sum has been raised. I have no doubt that the munificence of the merchant princes of Belfast will soon provide the balance. Therefore, whichever way I look at this jubilee, I feel that the College, more particularly with regard to its medical school, is entering upon a new era of prosperity. I rejoice with you in the fact, and I have felt it a great privilege to take part in your celebration.

[Since this address was delivered, the last number of the *Annales de l'Institut Pasteur* has appeared, containing a paper by M. Yersin, describing his experience above referred to. The details which he gives of the cases confirm in a remarkable manner the conclusion which the mere numbers suggest. Just as in diphtheria, and exactly as must occur if the antidote is really efficacious, the cure was most rapid when the treatment could be commenced on the first day of the disease; speedy also, but less so, when it was begun on the second day; and so from day to day till the fifth. Four patients were treated at this very late period, and the only failures were in two of these. More of the serum also was required in the more advanced cases.

Equally striking was the manner of recovery. In none of the twelve cases in which treatment commenced within two days of the onset of the complaint did the bubo suppurate. And in those of a later period in which matter did form, the abscess closed rapidly after being opened, instead of healing tediously, as it does when recovery takes place without this treatment. And the patients, instead of having a lingering convalescence, were healthy men and women in a time which was always relatively short, and astonishingly so when the treatment had been commenced early. These details are so extraordinarily confirmatory that, small though the number of cases is, they carry conviction to my own mind.

It gives me the most profound satisfaction to be able to state on the authority of the India Office, that the Bombay Government intend to employ M. Yersin, now on his way to the stricken region, to give a full trial to his method, and I have also learned through another channel that within a fortnight from this time (February 1) the serum treatment will probably have begun in Bombay. LISTER.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The election to the Professorship of Geology will take place during the present term.

This term the usual courses of lectures are being given in the various departments of Natural Science. Prof. H. H. Turner is lecturing on Elementary Astronomy, Prof. Odling on Organic Chemistry, and Profs. Vines and Gotch are continuing their advanced courses in Botany and Physiology respectively.

Prof. H. A. Miers is giving a series of lectures on the Relation between Chemical Composition and Crystalline Form.

In the Department of Comparative Anatomy, Prof. Ray Lankester is lecturing on Reptiles and Birds, Mr. R. W. T. Günther on Brachiopoda and Polyzoa, Mr. Barclay Thompson on the Osteology of the Sauropsida and on Sauropsidan Palæontology, and Mr. G. C. Bourne is conducting a class for the study of Vertebrate Histology. In the Hope Department, Prof. Poulton will give a series of lectures on the Age of the Earth.

Prof. Tylor is lecturing on the Early Stages of Knowledge, and Mr. Balfour on Realistic and Decorative Art of Primitive Peoples.

Elementary courses in the different departments are being given by Profs. Gotch and Vines, Dr. Benham, and Messrs. Churchill, Baynes, Watts, and Vernon Harcourt.

CAMBRIDGE.—The Gilbey Lecturer in the History and Economics of Agriculture will give four lectures this term on Fridays, at two o'clock, beginning on February 12. His subject is Ancient and Mediæval Agriculture.

At the matriculation on January 28, eighteen additional Freshmen were entered, bringing the total for the academic year up to 923.

Mr. W. Gardiner, F.R.S., has resigned his University Lectureship in Botany on his appointment as Bursar at Clare College, of which he is a Fellow.

DR. T. E. THORPE, F.R.S., will distribute the certificates in science subjects to evening students at the East London Technical College, People's Palace, on Monday, February 8.

MR. GARRETT A. HOBART, Vice-President-elect of the United States, has given to his *alma mater*, Rutger's College, 5000 dols. for the general expenses of the college.

At the Queen's Hall, Langham Place, to-morrow, February 5, the Prince of Wales will present the certificates to the winners of scholarships and exhibitions of the London County Council Technical Education Board.

THE Technical Instruction Committee of the Northumberland County Council have intimated that they would not be indisposed to make a grant to the Northumberland Sea Fisheries Committee, provided the latter will undertake to arrange for something definite in the direction of hatchery, or arrange some clearly-defined work of an educational value. The Sea Fisheries Committee are making inquiries with the object of devising and establishing experimental work in hatchery.

THE Durham County Council last week sanctioned the expenditure of no less a sum than £2254 for the erection of a "band-room" by the committee of the Earl's House Industrial School, which is under its control. Though it was rightly objected by one councillor that instrumental music was not legitimately a part of an industrial training, yet, following the lead of a member of Parliament present, the Council approved of the grant on the ground that band-playing "tends to elevate the boys, and make them better citizens."

IT is proposed that Staffordshire shall unite with Shropshire and Warwickshire in a scheme which shall provide advanced and elementary technical education, in colleges and schools specially adapted for the work, for the sons and daughters of farmers. The Staffordshire Committee are also to appoint a lecturer on pottery and porcelain, with the object of improving the ceramic industry of the northern part of the county, as well as appoint a lecturer and establish a metallurgical laboratory at Wednesbury in South Staffordshire.

PROBABLY the scholarships established by Sir Joseph Whitworth have been the means of bringing more talented young men to the front rank of engineers than any similar foundations. By a will just made known, it appears that the late Lady Whitworth recognised the advantages which scholarships offer to earnest students. She bequeathed such a sum as will provide a permanent income of £100 a year to be applied as "Lady Whitworth Scholarships" in connection with the public elementary school or schools established in Darley Dale, for the purpose of enabling scholars therein to maintain themselves at such schools wholly or partially, or to proceed to other place or places of higher education. The selection of scholars has always to be made according to merit, and not on the mere ground of poverty, or any considerations of private personal favour.

