THURSDAY, FEBRUARY 11, 1897.

SCIENCE AND MORALITY.—IN THE YEAR 2000.

Science et Morale. Par M. Berthelot. Pp. xii + 515. (Paris : Calmann Lévy, 1897.)

THOSE who wish to gain some idea of the spirit animating scientific workers in France at the present day may study with advantage this new proof of the inexhaustible energy of the marvellously versatile perpetual Secretary of the Academy of Sciences. The book is for the most part a collection of essays on biographical, educational, historical and philosophical subjects, together with addresses, letters, and speeches on similar matters ; although of unequal interest and importance, these will in many cases more than repay careful perusal and examination.

It is the work of a very remarkable man—one of the most remarkable of our time—who describes his own career most truly when he says :—

"Depuis cinquante ans, je recherche les connaissances des choses avec une curiosité et une sympathie infinies."

Infinite curiosity and infinite sympathy—although both qualities that should characterise all scientific workers—are too seldom sufficiently developed in one individual, the latter especially being often strangely absent : the study of a man in whom such qualities are conjoined is therefore interesting in many ways, and becomes the more so as the conviction grows that he is a striking example of a type of mind altogether rare.

A student in his laboratory during the earlier years of his life, since 1870, when the desire to serve his country in the hour of her great need led him to enter the public service, he has taken part in the work of national defence, of public instruction and of general politics, attaining recently to the high rank of Minister of Foreign Affairs—besides continuing with unremitting ardour the researches which have made his name famous throughout the scientific world.

The first to show that the natural fats could be artificially prepared from acids and glycerol ; the first to study the great group of vegetable oils, the turpentines, scientifically ; the first to establish (in 1859) the existence of acetylene as a definite compound, and the discoverer of the method of producing it directly from carbon and hydrogen : of late years he has devoted his attention chiefly to thermochemical inquiries, and has rendered lasting service especially by the invention of the calorimetric bomb—one of the most ingenious instruments of scientific research ever devised.

Moreover, recognising that

"En toutes choses, c'est en remontant aux origines que l'on arrive à mieux comprendre l'état présent,"

he has devoted himself with surprising assiduity also to the study of ancient Arabic, Greek and other writers from whom information could be gleaned of the history of scientific discovery.

The ultimate predominance of science in all human affairs is the key-note sounded throughout the volume this being carried in the final essay to a point beyond which even writers of fiction have scarcely dared to travel.

"La science domine tout : elle rend seule des services définitifs. Nulle homme, nulle institution désormais n'aura une autorité durable, s'il ne se conforme à ses enseignements !"

These, the closing words of the preface, are words of indubitable truth ; yet how few there are who will thoroughly appreciate their importance and significance—who will understand the *full* meaning of the word science : were it appreciated at all generally, how much more might be accomplished even with our present imperfect means ! The conviction that such is the case should at least lead us to do our utmost to make the doctrine intelligible and popular ; and to this end attention may be drawn to M. Berthelot as a most powerful and engaging witness.

"La Science et la Morale," the opening chapter in the book, is a vigorous and eloquent essay in which the thesis is maintained that morality has no other basis than that which science furnishes : that progress, past and present, of morality, both in the case of individuals and of society, has been and always will be correlative with the progress of science. Frankly hostile to all theories of the divine origin of moral laws, M. Berthelot, in fact, is the outspoken advocate of the view that man is himself the source of morality.

"L'homme trouve la morale en lui-même et il l'objective en l'attribuant à la divinité."

And a determined enemy of the ecclesiastical spirit, although less militant and incisive perhaps, he insensibly reminds us in many ways of Huxley—both having the same object in view and the same hatred of false pretence and unscientific method.

The next essay of importance, entitled "La Science Educatrice," written apparently in 1891, deals with the crisis in secondary education consequent on the revolution going on in France as elsewhere against an exclusively classical system, and in favour of the introduction of science as a necessary element. Although the arguments used are very largely those with which we are familiar, being presented with the literary grace peculiar to the skilful French writer, the article is one that may be read with pleasure as well as studied with profit. The history of secondary education in France is sketched in a most interesting manner, and the many faults of the present system are clearly recognised and pointed out, as well as the reasons for instituting changes.

M. Berthelot, of course, insists that scientific studies should be made correlative with other studies from the outset. He also dwells on the capital importance of science to the moral as well as the intellectual education of humanity.

"L'habitude de raisonner et de réfléchir sur les choses, le respect inébranlable de la vérité et l'obligation de s'incliner toujours devant les lois nécessaires du monde extérieur, communiquent à l'esprit une empreinte ineffaçable. Elles l'accoutument à respecter les lois de la société, aussi bien que celles de la nature, et à concevoir les droits et le respect d'autrui comme une forme même de son propre droit et de sa propre indépendance personelle."

It is noteworthy that M. Berthelot is in agreement with those of us who hold that our children—especially girls—are too frequently subject to severe over-pressure owing to the multiplicity of subjects they are forced to study at school.

"A surcharger l'esprit des enfants par l'acquisition réelle ou prétendue de tant de connaissances diverses, on risque de le fatiguer avant l'heure et d'en empêcher l'évolution normale. On ruine en même temps la santé à l'age du développement physique ; risque plus marqué encore pour les jeunes filles que pour les jeunes garçons."

And he also corroborates the view that great injury is often done by preparation for examinations. Thus, speaking of those who are preparing to compete for admission into higher schools, such as the École polytechnique, he writes :—

"Tandis que les candidats futurs s'y consacrent tout entiers, souvent avec un effort excessif qui épuise leur santé, ils abdiquent leur individualité et, absorbés par le mécanisme de la préparation, ils perdent, eux aussi, la curiosité et l'amour de la réflexion originale."

Would that this doctrine could be brought home to, and made popular with, our Indian Civil Service Commissioners and other such examining bodies. Perhaps the country will some day realise what price it has paid for the destruction of nepotism, even if it do not question the efficacy of the method it has adopted ; and at least we may hope that in times to come, medical men will respect the injunction, "Physician, heal thyself," after recognising the injury that is done by over-study to the mental powers of students qualifying to join the profession. But those will be days when true morality will have a place in education because true science has found a place in it.

"La haute culture et la loi militaire" is an interesting report of speeches delivered in the Senate in 1888–89, which were directed against the introduction of a law making three years' military service compulsory on all classes, and favouring the limitation of service to a much shorter period in the case of the student class, who are pictured as the backbone of the community. In the course of this debate M. Berthelot made the interesting statement that he is the grandson of a village farrier.

The biographical sketches in the volume include graceful notices of Pasteur, Claude Bernard, Paul Bert, and F. André.

In a charming account of the doings of a colony of ants which he had sought to dislodge, M. Berthelot displays himself as an ardent naturalist observer as well as psychologist ; but it is not the first time that he has appeared in such a character—indeed, he tells us that he has for years past made these remarkable insects the subject of careful study.

The historical essays printed in the latter part of the volume are good examples of his style and versatility : that on the discovery of alcohol and of distillation, as well as that on the origin of chemical industries, may be specially commended to chemists as being full of interest ; the essay on Papin is an eloquent attempt to do further justice to the memory of one for whom a capital share in the invention of the steam-engine may be claimed.

Very appropriately, as emphasising the point of view taken throughout the work, M. Berthelot publishes, as the last chapter in the volume, a speech delivered in 1894, in which a fanciful sketch is given of the changes that it may be expected will have been brought about at the close of another century—in 2000—through the introduction of science into all our affairs :—

"Dans ce temps-là, il n'y aura plus dans le monde ni agriculture, ni pâtres, ni laboureurs : le problème de l'existence par la culture de sol aura été supprimé par la chimie ! Il n'y aura plus de mines de charbon de terres, ni d'industries souterraines, ni par conséquent de grèves de mineurs ! Le problème des combustibles aura été supprimé par le concours de la chimie et de la physique. Il n'y aura plus ni douanes, ni protectionnisme, ni guerres, ni frontières arrosés de sang humain ! La navigation aérienne, avec ses moteurs empruntés aux énergies chimiques, aura relégué ces institutions surannées dans le passé ! Nous serons alors bien prêts de réaliser les rêves du socialisme . . . pourvu que l'on réussisse a découvrir une chimie spirituelle, qui change la nature morale de l'homme aussi profondément que notre chimie transforme la nature matérielle !"