THE great Fayerweather Will contest has just been finally settled by the Court of Appeals of the State of New York, confirming the judgment of the Supreme Court, and dividing the residue of the estate, amounting to about 3,000,000 dols., equally among the following educational institutions, in addition to the following named bequests, which have already been divided among them under the ninth paragraph of the will:—Yale University, 300,000 dols.; Columbia and Cornell University, 200,000 dols. each; Bowdoin, Dartmouth, Williams, Amherst, Hamilton and Maryville College, Wesleyan, Lincoln and Hampton University, and the University of Virginia and of Rochester, 100,000 dols. each; Union Theological Seminary, Lafayette, Marietta, Adelbert, Wabash and Park College, 50,000 dols. each.

WE have received a copy of the scheme agreed to between the Leathersellers' Company and the Executive Committee of the City and Guilds of London Institute for the administration of a grant of £150 a year, offered by the Leathersellers' Company, to be applied to chemical research. It has been resolved that the fellowships shall be open to natural-born British subjects, who are (*a*) students of the Institute who have completed a full three years' course of instruction in the chemical department of the Central Technical College, or (*b*) candidates duly qualified in the methods of chemical research in its relation to manufactures, without restriction as to age or place of previous study, but preferably to class (*a*). Every fellowship will be tenable for part of a year or for one year, and may be renewed for a second or third year, but in no case can be held for a further period. Holders of fellowships must devote their whole time to the prosecution of research. The researches have to be carried out at the Central Technical College. Applications for fellowships must be made in writing to the Hon. Secretary of the Institute, at the Head Office, Gresham College, E.C., and must state the name of the proposed research and the qualifications of the candidate.

THE report of the Director of Technical Instruction to the County Council for the County Palatine of Lancaster for the year ending August 31, 1896, which is to be presented to the meeting of the Council on February 4, is of the most exhaustive nature. The amount which the Technical Instruction Committee resolved to distribute among the urban and rural districts of the county for the year was £24,225, being a decrease of £4285 on the sum distributed in the previous twelve months. Short accounts of the various conferences at which the Lancashire County Council have been represented throughout the year are given, and also full information respecting the scholarships awarded by the Council, and of all grants made in aid of the different branches of study throughout the county. Under the heading "Renewal of Scholarships," we notice that a Lancashire student at Cambridge, who was Second Wrangler in 1895, has been granted a special scholarship of £60 a year to enable him to complete the terms required for a Fellowship of his college, and to make it possible for him to compete for the Smith's Prizes. A series of useful tables showing the whole of the scholarships and exhibitions awarded, as well as the total number of students receiving instruction, makes it possible to compare the work of the session 1895 6 with that of previous years. It is interesting to note that the amount actually awarded for these purposes during the year under consideration more nearly approximated to that set aside for the purpose than in any previous session. The highest number of entries of students in all subjects was in the year 1893-4, when the total reached 58,534; with the exception of this particular year there has been a steady increase up to 1896, when the total was 54,719. The excellent report of the work of the County Council Farm at Hutton completes the history of a most satisfactory year's work.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 17, 1896.—"On the Effect of Pressure in the Surrounding Gas on the Temperature of the Crater of an Electric Arc. Correction of Results in former paper." By W. E. Wilson, F.R.S., and G. F. Fitzgerald, F.R.S. Received November 30, 1896.

This paper describes experiments made with the surrounding gas as air, oxygen, hydrogen, and carbon dioxide. It was found that with air and oxygen large quantities of NO_2 are formed at high pressures, and that observations of the radiation at these pressures is consequently impossible. The experiments described in the former paper were made with nitrogen, and there is every reason to believe that the remarkable diminution in radiation then observed was due to the nitrogen containing sufficient oxygen as an impurity to produce NO_2. Experiments with hydrogen showed that in this gas the arc is long and thin with a red line down its centre, giving the hydrogen lines not nearly so expanded as in a spark spectrum at the same pressure. Observation of the crater under high pressures of hydrogen was impossible, because (*a*) only a very short arc could be maintained, and (*b*) soot trees and a deposit of graphitic carbon all round the margin of the crater at high pressures completely hid it. The experiments in CO_2 were the most satisfactory, but, owing to a variety of difficulties, it was found impossible to decide with certainty whether the crater was hotter or colder at high pressures.

A thermodynamic investigation of the rise of temperature in the crater due to increased pressure, on the assumption that the vapour pressure then is the same as that of the surrounding atmosphere, and that the latent heat of carbon is 4000 calories, leads to the conclusion that the temperature of the crater should have risen 220° C. for each atmosphere added, and that the radiation would have doubled for an increase of four atmospheres. Such a large increase would have, almost certainly, been observable in our experiments. Another difficulty, in the way of supposing that the carbon vapour near the crater is at the pressure of the surrounding atmosphere, is pointed out, arising from the slow evaporation of the carbon. Mercury evaporates very rapidly when used as the positive pole of an arc, and there seems no sufficient reason why the much less dense carbon vapour, at a much higher temperature, should evaporate so very much more slowly.

January 21.—"On *Cheirostrobus*, a New Type of Fossil Cone from the Calciferous Sandstones." By D. H. Scott, F.R.S., Hon. Keeper of the Jodrell Laboratory, Royal Gardens, Kew.

The cone described was found at Pettycur, near Burntisland, Scotland, in 1883, by Mr. James Bennie, of Edinburgh. The horizon of the deposit in which it occurs is that of the Calciferous Sandstones, at the base of the Carboniferous Formation. The specimen is calcified, and its structure preserved with remarkable perfection, allowing of the investigation even of minute histological characters.

The author is indebted to Mr. R. Kidston for the loan of his original sections of the cone, and for the opportunity of having additional sections prepared from the same block. No other specimen of the actual fructification is at present known, but a fragment of stem, of which sections are preserved in the Williamson Collection (now at the British Museum) appears to be the peduncle of a specifically identical cone.

It is necessary to establish a new genus for the reception of this fossil; the generic name proposed is *Cheirostrobus*, intended to suggest the *palmate* division of the sporophyll lobes (χειρ, hand). The species may be appropriately named *Pettycurensis*, from the locality where the important deposit occurs, which has yielded this strobilus, and so many other valuable specimens of palæozoic vegetation. The diagnosis may provisionally run as follows:—

Cheirostrobus, gen. nov.

Cone consisting of a cylindrical axis, bearing numerous compound sporophylls, arranged in crowded many-membered verticils.

Sporophylls of successive verticils superposed.

Each sporophyll divided, nearly to its base, into an inferior and a superior lobe; lobes palmately subdivided into long segments, of which some (probably the inferior) are sterile, and others (probably the superior) fertile, each segment consisting of an elongated stalk bearing a terminal lamina.

Laminæ of sterile segments foliaceous; those of fertile segments (or sporangiophores) peltate.

Sporangia large, attached by their ends remote from the axis, to the peltate laminæ of the sporangiophores.

Sporangia on each sporangiophore, usually four.

Spores very numerous in each sporangium.

Wood of axis polyarch.

C. Pettycurensis, sp. nov.

Cone, 3–4 cm. in diameter, seated on a distinct peduncle. Sporophylls, twelve in each verticil.

Each sporophyll usually sexpartite, three segments belonging to the inferior, and three to the superior, lobe.

Sporangia densely crowded.

Spores about 0·065 mm. in diameter.

The new cone, though widely different from any forms of Vascular Cryptogams hitherto recorded, appears to have more in common with *Sphenophyllum*—until now a perfectly isolated group of palæozoic plants—than with any other known genus.

The sum of its characters justifies the suggestion that *Cheirostrobus* may be provisionally placed in the same *phylum*, or main division of Pteridophyta, with *Sphenophyllum*, though indications of possible affinities in other directions are not wanting, and will be discussed on another occasion.

Cheirostrobus, even more than *Sphenophyllum* itself, appears to combine Calamarian with Lycopodiaceous characters, and might reasonably be regarded as a highly specialised representative of an ancient group of plants lying at the common base of these two series.

Mathematical Society, January 14.—Prof. Elliott, F.R.S., President, in the chair.—Prof. Sylvester, F.R.S., spoke on the partition of an even number into two primes, and answered numerous questions.—Mr. J. J. Walker, F.R.S., gave a solution of a certain quadratic vector equation.—The titles of the following papers were read: "Supplementary Note on Matrices," Mr. J. Brill; "Some Properties of Bessel's Functions," Dr. Hobson, F.R.S.—Mr. T. I. Dewar exhibited, with the aid of stereoscopes, several diagrams of the algebraic catenary.

Zoological Society, January 19.—Dr. St. George Mivart, F.R.S., Vice-President, in the chair.—The Secretary exhibited a set of seven slightly enlarged photographs, illustrating the manner in which the rough-keeled snake (*Dasypeltis scabra*) swallows an egg. These had been taken from a living specimen in the Society's Gardens by Mr. R. F. Nesbit, by whom they had been presented to the Society. The specimen from which the photographs had been taken, measuring about 28 inches in length, was also exhibited.—The Secretary also exhibited a specimen of the Cerastes viper (*Cerastes cornutus*), which had been received in exchange from the Zoological Gardens, Ghizeh, Egypt, and had lately died in the Gardens. This was the specimen, with false horns made of hedgehog spines, which had been alluded to in the newspapers of the last few weeks. On examination it was found that one of the spines had been driven through the skull into the mouth of the snake, and this had probably caused its death.—Mr. Sclater exhibited a photograph of a young anteater (*Myrmecophaga jubata*) two days old, born in the Zoological Garden of Herr Adolf Nill at Stuttgart. Mr. Sclater remarked that this was the first instance, so far as he knew, of this animal having bred in captivity.—Lord Walsingham, F.R.S., read a paper entitled "A Revision of the West Indian Microlepidoptera, with Descriptions of New Species." This memoir gave a complete catalogue of all the species of Microlepidoptera known to occur in the West Indian Islands.—Mr. F. E. Beddard, F.R.S., read some notes on the anatomy of the manatee (*Manatus inunguis*) lately living in the Society's Gardens.—Dr. Lindsay Johnson read a paper on the ophthalmoscopic appearances of the fundus oculi in the Primates. Dr. Johnson had for some considerable time past devoted himself to the careful examination of the eyes of animals, using the means commonly employed by oculists when examining the human eye. He had found that the back of the eye when viewed with the ophthalmoscope presented different appearances in various animals. He showed that the eye of the negro only differed from that of the European in colour, that the higher apes closely resembled man in having binocular vision, and alone had the so-called *macula lutea*, or yellow spot, which is the seat of acute vision. In the lemurs and galagos the back of the eye differed entirely from that of the true monkeys, showing no *macula*. The galagos, which are night animals, had instead of a red or brown fundus a brilliant golden-yellow background to the eye.—Mr. Lydekker described certain deer of the *Cervus sica* group, living in the Duke of Bedford's Menagerie at Woburn.—A communication was read from Mr. Guy A. K. Marshall, on the butterflies of the genus *Teracolus*. The geographical distribution of the genus was described, and seventy-two species were enumerated, two of which were described as new.