It is suggested that we shall have tapped the central fires of the earth, and thence derive our supplies of energy, and that we shall live on tabloids artificially prepared. As a modest picture of the chemist's potential activity, the sketch is perfect, and it is unfortunate that it is necessary to introduce so important a *pourvu que* in order to keep expectation within due bounds ! M. Berthelot is even a little inconsequent, and forgets, perhaps, that in an earlier address on the place of science in agriculture he paints a somewhat different picture and, perhaps, a nobler one :—

"Or nul idéal n'est supérieur a celui de l'agriculture. La vie des champs est le type normal de la vie humaine. Là seulement, l'homme se développe en toute plénitude. La vie des champs favorise à la fois la santé matérielle des corps et la santé morale de l'esprit. Le paysan robuste, laborieux et intelligent, a toujours fait la force des nations."

If agriculturists are thrown out of employment by the disappearance of agriculture, what are they to do ? All cannot engage in the manufacture of compressed food in the synthetical laboratories which will supersede Nature ; and besides this to waste solar energy in the manner implied would be unscientific. Moreover, even the most ardent evolutionist will require more than one hundred years to reduce the stomach of the city alderman to such dimensions that a few wafers of nitrogenous and carbohydrate materials will suffice to produce in it the effect of a full meal, even if fed besides with speeches of inordinate length and dulness.

But closely as he enters into competition with Jules Verne, in the course of his "excellent fooling," M. Berthelot does not venture to look across the water and comfort us with the assurance that in the year 2000 we shall have a Minister of Education whose interest in the subject will be in some measure comparable with that of his distinguished French predecessor of a century before, and that there will be a true university established in London in which all branches of science and morality will consort and prevail in place of examinations and narrow-mindedness. No doubt he desired to draw the line at the probable. H. E. A

A STUDENT'S COURSE OF ASTRONOMY.

Cours d'Astronomie. Par M. B. Baillaud. Two vols. Pp. 280 and 509. (Paris: Gauthier-Villars et Fils, 1896.)

IT is a remarkable but no less accurate statement to say that the English student who wishes to dive deep into the inner circle of astronomical science must be dependent to a great extent on works produced outside this country. Oppolzer, Chauvenet, Watson, Klinkerfues, Olbers, and many others are books with which the serious reader must become well acquainted, to say nothing of works of a more advanced type, such as those by Tisserand, Gyldén, &c.

Our literature deals, for the most part, with descriptive astronomy, in which the sun, moon and planets, &c., are lavishly described and illustrated: of these there is no limit. We are also well supplied with works on physical astronomy, but this branch of science is not included in the above remarks.

In the two volumes before us, which we owe to the director of the observatory at Toulouse, M. Baillaud, we have an excellent course of astronomy for students. This work is not one devoted to descriptive astronomy, nor a treatise on celestial physics, but a mathematical course, presenting the reader with a survey of the various problems and modern methods of astronomy, including some of the more important results which have been obtained.

In a brief and yet not too concise a manner, the author has brought together all the essential points that are necessary for a course in astronomy without extending any of them disproportionally.

The first volume, we find, was published in the year 1893. In this some of the theories applicable to the study of experimental science are handled, the knowledge of which is as important to physicists as to astronomers. Thus the author discusses the principles of the calculus of probabilities, showing how they may be applied to the theory of the errors of observation: the method of solving equations by the method of least squares is also here referred to in full. Next in order comes the general theory of optical instruments, which is investigated at some length, followed by the descriptions of the principles and problems involved in the action of lenses, prisms, eyepieces, various kinds of telescopes, &c. In the chapter on the different kinds of instruments used in making observations, chronometers, pendulums, levels and verniers are first in some detail described before the actual instruments, such as the meridian circle, equatorial, altazimuth, &c., are dealt with. The equatorial coudé comes in for a good description, and, like the others, is well illustrated. The last two chapters are devoted to the various methods of angular measurement, including the trigonometrical formulæ for facilitating the solutions of spherical triangles, and to the formulæ for interpolation as suggested by the works of such men as Newton, Legrange, Gauss, and Jacobi.

The second volume, which has only recently been published, contains as many as 500 pages, and may be considered the more important part of the work.

The first few chapters are devoted to the solution of such problems which may be considered here as preliminary to the main question of orbit determination. These include such subdivisions as systems of co-ordinates, refraction, parallax, aberration, precession, &c., each of which M. Baillaud has expounded with clearness and in sufficient detail to enable the reader to understand them. The apparent movements of the sun, together with those of the major planets, are next handled, the author discussing the various peculiarities of these motions, and how some of them may be dependent on the movements of the earth. This leads him naturally to deduce the laws of motion from observation, eventually leading up to the problem of orbit determination.

The chapter dealing with the methods of computation adopted at the present day for the determination of the orbits of comets, planets, &c., will be found expounded in a manner that is very helpful for the student. The author has kept strictly in view the main line of thought in the solution of the various problems, and has not overwhelmed the reader with the presence of too much detail on comparatively minor points. In this respect the student is at an advantage; but, wherever necessary, he can always refer to that classical work of Oppolzer for further inquiry into minor details on any special question.

In the chapter on perturbations, all the three well-known methods, which we owe to Bond, Encke, Hansen, and Tietjen's modification of the last-mentioned, have been dealt with in a similar manner.

The movements of the moon and of Jupiter's satellites are next the subject of discussion, after which attention is devoted to the form and dimensions of the earth, a description being given of the various instruments and methods employed in such determinations. In addition to other problems, those relating to eclipses are referred to at some length; while the last chapter professes to give a brief summary of what is termed modern astronomy. This latter is found to be very scanty indeed, and is likely to do a student more harm than good. The lack of references of any kind, and the numerous omissions of importance are not likely to inspire confidence. In a future edition it would be advisable either to make this part more complete, and add to its usefulness by abundant references; or, on the other hand, omit it entirely, as it is quite unnecessary in a book of this kind.

In the above notice, only a brief survey of the contents of these volumes has been made. It must be understood, however, that the author has dealt with several other problems of minor importance, their solutions being conspicuous by the conciseness of the methods employed.

To sum up in a few words, the work as a whole may be said to form a serviceable contribution to the student's library. Not only will it be used by those for whom it is specially intended, but English students, and especially those unacquainted with the German language, will find it an important help in their work.

The text is relieved throughout by the insertion of many figures and woodcuts.

OUR BOOK SHELF.

Register of the Associates and Old Students of the Royal College of Chemistry, the Royal School of Mines, and the Royal College of Science. Edited by Theodore G. Chambers, Assoc.R.S.M. Pp. cxxii + 231. (London: Hazell, Watson, and Viney, Ltd., 1896.)

THIS Register contains the names and short biographical notices of many hundreds of the past students of the three institutions, the history of which has been so closely interwoven. Much praise is due to Mr. Chambers, and those who have assisted him, for the care and patience with which man after man has been tracked down and run to earth, that he may yield a few lines of print to this book. A glance over its pages cannot fail to be gratifying to any old student, for it is at once apparent how much the pure sciences, as well as Mining and Metallurgy, owe to the men who have been trained at these colleges. Such names as those of De La Rue, Odling, Frankland, Armstrong, Tilden and Abel among chemists; of Mathiessen, Roberts-Austen, Bauerman and Gilchrist among metallurgists; of Judd, of Le Neve Foster, and of the Blanfords, are indissolubly linked with the history of the sciences which they respectively represent. But besides these, on almost every page of the Register the names occur of men, Fellows of the Royal Society and others, of whom any college or university might well be proud.

The history of the united schools, which is also given, clearly shows their continuous growth from their foundation up to the present time, and the biographies and excellent portraits of the past and present professors will be highly valued by their old students as interesting mementos of those who have largely influenced and directed the course of their lives.

Fruit-Culture for Amateurs. By S. T. Wright. With an Appendix on Insect and other Pests injurious to Fruit Trees. By W. D. Drury. Pp. 244. (London: Upcott Gill, 1897.)

THE culture of hardy fruits has received a great impetus of late years from the depressed state of agriculture, whilst the enormous importations from America and from France have at length enabled our cultivators to realise the consequences of their own neglect.