Entomological Society, January 20.—Sixty-fourth Annual Meeting.—Prof. R. Meldola, F.R.S., President, in the chair.—An abstract of the Treasurer's accounts, showing a balance in the Society's favour, having been read by one of the Auditors, the Secretary, Mr. H. Goss, read the Report of the Council. It was then announced that the following gentlemen had been elected as Officers and Council for 1897:—President, Mr. Roland Trimen, F.R.S.; Treasurer, Mr. Robert McLachlan, F.R.S.; Secretaries, Mr. Walter F. H. Blandford and Mr. Frederic Merrifield; Librarian, Mr. George C. Champion; and as other members of the Council, the Rev. Canon Fowler, Mr. Herbert Goss, Sir George F. Hampson, Bart., Herr Martin Jacoby, Prof. Meldola, F.R.S., Mr. Osbert Salvin, F.R.S., Mr. James W. Tutt, and Mr. G. H. Verrall. The President then delivered an address, and took for the subject, "The Utility of Specific Characters from the Point of View of the Darwinian Theory." His remarks had reference to the paper on this subject, read last June before the Linnean Society, by Dr. A. R. Wallace, and the subsequent discussion. Prof. Meldola pointed out that the question of "utility," as necessitated by the theory of natural selection, had hitherto been made to depend too exclusively upon external and visibly manifest utility, a restriction which he did not believe to be warranted by facts. He argued in favour of a connection of the nature of correlation between apparently trivial external characters and latent physiological characters of great importance to the welfare of the species. From this point of view it was contended that the diagnostic characters used for purposes of description did not truly represent the sum total of the characters which must be regarded as specific. The President concluded by referring to the losses by death during the year of several Fellows of the Society and other entomologists, special mention being made of Mr. A. S. Olliff, Mr. Edward Armitage, R.A., Mr. Peter Inchbald, Miss G. E. Ormerod, M. Auguste Sallé, Mr. Arthur Dowsett, Herr Julius Flohr, Mr. J. Chappell, and Dr. Morawitz.—A vote of thanks to the President was proposed by Lord Walsingham, F.R.S., seconded by Mr. Osbert Salvin, F.R.S., and carried. A vote of thanks to the officers was then

proposed by Prof. Poulton, F.R.S., seconded by Mr. R. Trimen, F.R.S., and carried. Prof. Meldola, Mr. McLachlan, and Mr. Goss replied, and the proceedings terminated.

Royal Meteorological Society, January 20.—Annual General Meeting.—Mr. E. Mawley, President, in the chair.—The Secretary read the Report of the Council, which showed that the Society had made steady progress during the past year, there being an increase of seventeen in the number of Fellows.—The President then delivered an address on shade temperatures, in which he stated that of all meteorological observations there were none approaching in importance those made of the temperature of the air, generally known as "shade temperature." Indeed, the first question invariably asked in regard to almost any climate was as to its temperature. Mr. Mawley traced the history of the different methods of exposing thermometers since the time that regular observations of the weather had been made in this country. For many years open screens were most favoured by meteorologists, that devised by Mr. J. Glaisher, F.R.S., and the late Astronomer Royal (Sir G. B. Airy) being the pattern principally used. In 1864 Mr. T. Stevenson invented an admirable form of closed screen with louvred sides, which was considered preferable to the open type of screen, and has now almost entirely superseded the Glaisher stand. In 1883 the Stevenson screen was considerably improved by a Committee of the Royal Meteorological Society. Mr. Mawley then described his own experiments at Croydon and Berkhamsted as regards this improved screen, known as the Royal Meteorological Society's pattern. He showed that the only two defects which had been attributed to this form of thermometer exposure were virtually non-existent, and therefore advised its general adoption both in this country and on the continent. Mr. Mawley had recently made observations in the Stevenson screen, and also in the screens used in France and Germany, and the conclusion he had come to was that the results obtained in the Stevenson screen were not only the nearest to the true air temperatures, but also more likely to be strictly comparable with temperatures taken in a similar screen, but with different surroundings elsewhere.

Linnean Society, January 21.—Mr. C. B. Clarke, Vice-President, in the chair.—Dr. John Lowe exhibited some fossil antlers of *Cervus elaphus* of unusually large size from Southern Fen, Cambridge. With these were also exhibited various fragments of implements and weapons which had been discovered in proximity, showing that the animal had lived contemporaneously with man.—Dr. H. O. Forbes referred to similar antlers of great size which had been discovered in Lancashire during the cutting of the Manchester Ship Canal, and which were preserved in the Liverpool Museum.—Mr. J. E. Harting showed drawings of large antlers found at Bourne End in 1894, during the construction of the new viaduct over the Thames, and at Boston, Lincolnshire, in 1895, by a man ploughing. It was remarkable that while the antlers of Red Deer at the present day showed a marked deterioration in size and weight when compared with those obtained in a fossil state in England, this was not the case with the Roe Deer. He had seen no fossil horns of the Roe which were superior in size to those of the same species procurable at the present time in Scotland. The reason for this had not been explained.—Mr. Horace Monckton exhibited specimens of a common freshwater mollusc, *Limnæa peregra*, collected by him at the Howietoun Ponds, Selkirkshire, showing a variation from the normal type in being more or less banded. Mr. B. B. Woodward exhibited a similar variation in shells of *Limnæa stagnalis*, wherein the banding was longitudinal—a peculiarity which had been recorded by Mr. T. D. Cockerell.—Sir James Maitland, Bart., gave the results of an analysis which had been made of the water at Howietoun and Craigend, with a view to determine the bearing it might have on the growth of fish and variation in the shells of the mollusca referred to.—The Secretary read a letter from Mr. J. Y. Johnson, of Funchal, Madeira, commenting upon Dr. D. Morris's exhibition (Nov. 5, 1896) of raphides composed of oxalate of lime in the bulbs of hyacinths, the handling of which had produced a form of eczema. Mr. Johnson mentioned a parallel case in *Richardia æthiopica*, a beautiful aroid known to gardeners as the Lily of the Nile. The laundresses at Funchal had tried to utilise the starch obtainable from the corms, but complained of the irritation in the hands produced by it, which, on examination, was found to result from the presence of numerous needle-shaped raphides, as in the case of the hyacinth-bulbs referred to.—Dr. G. Elliott Smith read a paper on the origin of the *Corpus callosum*: a comparative study of the hippocampal region of the cerebrum of marsupialia and certain cheiroptera.—On behalf of Dr. J. Gilchrist a paper was read on the minute structure of the nervous system of the mollusca.

EDINBURGH.

Royal Society, January 18.—Sir Arthur Mitchell in the chair.—Dr. John Murray read a paper on the Ocean Ranger Reef of the South-west Pacific. This was a reef which the ship *Ocean Ranger* had reported encountering in lat. 88° 44′ S., long. 157° 2′ E., and desired to have marked as dangerous to navigation. The *Penguin*, under Commander Balfour, was sent there, but could find no reef that would be dangerous. The very careful soundings which were then taken had an interest of another kind. They revealed the presence of a huge pinnacle reaching to within 837 fathoms of the surface, and sinking to 1800 or 1900 fathoms at the base. A coloured map and section, which showed that the pinnacle had a crag-and-tail shape, were submitted for inspection. At the highest point, the soundings showed 85 per cent. of calcium carbonate, and 65 per cent. at the lowest. From the nature of the fragments found in the soundings the rock was evidently of volcanic origin, and it was being disintegrated by the action of the sea.—Dr. Murray then read a paper on the physical conditions of the ocean to the east of the Australian continent. Of recent years great additions had been made to our knowledge of this part of the ocean, due to the careful surveys of Government ships. He had examined over 2000 soundings sent him from time to time by the hydrographer. After reviewing the physical and geographical features of this region, Dr. Murray said that the most interesting point was the reading of the deepest ocean sounding yet taken. Before this, 4600 fathoms had been found off the coast of Japan, and an American boat had gone some 70 fathoms better; but Captain Balfour had found a depth of 5155 fathoms east of the Kermadec Islands. The inference to be drawn from this and other data, taken together, was that we had here the remains of a continent that had sunk beneath the waves. Speaking next of the temperature of this part of the ocean, he said that the heated waters of the equator, and north of it, were driven by the prevailing wind to this part, where they formed a huge whirl like the Saragossa Sea. At 100 fathoms under the surface near the equator the highest temperature for the whole ocean was recorded; and all over, throughout the year, the temperature never fell below 70°; and hence Prof. Dana's condition for the formation of coral was fulfilled. There was more coral here than anywhere else. Speaking of Falcon Island, which at one time was several miles in extent and from 250 to 290 feet high, he remarked that in 1896 it was a black line upon the surface, surrounded by shoals. What had happened accorded with his own idea of coral-reef formation, which he had arrived at many years ago, and had since seen no occasion to change. The bottom temperature in the centre was 36° after 1500 fathoms. The water in the deep and wide gullies was colder than in the centre. Dr. Murray then briefly described the distrbution of products in this region. Calcium carbonate was the principal. At depths less than 100 fathoms it occurred in the percentage of 80 or 90, while it ranged between 50 and 70 for depths down to 2400 fathoms. Then it disappears very rapidly till 3000 fathoms is reached, and there is no trace of it in the lowest soundings. Further south there was more detrital matter, and it was more chalk-like in appearance. Nearly every kind of deposit was represented, though there was very little Regillarian ooze. The carbonate of lime disappeared at a less depth in extra-tropical regions than in tropical.—Dr. C. G. Knott made a brief note, introducing a second series of investigations into magnetic strains. He had set himself to discover how much of the changes already described was due to change of length and how much to change of width, and he exhibited graphs of the relations of these.—Prof. Tait read a paper on the physical properties of the electromagnetic medium. He developed the consequences of the hypothesis that the connection between the electric and magnetic vectors in Maxwell's equations may be due to the fact that they are not directly disturbances in the ether, but concomitants or results of the disturbance; just as the condensations and rarefactions of the air, which affect the drum of the ear, are concomitants of the displacements of the air.—Papers by Lord

Kelvin, on osmotic pressure against an ideal semi-permeable membrane, and on a differential method for measuring differences of density and of vapour pressure of solutions, were also read (see pp. 272–3).

DUBLIN.