It might be supposed that a market thus captured by the foreigner would never be regained; but there are signs that this is not so. Our home-grown supplies, to a large extent, come at a season when foreign competition is least active. English-grown apples, properly marketed, are the finest the world produces, and command the highest prices. Plums can be grown here so well and so abundantly as to effectually neutralise competition. Small fruits—under which category are included strawberries, raspberries, gooseberries, &c.—do not pay for long carriage, a point in favour of the British cultivator. The culture of grapes under glass has also increased to such an extent that lately it has been found profitable to export them even to the United States. All this shows that fruit-culture is extending, and that when carried on in a business-like way it returns a fair amount on the capital invested and the labour expended. The little book before us is specially intended for amateurs; but it contains just the sort of information which the novice in fruit-culture for market requires. It is the work of an experienced practitioner in whom the reader may place the fullest confidence. In this place we need not enter into cultural details; but it is instructive to note throughout Mr. Wright's pages, whether he be treating of apples or of figs, of strawberries or of medlars, how identical are the general principles of cultivation.

Mr. Wright had no intention of dealing with physiological matters—his aim is entirely practical—and yet we find throughout the general principles brought into prominence, unconsciously, perhaps, on the part of the author, but still manifestly so to the amateur reader. This is a great advantage to the book. Amateurs now-a-days know that no progress can be expected in practical arts unless the practitioner has some knowledge of the principles on which they are based. This is only another way of saying that a man must know his business before he can hope to succeed in it. Mr. Wright's book will greatly help the reader to this knowledge, and may be recommended accordingly.

The Appendix, by Mr. Drury, occupies nearly as much space as the chapters of the book. It is devoted to a description of the principal noxious insects and fungi, and is interesting as showing that, somewhat tardily perhaps, our cultivators are realising the advantages of "spraying," a detail in which our American cousins have got the start of us.

Annuaire de l'Observatoire Municipal de Montsouris, pour l'Année 1897. Pp. xii + 664. (Paris: Gauthier-Villars et Fils, 1897.)

THE Montsouris Meteorological Observatory was established by M. Duruy in 1871, by the influence of Dumas then president of the Municipal Council of the City of Paris. The work carried out in it is divided into three principal sections, which, while including purely scientific researches, take in also subjects relating to the climatology and hygiene of Paris. The first branch of the Observatory's work belongs to physics and meteorology, among the subjects included in this section being:—atmospheric electricity, the usual meteorological observations, the influence of smoke and vapours upon atmospheric variations, &c. The chemical work done at the Observatory refers to the variations in the composition of air in different parts of Paris, analysis of water, variations in the composition of sewage waters and of the Seine at different points, and methods of filtration. To the micrographic section of the Observatory is entrusted not only bacteriological statistics, and the determination of the meteorological conditions which affect the abundance of micro-organisms in air, soil, and water, but also the examination of the specific characters of bacteria. A bacteriological laboratory for the diagnosis of diphtheria, and of other diseases of which the active principles are known, was joined to the micrographic section of the Observatory at the beginning of last year, and has been found of great service to the public and to medical practitioners.

A large amount of valuable information on these and many other matters is given in this *Annuaire*. Meteorologists, bacteriologists, and students of public health will be particularly interested in the volume.

Essays of George John Romanes. Edited by C. Lloyd Morgan. Pp. 253. (London: Longmans, Green, and Co., 1897.)

BY collecting and republishing these essays, Prof. Lloyd Morgan has carried out a wish of Romanes, and at the same time has given general readers of science a very interesting volume. The subjects of the essays here reprinted from various magazines and reviews are:—primitive natural history, the Darwinian theory of instinct, man and brute, mind in men and animals, origin of human faculty, mental differences between men and women, the object of life, recreation, hypnotism, hydrophobia and the muzzling order. Such an attractive selection from the writings of a master-mind like Romanes, should appeal successfully to a wide circle of readers.

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.*]

The Direct Cynthesis of Optically Active Proteid-like Substances.

IN a recent communication to the Royal Society (*Proceedings*, No. 364, lx. 337–349), of which an abstract has appeared in NATURE, Dr. Pickering describes experiments he has made—in extension of those carried out by Grimaux several years ago—on the synthesis of certain proteid-like substances: the substances were obtained by heating amido-acids, such as par- and meta-midobenzoic acid and tyrosine, with amides, such as alloxan, biuret and xanthine, in presence of a dehydrating agent, or even by heating the amido-acid alone with the dehydrating agent. The substances so produced are said to be all soluble in warm water, forming opalescent *lævorotatory* solutions, the values given for α_D varying between -38 and -52; but it is not clear what is meant by this, as the symbol α_D is commonly used to denote the observed rotatory power, and is meaningless unless the strength of solution, &c., be stated, from which the specific rotatory power can be deduced.

Dr. Pickering does not appear to be aware that if his statements are correct, he has made a discovery of a startling character, altogether remarkable in the light of our present knowledge. In all cases hitherto studied—not excluding nitrogen compounds (*e.g.* artificial conine)—as Pasteur foresaw would doubtless be the case, optically active substances are never directly produced; the synthetic product is always inactive. For example, when tartaric acid is synthesised, a mixture is obtained consisting of mesotartaric acid—the internally compensated modification—and racemic acid, this latter being resolvable into equal quantities of the two equally but oppositely active tartaric acids.

It is therefore desirable that Dr. Pickering should state exactly what is the evidence on which he relies as proving that the substances he has obtained are possessed of optical activity. Having reason to think that nitrogen may manifest peculiarities hitherto unsuspected, I await such information with impatience.

Dr. Pickering speaks of having obtained several of the substances in translucent yellowish plates. What are we to understand from this? It would be interesting if we knew whether the substances are crystalline.

Grimaux, who has discussed coagulation phenomena in a thoroughly scientific manner, has pointed out that the proteids do not differ as colloids in any essential manner from mineral and other colloids such as Graham investigated; and it is perhaps, therefore, fair to question whether the production of intravascular coagulation, on which Dr. Pickering lays stress, is so significant a property as he supposes as indicating affinity with true proteids. The substances he has obtained cannot well, from the chemical point of view, bear any real structural relationship to natural proteid substances.

HENRY E. ARMSTRONG.

Carbon in Bright-Line Stars.

DR. HUGGINS should verify his references; it has taken me some considerable time to find the article he erroneously states to be contained in vol. xlviii. of NATURE.

That article was an attempt to summarise a good deal of work I had communicated to the Royal Society, with all necessary details.

To avoid the necessity of giving these details in the article, I distinctly stated that "in the Bakerian lecture for 1888 I gave a complete discussion of the spectra of bright-line stars," and referred to the "bright fluting of carbon which extends from 468 to 474."

The details were thus stated in my communications to the Royal Society:—"The bright band, with its maximum at 468, is the bright carbon fluting commencing at 474, and extending towards the blue with its maximum at 468, as photographed at Kensington" (*Roy. Soc. Proc.*, vol. xliv. p. 37, March 1888).

"It is necessary to state that the maximum luminosity of the blue band, under some conditions, is at about 468. As I have so often had occasion to refer to this, I here reproduce one of the many photographs of the spectra of carbon compounds which show it" (*Roy. Soc. Proc.*, vol. xlv. p. 169, November 1888).

In a paper communicated to the Royal Society, on November 9, 1889, in which this blue band of carbon is very frequently referred to, both in connection with comets and bright-line stars, its position is throughout defined by the figures 468–474, whether the brightest part was at 468 or 474. I had previously shown that the maximum might be at either wave-length in the spectra of different comets, and my earlier papers had sufficiently stated that in the case of bright-line stars the modified band, with the maximum at 468, was in question. Thus in comparing the spectra of comets and bright-line stars, "468–474" was used as a short title for the blue band, whether in flame, comet, or star, and this applied also to the new observations which were recorded at the same time, showing the coincidence of the star band with the spirit-flame band. With the instrument employed, the whole group in the flame spectrum appears as little more than a broad line; but that the previously noted shift of the maximum to 468 was simply regarded as ancient history, is shown by sketches in the Solar Physics Observatory note-books, which I shall be glad to show Dr. Huggins, if he cares to see them.

I certainly see no reason to withdraw my assistants' observations of the blue band, but in the article which has given rise to this discussion (NATURE, January 28, 1897) I regarded them as superseded, as most of Dr. Huggins' observations have been, by recent observations, made with much greater optical means. I am not aware that it is customary to formally withdraw *observations* which have simply been superseded with the help of improved instruments.

I retained the observations of the green fluting, however, for reasons sufficiently stated in my article.

Dr. Huggins apparently objects to my statement that Prof. Campbell does not discuss the origins of the lines and bands which he has measured, but it will be seen by his quotation from Prof. Campbell's paper that my statement is amply justified. Prof. Campbell makes only a general reference to the question of origins, and has only compared with "well-known artificial spectra." It is not quite clear what is meant by "well-known" spectra, but presumably it is the published tables of lines seen in the arc and spark spectra of the more familiar substances which are meant; these lines, however, would not be the only ones to be expected under the exceptional conditions which exist in a bright-line star. The experimental work on the blue band of carbon is only one indication of the necessity for observing terrestrial spectra under special conditions for such an investigation. It is certainly impossible that the resources of a comparatively young institution like the Lick Observatory can be sufficient to cope with this inquiry into origins.

With reference to Prof. Vogel's observations of the varying position of the maximum of the carbon band, I can only repeat the statement of my regret that I had forgotten them when my paper of 1888 was written. I have nowhere stated that this observer ascribed the blue band in the bright-line stars to carbon, but it is certainly strange he has not done so, since a similar band at about the same wave-length in the spectrum of comets was experimentally demonstrated by him to be probably due to carbon.

It would appear that if Dr. Huggins had done me the honour of reading my communications to the Royal Society, his letter would not have been written. J. NORMAN LOCKYER.

February 9.

Origin of the Cultivated Cineraria.

THE discussion in these pages, rather more than a year and a half ago, upon the origin of the "Cultivated Cineraria," by Mr. W. T. Thiselton-Dyer, Mr. W. Bateson and others, was productive of very considerable interest. It raised in my mind the idea of producing some living evidence on the question; but the unfortunate position is, that certain kinds required for the purpose are not in cultivation. I venture to appeal, therefore, to the readers of NATURE, who were interested in the discussion, and who may visit or live in the Canaries or Madeira, to be so good as to send me any seed they may be able to obtain. It is desirable to have seeds of all the herbaceous species of *Senecio*, without exception. *S. Tussilaginis* I consider important, whatever the facts of origin may have been, and it is necessary to have a new stock of *S. cruentus*. I have already used the material at command, and have made a variety of crosses among four distinct types. The set first in flower was exhibited, on account of its showy features, at a recent meeting of the Royal

Horticultural Society. This cross was between *S. multiflorus* (female) and several colour forms of the "Cultivated Cineraria," embodying certainly two distinct species. No direct evidence on origin has been in this particular experiment obtained, or expected, but the predominating influence of the "Cultivated Cineraria" in this and also in the reverse cross, upon the colour and size of the flower-heads, appears to suggest, I think, a possible predominance of one species over another, in other cases. The crosses to which I have referred, taken together, sufficiently demonstrate an extreme readiness to cross, since every one of the thirteen attempts has resulted in a numerous hybrid progeny, while not one of the several hundreds of plants raised has failed of being a hybrid. The only care taken was to exclude insects, which might have brought pollen from another plant, by means of muslin, and no attention was paid to the pollen produced within the muslin bags. This pollen, on the evidence of nearly five hundred plants, had no effect. From the facility with which these plants cross under cultivation—even the woody *S. Heritieri* with the completely herbaceous kinds—it is likely that they cross also in a state of nature, whenever the opportunity occurs. It would be interesting, therefore, to have information of the relative distribution of the kinds, and to know of all variations. There is no doubt a large field and good motive for exploration in the Canaries, and I should be exceedingly thankful for any seeds or plants that may be sent me.

Botanic Gardens, Cambridge. R. IRWIN LYNCH.

Prichard and Acquired Characters.

PROF. MELDOLA, in his suggestive address to the Entomological Society on January 20, very rightly puts Prichard before Galton and Weismann in the list of those who have formulated the theory that acquired characters are not inherited by offspring. Some years ago, when Platt Ball's interesting little book was published on the question, "Are the Effects of Use and Disuse Inherited?" I was struck by the careful way in which the author pointed out how "so sound and cautious an observer as Francis Galton had also [*i.e.* as well as Weismann], in 1875, concluded that 'acquired modifications are barely, if at all, *inherited* in the correct sense of that word.'" At the same time my memory went back to some allusions I had seen in an old book (Coombe's "Constitution of Man," Edinburgh, 1836, a copy of which I had recently bought at a marine store dealer's for one halfpenny) to the theories of Dr. Prichard. I subsequently looked up the references and made some notes, which have until now been pigeon-holed. I quote three passages and a note as bearing on the question, Who first pointed out that acquired characters are not inherited? ("Researches into the Physical History of Mankind," vol. ii. p. 536, by James Cowles Prichard, M.D., F.R.S.)

"It has often been a question among physiological writers what peculiarities of structure are liable to be transmitted by parents to their offspring, and what terminate with the individual, without affecting the race. Perhaps the following remarks may afford the solution of this difficulty:—

"It appears to be a general fact that all connate varieties of structure or peculiarities which are congenital, or which form a part of the natural constitution, impressed on an individual from his birth, or rather from the commencement of his organisation, whether they happen to descend to him from a long inheritance or to spring up for the first time in his own person, are apt to reappear in his offspring. It may be said, in other words, that the organisation of the offspring is always modelled according to the type of the original structure of the parent.

"*On the other hand, changes produced by external causes in the appearance or constitution of the individual are temporary, and, in general, acquired characters are transient; they terminate with the individual, and have no influence on the progeny.*[1] [The italics are mine.]

Dr. Prichard has very properly mentioned the source of his ideas, and it is to be hoped that we also may give credit where credit is due. WILFRED MARK WEBB.

Biological Laboratory of the Essex County Council, Chelmsford, January 27.

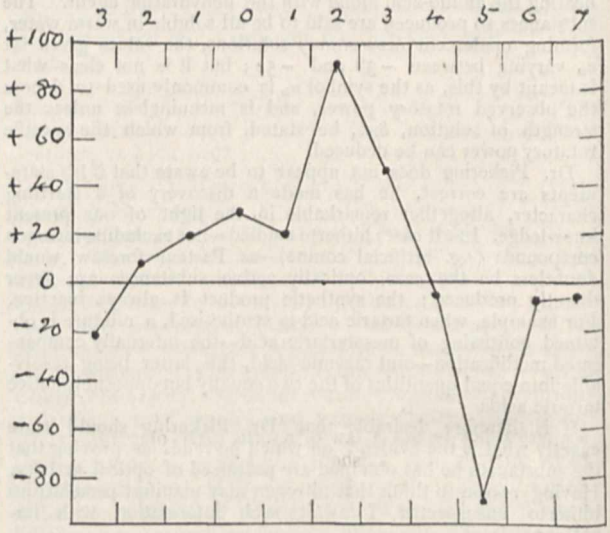
I AM very glad that Mr. Webb has also directed attention to Dr. Prichard's share in the establishment of the doctrine of the non-transmissibility of acquired characters. I should like to add that my attention was first called to the work in question (2nd edition, 1826) by my father-in-law, Dr. Maurice Davis. Prof. Poulton has taken the subject in hand, and is preparing an article on the whole question. R. MELDOLA.

"[1] This distinction, which has not been pointed out by any former writer on physiological subjects, was first suggested to me in conversation, many years ago, by Mr. Benjamin Grainger, of Derby."

Rainfall in the Lake District.

THE recent publication, in Mr. Symons' *British Rainfall* for 1895, of fifty years' data of rainfall at Seathwaite (1845–94), affords an opportunity of studying the climate of this very wet district in relation to the vexed question of sunspot influence on weather.

The following might, perhaps, be offered for criticism. Consider each maximum sunspot year, three years before it, and seven after it. (The intervals from maximum to minimum, it is known, are generally longer than those from minimum to



maximum.) Indicate the character of each year with a + or − sign, according as it is above or below the average (137 in.). We may further give the algebraic sums of each vertical group, and of certain horizontal groups (*a* to *b*) as shown; and plot in a

Sunsp. Max.	*a*		Max.			*b*					Sums *a* to *b*
	3	2	1	0	1	2	3	4	5	6	7	
1848	+	+	−	+	−	+	+	+	−	+	−	+ 14
1860	−	−	+	+	+	+	+	−	−	+	−	+133
1870	−	+	+	−	−	+	+	+	−	−	+	+ 29
1883	−	−	+	+	−	+	−	−	−	−	+	+ 27
1893	+	+	−	+	+							+ 5
	−21	+9	+20	+30	+20	+92	+46	−5	−88	−6	−5	

curve the values for the vertical groups. (Should any objection be taken to comparing vertical groups of four members with those of five, I may say that exclusion of the lowest row of values (1893 group) does not materially alter the result.)