Royal Dublin Society, December 16, 1896.—Mr. Thomas Preston in the chair.—The following papers were presented :—The geographical distribution of dragon-flies, by Mr. G. H. Carpenter.—A suggestion as to the origin of the canals of Mars, by Dr. J. Joly, F.R.S. The formation of the principal curved lines and double "canals" observed by Prof. Schiaparelli and Mr. Lowell is referred by the author to the disturbances of the crust of the planet produced by the gravitational attraction of small satellites in past times rotating close to the surface. It is shown that a satellite so small even as Phobos, if rotating some 50 or 60 miles above the surface, would produce very appreciable stresses in the surface crust of the planet. Integrating the horizontal component of the gravitational pull outwards from beneath the satellite, a ring of maximum stress defined as the base of a cone having the satellite at its summit and a semi-angle of 71°, is obtained. If the satellite is moving relatively to the surface of the planet, tangents to this circle in the direction of motion define parallel lines of probable rupture. There is also probable development of a central line of weakness vertically beneath the satellite's line of motion. These disturbances probably gave rise to mountain ranges—possibly of small altitude—which constitute the "double canals" and lines observed on the surface. Mountain ranges more readily explain the seasonal changes in visibility than any other hypothesis as to their nature. Satellites rotating so close to the surface will probably exist only for a score of years, or thereabouts, between such limits of distance as 70 to 50 miles, when, sinking deeper into the planet's atmosphere, their energy will be rapidly absorbed, and they will fall in; assuming as most probable that the day is longer than the month, or that the satellite's motion is retrograde. The intersection of the radius vector of the satellite with the surface of the planet will describe certain curves, the span of which upon the equator will depend upon the rates of relative angular velocity of planet and satellite. Given the span and rise, the curvature is completely defined. The curves upon Mr. Lowell's map, and those given by Prof. Schiaparelli, are apparently in close agreement with the theoretical curves. They are not great circles. It is shown that nodal points will give rise to centres of radiating lines. The location of Mars' orbit so close to the ring of asteroids—some of which are known to come within his mean distance from the sun—is considered to render *à priori* probable the assumption that Mars has throughout the past at intervals picked up satellites which, after describing a spiral path round him, ultimately fell in. Phobos is—according to lunar theory—probably in the way to do so at some future time. It is shown that a small solid satellite, even if composed of no stronger material than basalt, will be amply stable under the unbalanced gravitational and centrifugal forces to which it will be subject when close to Mars' surface.—An account of some experiments to determine the exact position from which the X-rays emanate in a focus tube was given by the Right Rev. Monsignor Molloy.

PARIS.

Academy of Sciences, January 25.—M. A. Chatin in the chair.—The President presented to M. Faye the medal struck on the occasion of the fiftieth anniversary of his nomination to the Academy, and gave a review of his contributions to Astronomy.—Verbal report on the contents of a sealed letter, opened at the request of the heirs of the late M. B. Heire; and relating to several questions in surgery, by M. le Dr. Guyon.—Note on a screwbrake, with vertical action on the rail, by M. G. Camps.—On two errata in the "Œures de Gauss," by M. Schering.—Photography of an extraordinary protuberance, by M. H. Deslandres. An account of a solar protuberance photographed at the Observatory of Paris on May 31, 1894, which attained the enormous height of 10′23″ of arc, or one-third of the solar diameter.—On the first integrals of dynamics and on the problem of *n* bodies, by M. P. Painlevé.—On the expansion of nickel steel, by M. C. E. Guillaume. By comparison with a platino-iridium bar, the expansion of which had been carefully studied, the expansion of nickel steels was found to be anomalous, in the sense that instead of following approximately the law of mixtures, the expansion was even higher than bronze. To further elucidate this point, the expansions of a series of nineteen bars were determined, in which the proportions of nickel varied from 0 to 100 per cent. The coefficient of expansion reaches a maximum at about 24 per cent. of nickel, and rapidly falls until a minimum is reached at 36 per cent. of nickel, after which it slowly increases until the original value is obtained.—Fluorescence of vitrified materials, under the action of the Röntgen rays, by M. Radignet. By the use of screens of glass (especially the glass from the manufactory of Saint-Gobain, called *crystal*), enamel, or porcelain instead of the usual ones of cardboard covered with fluorescent crystals, the images obtained are less brilliant, but more sharply defined.—On an absolute electrometer designed to measure small differences of potential, by MM. A. Perot and C. Fabry (see p. 327).—An optical apparatus by which objects cast or engraved can be seen in relief and in their normal position, by M. Ernest Moussard.—On the determination of the ratio of the two specific heats of acetylene, by MM. G. Maneuvrier and J. Fournier. The method of Clement and Desormes was used, the flask employed holding fifty litres. It was found that the acetylene obtained by the action of water upon calcium carbide was by no means pure, only 94 per cent. of it being absorbed by ammoniacal cuprous chloride. The system of purification adopted reduced this to less than 0·5 per cent., and the gas thus obtained was found to have lost its allicaceous odour, held up to the present to be one of its characteristic properties, although still possessing a strong penetrating odour. The value found for $\frac{C}{c}$ was 1·273.—The physical, physiological, and therapeutic effects of rapidly alternating currents, by M. Boisseau de Rocher.—Action of carbon monoxide and dioxide upon aluminium, by MM. Guntz and Masson. At a high temperature, in the presence of a little iodide or chloride of aluminuim, aluminium is readily burned in a current of either CO or CO_2. With the former the reaction is

$$6Al + 3CO = Al_2O_3 + C_3Al_4,$$

the aluminium carbide giving practically pure methane on boiling with water. Carbon dioxide gives the same product.—On the phosphides of chromium and of manganese, by M. A. Granger. By the action of phosphorus vapour upon the chlorides of chromium and manganese, the phosphides CrP and Mn_3P_2 were obtained.—Spectra of the metalloids in their fused salts, silicon, by M. A. de Gramont.—Influence of temperature upon the rotatory power, by M. P. A. Guye and Miss E. Aston.—On two isomeric triethylene-diphenylhydrazines, by M. H. Causse.—On a superior homologue of urea, by M. Oechsner de Coninck. The substance has the composition $C_4H_{10}N_2O$, and was obtained from the urine of a person suffering from alcoholism.—New researches on the embryonic nervous system of the Crustacea, by H. Nicholas de Zograf.—On the histology and microscopical anatomy of the encephalon in fishes, by M. Catois. The results obtained by the use of methylene-blue as a staining reagent are entirely confirmatory of the researches of R. Cajal.—On the biology of *Dendroctonus micans* (Ratz), by MM. A. Menegaux and J. Cochon.—On the pseudo-larval pairing of some *Sarcoptidæ*, parasitic in the domestic pigeon, by M. S. Jourdain. The species studied were *Pterolichus falciger*, *Dermoleichus asternalis*, and *Pterophagus strictus* (Mégnin).—Phenomena of autotomy observed in the goubs of *Monandroptera inuncans* and *Raphiderus scabrosus*, by M. Edmond Bordage.—On the gases given off in water by metallic carbides, by M. E. Maumené.