These latter values we find rising (with one slight break) to a maximum in the *second* year after the sunspot maximum, then sinking rapidly to a minimum in the fifth year, and continuing under average in the two following years.

It will be noted that in the enclosed groups *a* to *b*, the + signs largely preponderate (16 + to 7 −); that they preponderate in each horizontal group, and in each vertical group but one; and that the sums of all those groups have + signs.

A. B. M.

The Epistemology of Natural Science and Mr. Karl Pearson.

ONLY a few days ago I happened to see the review of my "Erkenntnistheoretische Grundzüge der Naturwissenschaften" (Leipzig, 1896) in NATURE of November 5, 1896. I too highly esteem English science and literature to follow Mr. Karl Pearson in the department of his "familiar ideas"; I shall confine myself to showing how little my reviewer has succeeded in rendering my views (see p. 3).

I have nowhere called the undulatory *theory* of light an hypothesis; I have called the undulatory *conception* (Vorstellung) of light an hypothesis. I have nowhere said that "it is the *sinnliche Wahrnehmung* which changes the *Hypothese* to the *Naturgesetz*." Perception, as was seen in the case of photographs of light-waves obtained by Prof. Wiener, makes hypothesis a matter of fact. To call this fact a law, has never come into my mind.

I have nowhere stated Galilei's law of inertia to be a law of nature; I have declared it to be a postulate laid down on the basis of rich empirical materials (ein auf grundreichen empirischen Materials aufgestelltes Postulat, p. 169). Newton's law of gravitation and the principle of energy are typical examples of natural laws. The law of inertia belongs to the "axiomata sive leges motus" of Newton, and in this respect I have compared the law of inertia to the axioms of geometry, and, considering the rich experience of *to-day*, I have spoken as of an *appearance* of obviousness and immediateness (von einem *Scheine* des Einleuchtenden und Unmittelbaren, p. 168). How little I really think the law of inertia to be so obvious and immediate (so einleuchtend und so unmittelbar), my reviewer might also have learned from pages 74–76 of my book. In a postulate, as well as in a law of nature, immediate perception is entirely out of the question.

These few examples will suffice to show that my reviewer, perhaps owing to some difficulties in understanding the German language, has constructed certain ideas which, in fact, do not exist at all, and are, by no means, advocated by myself. As it is, I do not feel obliged to enter into a discussion of his other remarks, in which he, at least, quotes from my book correctly.

PAUL VOLKMANN.

University of Königsberg, January 18.

FOR our *Principle of Inertia* the Germans use two expressions, *Trägheitsprincip* and *Trägheitsgesetz*. Dr. Volkmann in his work almost invariably adopts the latter, and even speaks of the principle of inertia as *das physikalische Gesetz der Trägheit*. If a physical law be not a law of nature, Dr. Volkmann ought to have carefully distinguished between a *Naturgesetz* and a *physikalisches Gesetz*. I am sorry, however, to have given him more credit for logical consistency than he desires to lay claim to. The law of inertia describes how an insensible particle would move relatively to certain "fixed axes" under certain purely conceptual, not physically realisable conditions. The law of gravitation describes how two insensible particles would move relatively to certain "fixed axes" under certain purely conceptual, not physically realisable conditions. If Dr. Volkmann wishes to draw a distinction between the two, and calls the latter alone a law of nature, then my opinion of his *Erkenntnistheoretische Grundzüge* is now lower than it was when I wrote my notice of it. Dr. Volkmann refers me to pp. 74–76 of his work to illustrate that he did not consider the law of inertia *so einleuchtend und so unmittelbar*, yet those are precisely the pages from which I cited in my review the motion of the railway train, which Dr. Volkmann considers can illustrate the law of inertia, an example which I hold to be most illusory. It is especially dangerous to the young student, and most misleading in popular lectures like Dr. Volkmann's *Allgemein wissenschaftliche Vorträge*.

Dr. Volkmann tells us that Wiener's researches have changed the undulatory conception (*Vorstellung*) of light into *eine vollendete Thatsache*, it has now ceased to be an hypothesis. How a conception can become a physical fact by any amount of research, I fail to understand; although I do grasp how the contents of that conception may by new discoveries be found to adequately describe our physical sensations. But when the contents of the conception are found to adequately describe our sensations, then it seems to me that the orderly account of those contents, which we term theory, ceases to be hypothesis, and becomes a law of nature. If Wiener's work makes the undulatory conception an adequate account of sensation, then it converts the undulatory theory into a law of nature. But Dr. Volkmann tells us this is not what he has said. Perhaps the undulatory theory, now that the undulatory conception has become *eine vollendete Thatsache*, still remains a theory, or is a postulate, or a physical law, or something else in Dr. Volkmann's classification. I certainly do not sufficiently grasp Dr. Volkmann's *Grundzüge* to be able to classify it.

Lastly, I hope my "understanding of the German language" has misled me; otherwise I should say that Dr. Volkmann's present interpretation of what he has written on p. 168 "appears" to me disingenuous. What he has written there runs:—

"Wir befinden uns dem Trägheitsgesetz gegenüber heute vielleicht in ähnlicher Lage wie der Geometer seinen Axiomen gegenüber, dem es gerade darum so schwer fällt, an seinen elementaren Sätzen erkenntnistheoretische Studien anzustellen, weil der Inhalt dieser Sätze so einleuchtend, so unmittelbar zugänglich ist. So scheint dem Physiker heute das Trägheitsgesetz so einleuchtend, so unmittelbar, dass es als Axiom vorgetragen zu werden pflegt. Aber es gab eine Zeit, wo der Inhalt des Trägheitsgesetzes dem menschlichen Geiste durchaus nicht so unmittelbar zugänglich erschien, und dies werden wir uns zu vergegenwärtigen haben, um die Bedeutung der Galileischen Forschung noch heute würdigen zu können."

I take this to mean that the law of inertia appears obvious to the physicist of to-day, but at the time of its discovery it was not at all an obvious conception. Dr. Volkmann says that in this passage he has spoken *von einem Scheine des Einleuchtenden und Unmittelbaren*. He has certainly used the verb *scheinen*, but when I say, for example, that twice two makes four *appears* to me a direct and obvious truth, I certainly do not mean to indicate that the directness and obviousness are *specious*. I must apologise to Dr. Volkmann for having misunderstood this subtlety of the German language.

It is perhaps necessary to add that Dr. Volkmann is raising a verbal controversy which has nothing to do with our radical difference of view. For me a law of nature is purely a product of the human intellect; it is a formula which describes in the briefest terms yet discovered as wide a range as possible of the motions we attribute to atoms, particles, molecules, ether, &c., which kinetic *concepts* form parts of the entirely *conceptual* model by aid of which we describe the sequences of our physical sensations. For Dr. Volkmann the law of nature is something existing *ausser uns* (p. 56) in some manner kept in harmony with the *Denknothwendigkeiten in uns*. Presumably the law lies in the *Dinge an sich*, for it would be impossible to find a law like that of gravitation in the contents of our physical sensations. It is at this point that the older view of the physical sciences, as something quite different from *descriptive* sciences, runs us aground on the metaphysical mudbank. KARL PEARSON.

Durham Degrees in Science.

JUST two remarks in answer to the Rev. Henry Palin Gurney's letter in your last issue.

He admits by his silence my main contention, viz.—that the nature of the M.Sc. degree at Durham has been radically changed owing to the recent action of the University in granting the degree by vote of Convocation.

I did not insinuate in my letter that "these gentlemen had no qualification for the honour."

It is impossible for me to know the necessary qualifications for the degree other than those published by the University in their Calendar. It was sufficient for me that the latter were ignored. X.

February 6.