SYDNEY.

Royal Society of New South Wales, September 2, 1896.—Mr. J. H. Maiden, President, in the chair.—Papers read :—Note on recent determinations of the viscosity of water by the efflux method, by G. H. Knibbs—Current Papers, No. 2, by H. C. Russell, F.R.S.

October 7.—On the occurrence of precious stones in New South Wales, with a description of the deposits in which they are found, by Rev. J. Milne Curran. The Society's bronze medal and money prize of 25*l.* were awarded to the writer of this paper—On the constituents of the sap of the "silky oak" *Grevillea robusta*, R.Br., by Henry G. Smith.

November 4.—On sill structure and occurrence of fossils in eruptive rocks in New South Wales, by Prof. T. W. E. David.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 4.

ROYAL SOCIETY, at 4.30.—On the Condition in which Fats are absorbed from the Intestine: B. Moore and D. P. Rockwood.—The Gaseous Constituents of certain Mineral Substances and Natural Waters: Prof. W. Ramsay, F.R.S., and M. W. Travers.—Some Experiments on Helium: M. Travers.—On the Gases inclosed in Crystalline Rocks and Minerals: Prof. Tilden, F.R.S.—Meteorology of India during the past Five Years in Relation to the present Scarcity in India: J. Eliot, F.R.S.—On Lunar Periodicities in Earthquake Frequency: Prof. Knott.

ROYAL INSTITUTION, at 3.—Some Secrets of Crystals: Prof. H. A. Miers, F.R.S.

SOCIETY OF ARTS, at 8.—The Mechanical Production of Cold: Prof. James A. Ewing, F.R.S.

LINNEAN SOCIETY, at 8.—A Revision of the Tribe Naucleæ (Nat. Ord. Rubiacieæ): Dr. G. D. Haviland.—A Contribution to the History of New Zealand Echinoderms: H. Farquhar.

CHEMICAL SOCIETY, at 8.—The Oxidation of Nitrogen: Lord Rayleigh.—Researches in the Stilbene Series, I.: Dr. J. J. Sudborough.—Diortho-substituted Benzoic Acids, III.; Hydrolysis of Substituted Benzamides: Dr. J. J. Sudborough, Percy G. Jackson, L. L. Lloyd.—Apparatus for Steam Distillation: Dr. F. E. Matthews.—Oxidation of Sulphurous Acid by Potassium Permanganate: T. S. Dymond, F. Hughes.

INSTITUTION OF MECHANICAL ENGINEERS, at 7.30.—Fourth Report to the Alloy Research Committee: Prof. W. C. Roberts-Austen, C.B., F.R.S.

CAMERA CLUB, at 8.15.—Flying Machines and Automatic Guns: Hiram Maxim.

FRIDAY, FEBRUARY 5.

INSTITUTION OF MECHANICAL ENGINEERS, at 7.30.—Partially-immersed Screw Propellers for Canal Boats, and the Influence of Section of Waterway: Henry Barcroft.—Mechanical Propulsion in Canals: Leslie S. Robinson.

GEOLOGISTS' ASSOCIATION, at 7.30.—The Evidence for the Presence of Man in the Tertiary Period: E. T. Newton, F.R.S.

SUNDAY, FEBRUARY 7.

SUNDAY LECTURE SOCIETY, at 4.—The Light of the Stars: A. W Clayden.

MONDAY, FEBRUARY 8.

SOCIETY OF ARTS, at 8.—Material and Design in Pottery: Wm. Burton.

ROYAL GEOGRAPHICAL SOCIETY (Albert Hall), at 9.—Lecture by Dr. Nansen on his Arctic Expedition.

IMPERIAL INSTITUTE, at 8.30.—European Wines and their Manufacture: Dr. J. L. W. Thudichum.

CAMERA CLUB, at 8.15.—Captain Abney, C.B., F.R.S.

TUESDAY, FEBRUARY 9.

ROYAL INSTITUTION, at 3.—Animal Electricity: Prof. A. D. Waller, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Cold Storage at the London and India Docks: H. F. Donaldson.

ROYAL PHOTOGRAPHIC SOCIETY, at 8.—Annual Meeting.

ROYAL VICTORIA HALL, at 8.30.—Photography of the Heavens: R. A. Gregory.

WEDNESDAY, FEBRUARY 10.

SOCIETY OF ARTS, at 8.—The Chemistry of Tea: David Crolé.

THURSDAY, FEBRUARY 11.

ROYAL SOCIETY, at 4 30.—The following Papers will *probably* be read:—Report to the Committee of the Royal Society appointed to investigate the Structure of a Coral Reef by Boring, with Prefatory Note by Prof. Bonney, F.R.S.—Preliminary Communication on a Theory of the Suction-Force of Branches: Prof. Vines, F.R.S.—The Artificial Insemination of Mammalia and subsequent possible Fertilisation or Impregnation of their Ova: W. Heape.—On the Regeneration of Nerves: Dr. R. Kennedy.

ROYAL INSTITUTION, at 3.—Problems of Arctic Geology: Dr. J. W. Gregory.