ON THE CONDUCTIVE EFFECT PRODUCED IN AIR BY RÖNTGEN RAYS AND BY ULTRA-VIOLET LIGHT.[1]

WE propose in this communication to describe results of experiments on the electrical effects of Röntgen rays and of ultra-violet light when shone on metals, or through air between two metals mutually insulated; and electrified to begin with, by previously producing a difference of potentials between platinum electrodes of an electrometer metallically connected with them. In some of our experiments this potential-difference was zero, and the initial ± electrifications of the opposed surfaces depended solely on difference of volta-electric quality between their opposed surfaces.

To investigate the effects of Röntgen rays, a hollow cylinder of unpolished aluminium connected to the

[1] A paper by Lord Kelvin, Dr. J. C. Beattie, and Dr. Smoluchowski de Smolan, read before the Royal Society of Edinburgh, February 1.

electrometer sheaths was used. Along the axis of this a metallic bar was placed, supported by its ends on small blocks of paraffin so situated as not to be shone on by the Röntgen rays. This insulated metal was connected by a copper wire to the insulated terminal of the electrometer. To protect it from inductive effects it was enclosed in a lead tube connected to the other terminal and to sheaths (see Diagram 1).

The Röntgen lamp was placed in a lead cylinder connected to sheaths. The rays passed into the tube of aluminium through a window in the lead cylinder, which could be screened or unscreened at will, as described in our former paper (*Proc. R.S.E.*, December 1896).

The course of the experiment was the same with each insulated metal. The metal was charged first positively, then negatively; the Röntgen rays were then shone on it through the aluminium cylinder surrounding it, and the electrometer readings taken at fixed intervals, until a steady reading on the electrometer was obtained. The point at which the electrometer reading remained steady with the rays acting we shall call the *rays-zero*.

Finally, the insulated metal was discharged by metallic connection in the electrometer, and re-insulated; the

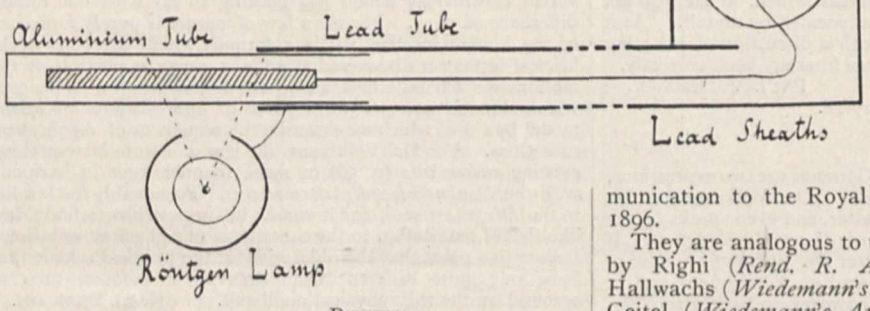


DIAGRAM 1.

rays were again shone on it until the rays-zero was again reached.

The following figures, taken from the laboratory book, show the effect obtained in this way when the insulated metal was amalgamated zinc.

The zero with the electrometer quadrants in metallic connection we shall afterwards speak of as the *metallic zero*.

December 31, 1896, 5.56 p.m.—Readings with one pair of electrometer quadrants insulated, and with Röntgen lamp acting.

− 72	scale divisions	from	metallic	zero	after 5 secs.
− 87	,,	,,	,,	,,	10 ,,
− 91	,,	,,	,,	,,	15 ,,
− 92	,,	,,	,,	,,	30 ,,
− 93	,,	,,	,,	,,	2 mins.

Afterwards steady.

Thus the difference between the rays-zero and the metallic zero is in this case − 93 scale divisions, or − 0·66 of a volt.

[Sensibility of electrometer 140 divs. per volt.]

This deviation from the metallic zero was not stopped by placing an aluminium screen over the window of the lead cylinder; on the other hand, it was stopped if a lead screen was used. If a positive or a negative charge was given to the insulated metal and the Röntgen rays were shone through the aluminium cylinder surrounding it, the discharge went on till the rays-zero was reached; only then was the electrometer reading steady.

In the following table, Column II. gives the potential differences of the rays-zero from the metallic zero for twelve different metals insulated within the unpolished aluminium cylinder as described above. Column III. gives the differences for two of the same metals in the interior, but with the surrounding aluminium cylinder altered by its inner surface being polished by emery paper.

I. Insulated metal.	II.	III.
Magnesium tape	−0·671 of a volt	
Amalgamated zinc ...	−0·66 ,, ,,	
Polished aluminium ...	−0·465 ,, ,,	
Polished zinc	−0·343 ,, ,,	
Unpolished aluminium	−0·349 ,, ,,	... +0·35 of a volt
Polished lead	−0·257 ,, ,,	
Polished copper	+0·129 ,, ,,	
Polished iron nail ...	+0·182 ,, ,,	
Palladium wire	+0·255 ,, ,,	
Gold wire	+0·264 ,, ,,	... +0·930 of a volt
Carbon	+0·429 ,, ,,	

It is to be noted that the preceding experiments tell us insufficiently as to what would happen had we shone the rays on an insulated metal surrounded by an absolutely identical metallic surface connected to sheaths. Another experiment towards answering this question will be described in a later part of our paper.

The preceding results of the action of Röntgen rays are very similar to, and wholly in accordance with, the results found by Mr. Erskine Murray, and described by him in a communication to the Royal Society of London, March 19, 1896.

They are analogous to those found for ultra-violet light by Righi (*Rend. R. Acc. dei Lincei*, 1888, 1889); Hallwachs (*Wiedemann's Annalen*, 34, 1888); Elster and Geitel (*Wiedemann's Annalen*, 38, 41, 1888); Branly (*Comptes rendus*, 1888, 1890), and others.

We have also made some experiments with ultra-violet light, in which this similarity is further brought out. The method we have employed is that of Righi.

A cage of brass wire gauze was made and connected to sheaths. Inside it the insulated metal was placed on a block of paraffin, and connected to the insulated terminal of the electrometer by a thin copper wire protected

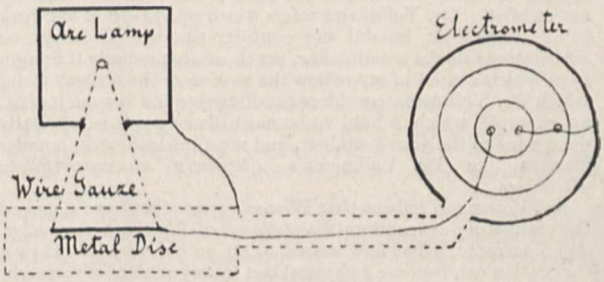


DIAGRAM 2.

against inductive effects. The light from an arc lamp was then shone through the gauze so as to fall on the insulated metal perpendicular to its surfaces (see Diagram 2).

The experiments were of the same nature as those with the Röntgen rays, except that wire gauze letting through the ultra-violet light was substituted for the non-perforated aluminium cylinder transparent to the Röntgen rays. The insulated metal disc was 2 cms. distant from the gauze of brass wire. The steady electrometer readings after the two pairs of quadrants were insulated and the ultra-violet light shining (which we shall hereafter refer to as the *ultra-violet-light-zero*) was observed.

The insulated metal was afterwards charged positively, and then negatively. The rate of discharge was observed till the ultra-violet-light-zero was reached.

With polished zinc as the insulated metal the following results were obtained.

The insulation was first tested. When no ultra-violet light was used it was found that the electrometer reading remained the same whether the two pairs of quadrants were in metallic connection or not. With the ultra-violet light shining the reading with the quadrants in metallic connection was the same as before, the readings with the quadrants disconnected were :—

January 14th, 3h. 41m. p.m.

− 25	sc. divs.	from	metallic zero	after 15 secs.
− 45	,,	,,	,,	30 ,,
− 59	,,	,,	,,	45 ,,
− 67	,,	,,	,,	1 min.
− 80	,,	,,	,,	1½ ,,
− 89	,,	,,	,,	2 ,,
− 99	,,	,,	,,	3 ,,
− 101	,,	,,	,,	4 ,,

Afterwards steady.

[Sensibility of electrometer, 140 sc. divs. per volt.]

The difference thus found, between the metallic zero and the ultra-violet-light-zero, is −101 or −0·72 of a volt.

3h. 47m. Zinc charged positively to 219 scale divisions from the metallic zero.

Reading from metallic zero with ultra-violet light shining.—

	Time.
+124	after 15 secs.
+ 64	,, 30 ,,
+ 23	,, 45 ,,
− 13	,, 1 min.
− 55	,, 1½ ,,
− 79	,, 2 ,,
− 93	,, 2½ ,,
−100	,, 3½ ,,
−103	,, 4 ,,

Afterwards steady.

3h. 55m. Zinc charged negatively to 238 scale divisions from metallic zero :—

−177	sc. divs.	from	metallic zero	after 15 secs.
−149	,,	,,	,,	30 ,,
−132	,,	,,	,,	45 ,,
−124	,,	,,	,,	1 min.
−113	,,	,,	,,	2 ,,
−111	,,	,,	,,	3 ,,

Afterwards steady.

The following table shows the steady potential differences in the electrometer due to the conductive effect of ultra-violet light in our apparatus between the brass wire gauze and plates of various other metals.

Insulated metal :—

Polished zinc	−0·75 of a volt.
Polished aluminium ...	−0·66 ,,
German silver	−0 19 ,,
Gilded brass	+0·04 ,,
Polished copper ...	+0·12 ,,
Oxidised copper ...	+1·02 ,,

The copper was oxidised by being held in a Bunsen flame.

In the case of polished zinc, polished aluminium, polished copper, and oxidised copper, both positive and negative charges were discharged at the same rate, if we reckon the charge of the insulated metal from its ultra-violet-light-zero. The rates of reaching the ultra-violet-light-zero were not observed for gilded brass and German silver.

It must again be noticed that our experiments do not tell us what would happen if an insulated metal, shone on by ultra-violet light, were surrounded by a metal of precisely the same quality of surface connected to sheaths.

So far we have mentioned only experiments in which the rays, whether Röntgen or ultra-violet, fell perpendicularly on the insulated metal. We have also made some experiments with the rays going parallel to the metal surfaces.

For this purpose a cardboard box 46 cms. long, 19 cms. square (see Diagram 3), lined, in the first instance, with tinfoil, connected to sheaths, was used. Inside this box an insulated disc of oxidised copper of 10 cms. diameter was supported in such a way as to allow of its being fixed at different distances from the tinfoil-coated end-wall of the box facing it.

The distance between the disc and the tinfoil was at first 4 cms. The arc lamp was distant about 20 cms. from the box. The light from it shone through a slit in the tinfoil covering the side of the box perpendicular to the surface of the oxidised copper. The slit was 4 cms. long, 1 cm. broad. Its length was first placed parallel to the copper surface, so that the light admitted by it shone in the space between the two metals in such a way as not to illuminate either directly. It was found (1) that the ultra-violet-light-zero did not deviate from the metallic zero when the sheet of light passed between the two metals ; (2) that a negative charge given to the insulated oxidised copper was not discharged ; and (3) that a positive charge was removed very slowly—about four scale divisions per minute from a charge of 197 scale divisions from the metallic zero.

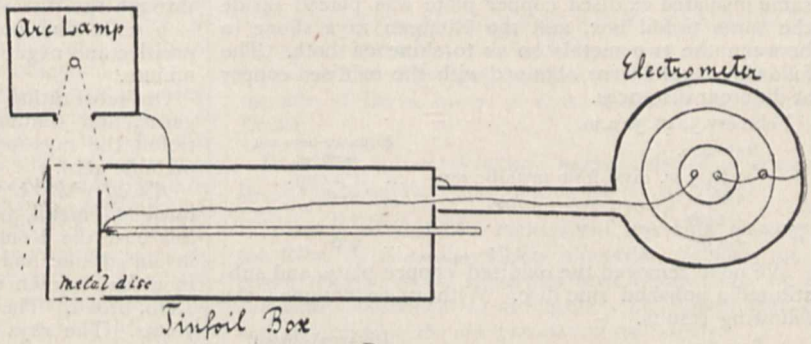


DIAGRAM 3.

When the length of the slit was placed perpendicular to the surface, so that a small portion of both metals, as well as the intervening air, was illuminated, it was found that the reading deviated about +1 scale division per minute from the metallic zero. The oxidised copper was charged positively ; and negatively. Discharge took place at about four scale divisions per minute, from a charge of +202 scale divisions ; and three scale divisions per minute from a charge of −246 scale divisions : the charge reckoned from the metallic zero in each case.

The slit was then so arranged as to allow the light to shine on the oxidised copper alone. In this case the deflection went towards an ultra-violet-light-zero at about +6 sc. divs. per minute ; and both positive and negative charges were discharged, the negative much more quickly than the positive.

The ultra-violet light was now shone between the oxidised copper and the disinsulated tinfoil wall opposite to it, parallel to their surfaces so as to illuminate both. The difference between the metallic zero and the ultra-violet-light-zero was found to depend on the distance between the two surfaces. This will be seen from the following table :—

Jan. 28.	Ultra-violet-light-zero.	Distance between surfaces.	Time required to come to steady reading.
12.20 p.m.	+150 {sc. divs. from metallic zero}	4·3 cms.	4 mins.
2.0 ,,	+134 ,, ,,	3·0 ,,	9 ,,
2.10 ,,	+121 ,, ,,	2·0 ,,	5 ,,
2.20 ,,	+102 ,, ,,	1·0 ,,	5 ,,
2.40 ,,	+ 86 ,, ,,	0·6 ,,	5 ,,
2.50 ,,	+169 ,, ,,	4·0 ,,	10 ,,
3.0 ,,	+161 ,, ,,	5·0 ,,	5 ,,
3.20 ,,	+199 ,, ,,	7·0 ,,	5 ,,

[Sensibility of electrometer 140 sc. divs. per volt.]

The fact that in experiments (2) and (6) a longer time was required before a steady reading was obtained, probably depended on the way the light fell on the surfaces and on variations in intensity of the light.

In this table we see that the steady electrometer reading (which we have called the ultra-violet-light-zero) is largely influenced by the distance between the plates, being greater the greater the distance. This is a very remarkable result. It was first discovered by Righi, and very clearly described in papers of his to which we have referred. It may be contrasted with the non-difference of electrometer readings for different distances between the plates in a volta-zinc-copper and single fluid cell.

Added February 6. [We have also made an exactly similar series of experiments with Röntgen rays. The same insulated oxidised copper plate was placed inside the same tinfoil box, and the Röntgen rays shone in between the two metals so as to shine on both. The following results were obtained with the oxidised copper at different distances.

February 5, 11.30 a.m.

Rays-zero.	Distance between surfaces.
+23·5 sc. divs. from metallic zero ...	1·2 cms.
+25·0 ,, ,, ,, ...	2·2 ,,
+23·0 ,, ,, ,, ...	3·8 ,,
+23·0 ,, ,, ,, ...	6·0 ,,

We next removed the oxidised copper plate, and substituted a polished zinc disc. With it we obtained the following results.

Rays-zero.	Distance between surfaces.
−82 sc. divs. from metallic zero ...	1 cm.
−79 ,, ,, ,, ...	1·5 ,,
−81 ,, ,, ,, ...	3·0 ,,
−90 ,, ,, ,, ...	7·0 ,,
−90 ,, ,, ,, ...	7·5 ,,

The steady reading of the rays-zero was very nearly reached in each case in about 15 secs., but the observation was continued for one or two minutes till we found the reading steady.

Thus we see that, as previously found by Mr. Erskine Murray, the rays-zero is independent, or nearly independent, of the distance between the opposed metallic surfaces.]

Towards realising the case of an insulated metal surrounded by metal of identical surface-quality connected to sheaths, we covered over the oxidised copper with tinfoil. The tinfoil wall facing it was very rough, and not so well polished. The insulated tinfoil was 4 cms. distant from the end of the box to which its surface was parallel.

When the ultra-violet light fell on the insulated metal alone through a slit, the ultra-violet-light-zero was + 53 scale divisions from the metallic zero. A charge given to it, whether positive or negative, was discharged slowly. After making these experiments, we again observed the difference of zeros, and found that now the ultra-violet-light reading was at the end of the first four minutes + 2 scale divisions from the metallic zero ; at the end of the next four minutes it was − 8 scale divisions from it.

When the ultra-violet light fell on the disinsulated metal and not on the insulated, the insulated when charged retained its charge.

With the light shining on both through a window 7 cms. broad, 13 cms. high, both positive and negative charges given to the insulated metal were discharged, and the ultra-violet-light-zero deviated from the metallic zero by − 152 scale divisions.