SOCIETY OF ARTS (Imperial Institute), at 4.30.—The Progress of Science Teaching in India: Prof. Jagadis Chundra Bose.

SOCIETY OF ARTS, at 8.—The Mechanical Production of Cold: Prof. James A. Ewing, F.R.S.

MATHEMATICAL SOCIETY, at 8.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Electric Interlocking the Block and Mechanical Signals on Railways: F. T. Hollins.

CAMERA CLUB, at 8.15.—The Making and Exhibiting of Living Photographs: Birt Acres.

FRIDAY, FEBRUARY 12.

ROYAL INSTITUTION, at 9.—Recent Advances in Seismology: Prof. John Milne, F.R.S.

ROYAL ASTRONOMICAL SOCIETY, at 3.—Annual Meeting.

PHYSICAL SOCIETY, at 5.—Annual Meeting.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Cooling Reservoirs for Condensing Engines: Harold W. Barker.

MALACOLOGICAL SOCIETY, at 8.—Annual Meeting.

SATURDAY, FEBRUARY 13.

ROYAL INSTITUTION, at 3.—The Growth of the Mediterranean Route to the East: W. F. Lord.

ROYAL BOTANIC SOCIETY, at 4.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Geography of Africa: E. Heawood (Macmillan).—The Sacred Tree: Mrs. J. H. Philpot (Macmillan).—The Mechanics of Pumping Machinery: Dr. J. Weisbach and Prof. G. Herrmann, translated by K. P. Dahlstrom (Macmillan).—Guide pour Le Soufflage du Verre: Prof. P. Lugol (Paris, Gauthier-Villars).—Aristotle on Youth and Old Age, Life and Death and Respiration, translated by Dr. W. Ogle (Longmans).—Ostwald's Klassiker der Exakten Wissenschaften, Nos. 80–85 (Leipzig, Engelmann).—Advanced Mechanics. Vol. 2. Statics: W. Biggs and Dr. G. H. Bryan (Clive).—Essays by Geo. John Romanes, edited by C. Lloyd Morgan (Longmans).—A Handbook to the Order Lepidoptera: W. F. Kirby, Vol. 3 (Allen).—The Application of Electricity to Railway Working: W. E. Langdon (Spon).—A Manual and Dictionary of the Flowering Plants and Ferns: J. C. Willis, 2 Vo's. (Cambridge University Press).—Annuaire de L'Observatoire Municipal de Montsouris, 1897 (Paris, Gauthier-Villars).—Annuario de Estado do Rio Grande do Sul, 1897 (Porto Alegre).—Th. Thoroddsen, Geschichte der Isländischen Geographie, i. Band, Autorisierte Übersetzung von A. Gebhardt (Leipzig, Teubner).—A History of the Fens of South Lincolnshire: W. H. Wheeler, 2nd edition (Boston, Newcomb).—Summer Days for Winter Evenings: J. H. Crawford (Macqueen).—Planches de Physiologie Végétale: L. Errera and E. Laurent, Text and Plates (Bruxelles, Lamertin).—Catalogue of the Michigan Mining School, 1894–95 (Houghton, Michigan).—Geological Survey of Alabama. Report on the Valley Regions of Alabama, Part 1 (Montgomery, Alabama).—Catalogus Mammalium, nova editio, Fasc 1: Dr E. L. Troussart (Berolini, Friedländer)—The British Mercantile Marine: E. Blackmore (Griffin).—Traité Elémentaire de Mécanique Chimique fondée sur la Thermodynamique: Prof. P. Duhem, Tome 1 (Paris, Hermann).—The Story of the Weather: G. F. Chambers (Newnes).—Water and its Purification: Dr. S. Rideal (Lockwood).—Theorie des Mesoderms; Dr. C. Rabl, Erster Band (Leipzig, Engelmann).—Pioneer Work in the Alps of New Zealand; A. P. Harper (Unwin).—Magnetic Fields of Force: Prof. H. Ebert, translated by Dr. C. V. Burton, Part 1 (Longmans).—Life and Letters of Wm. Barton Rogers, edited by his Wife, 2 Vols. (Boston, Houghton).—Short Studies in Physical Science: V. Cornish (Low).—Sciagraphs of British Batrachians and Reptiles: J. Green and J. H. Gardiner (St Kilda, Manor Road, Wallington).

PAMPHLETS.—Julius Thomsen's Dualismus der Chemischen Masse beleuchtet durch Aufstellung einer neuen Wärmetheorie: P. S. Baron Wedell-Wedellsborg (Kopenhagen, Höst).—Report of S. P. Langley, Secretary of the Smithsonian Institution, for the Year ending June 30, 1896 (Washington).—Analytic Keys to the Genera and Species of North American Mosses: Prof. C. R. Barnes and F. de F. Heald (Madison).

SERIALS.—Journal of the Royal Microscopical Society, December (Williams).—History of Mankind: F. Ratzel, translated, Part 16 (Macmillan).—Hypnotic Magazine, January (Chicago).—Record of Technical and Secondary Education, January (Macmillan).—Contemporary Review, February (Isbister).—Humanitarian, February (Hutchinson).—Zeitschrift für Physikalische Chemie, xxi. Band, 4 Heft (Leipzig, Engelmann).—Chambers's Journal, February (Chambers).—National Review, February (Arnold).—Century Magazine, February (Macmillan).—Fortnightly Review, February (Chapman).—Annales de L'Observatoire Magnétique de Copenhague, Années de 1893–94, Livr. 1 (Copenhague).—Astrophysical Journal, January (Chicago).—Repertorium zu den Acta und Nova Acta der Akademie, Zweiter Band, Erste Hälfte (Halle).

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