This difference was reduced to about − 30 scale divisions when the experiments were repeated after the apparatus had been left to itself for a night.

To make similar experiments with the Röntgen rays, it was found necessary to cover the window near the lamp with tinfoil gauze connected to sheaths, and the window on the opposite side was covered with non-perforated tinfoil. In this way direct electrostatic induction was avoided. We had also a thin sheet aluminium window between the tinfoil gauze and the Röntgen lamp.

When the Röntgen rays fell on both insulated and disinsulated metal the rays-zero was − 5 scale divisions from the metallic zero, and both positive and negative charges fell to this zero in a few seconds.

With the rays shining only on the insulated metal the same small difference of zeros was obtained, and both positive and negative charges fell to the rays-zero, though much more slowly than before—in about four minutes.

With the Röntgen rays shining on the insulated tinfoil through the disinsulated tinfoil gauze, the rays-zero was − 9 scale divisions from the metallic zero, and both positive and negative charges were removed in about a minute.

On substituting an aluminium gauze for the tinfoil gauze, and sending rays through it on the insulated tinfoil, the rays-zero was + 25 scale divisions from the metallic zero.

Added February 6. With a polished zinc disc as the insulated metal, and with the same windows to the tinfoil box, the Röntgen rays were shed in between the insulated zinc and the opposite wall of tinfoil from a slit in a lead screen outside. This slit was 4 cms. long by 1 cm. broad. The distance between the two metals was 7 cms. The rays illuminated only part of the air space between the two, and also a part of the tinfoil covering the two windows.

The following are some of the results obtained :—

[Sensibility of electrometer 140 sc. divs. per volt.]

February 5, 1897. Zinc charged negatively to 285 scale divisions from the metallic zero.

Reading from metallic zero with Röntgen lamp acting :—

	Time.
− 276 scale divisions ...	after 1 min.
− 265 ,, ...	,, 2 ,,
− 255 ,, ...	,, 3 ,,
− 243 ,, ...	,, 4 ,,
− 227 ,, ...	,, 5 ,,
− 214 ,, ...	,, 6 ,,
− 184 ,, ...	,, 8 ,,

Discharge still continued.

The zinc was then discharged by metallic connection. The readings, with the Röntgen light shining, and the two pairs of electrometer quadrants again disconnected, were :—

− 4 sc. divs. from metallic zero	after ½ min.
− 13 ,, ,, ,,	1½ ,,
− 41 ,, ,, ,,	2½ ,,
− 53·5 ,, ,, ,,	3½ ,,
− 61 ,, ,, ,,	4½ ,,
− 67 ,, ,, ,,	5½ ,,
− 70·5 ,, ,, ,,	6½ ,,
− 71·0 ,, ,, ,,	7 ,,

The difference between the rays-zero and the metallic zero is thus found to be − 71 sc. divs., or − 0·5 of a volt. Immediately after this experiment, we removed the lead window and allowed the Röntgen light to shine on both

metals, still 7 cms. apart. We then found the difference of zeros to be – 89 sc. divs., or – 0·64 of a volt; but instead of seven minutes, scarcely a quarter of a minute was taken to reach the rays-zero after the metallic connection was broken. These results are substantially in accordance with Erskine Murray's §§ 9 of his paper already referred to.

KELVIN.
J. C. BEATTIE.
SMOLUCHOWSKI DE SMOLAN.

THE EFFECT OF MAGNETISATION ON THE NATURE OF LIGHT EMITTED BY A SUBSTANCE.[1]

IN consequence of my measurements of Kerr's magneto-optical phenomena, the thought occurred to me whether the period of the light emitted by a flame might be altered when the flame was acted upon by magnetic force. It has turned out that such an action really occurs. I introduced into an oxyhydrogen flame, placed between the poles of a Ruhmkorff's electromagnet, a filament of asbestos soaked in common salt. The light of the flame was examined with a Rowland's grating. Whenever the circuit was closed both D lines were seen to widen.

Since one might attribute the widening to the known effects of the magnetic field upon the flame, which would cause an alteration in the density and temperature of the sodium vapour, I had resort to a method of experimentation which is much more free from objection.

Sodium was strongly heated in a tube of biscuit porcelain, such as Pringsheim used in his interesting investigations upon the radiations of gases. The tube was closed at both ends by plane parallel glass plates, whose effective area was 1 cm. The tube was placed horizontally between the poles, at right angles to the lines of force. The light of an arc lamp was sent through. The absorption spectrum showed both D lines. The tube was continuously rotated round its axis to avoid temperature variations. Excitation of the magnet caused immediate widening of the lines. It thus appears very probable that the period of sodium light is altered in the magnetic field. It is remarkable that Faraday, as early as 1862, had made the first recorded experiment in this direction, with the incomplete resources of that period, but with a negative result (Maxwell, "Collected Works," vol. ii. p. 790).

It has been already stated what, in general, was the origin of my own research on the magnetisation of the lines in the spectrum. The possibility of an alteration of period was first suggested to me by the consideration of the accelerating and retarding forces between the atoms and Maxwell's molecular vortices; later came an example suggested by Lord Kelvin, of the combination of a quickly rotating system and a double pendulum. However, a true explanation appears to me to be afforded by the theory of electric phenomena propounded by Prof. Lorentz.

In this theory, it is considered that, in all bodies, there occur small molecular elements charged with electricity, and that all electrical processes are to be referred to the equilibrium or motion of these "ions." It seems to me that in the magnetic field the forces directly acting on the ions suffice for the explanation of the phenomena.

Prof. Lorentz, to whom I communicated my idea, was good enough to show me how the motion of the ions might be calculated, and further suggested that if my application of the theory be correct there would follow these further consequences: that the light from the edges of the widened lines should be circularly polarised when the direction of vision lay along the lines of force; further, that the magnitude of the effect would lead to the determination of the ratio of the electric charge the ion bears to its mass. We may designate the ratio e/m. I have since found by means of a quarter-wave length plate and an analyser, that the edges of the magnetically-widened lines are really circularly polarised when the line of sight coincides in direction with the lines of force. An altogether rough measurement gives 10^7 as the order of magnitude of the ratio e/m when e is expressed in electromagnetic units.

On the contrary, if one looks at the flame in a direction at right angles to the lines of force, then the edges of the broadened sodium lines appear plane polarised, in accordance with theory. Thus there is here direct evidence of the existence of ions.

This investigation was conducted in the Physical Institute of Leyden University, and will shortly appear in the "Communications of the Leyden University."

I return my best thanks to Prof. K. Onnes for the interest he has shown in my work. P. ZEEMAN.

Amsterdam.

[1] Translated by Arthur Stanton from the *Proceedings* of the Physical Society of Berlin.

NOTES.

THE Council of the Royal Society have invited Prof. C. S. Sherrington, F.R.S., Professor of Physiology in University College, Liverpool, to deliver the Croonian Lecture on April 1, the subject being "The Spinal Cord and Reflex Actions."

TUESDAY'S *Gazette* contains the formal intimation that the dignity of a Baron of the United Kingdom has been granted to Sir Joseph Lister, Baronet, President of the Royal Society, by the title of Baron Lister, of Lyme Regis, in the county of Dorset.

PROF. DR. RUDOLF VIRCHOW has been elected president of the German Anthropological Society for the year 1897.

IT is expected that Prof. Barnard will attend the meeting of the Royal Astronomical Society to-morrow, February 12, to receive the gold medal which has been awarded him for his numerous contributions to astronomy. Sir Robert Ball has been nominated as the new president of the Society.

THE Council of the Royal Meteorological Society have arranged to hold, from March 16 to 19, in commemoration of the diamond jubilee of H.M. the Queen, an exhibition of meteorological instruments in use in 1837 and in 1897, and of diagrams, drawings, and photographs illustrative of the advances which have been made.

THE Government of the Colony of the Cape of Good Hope has undertaken an investigation of the marine fauna of the South African coast, with reference both to economic value and scientific interest. A small marine station will probably be erected on False Bay, and a suitable steam vessel of about 150 tons is now being built for this purpose. It is confidently hoped that results of some scientific value may be obtained from the exploration of this little-known coast, and more especially of the Agulhas Bank. We are requested to state that the services of specialists are invited to work up the material that may be procured, under the following arrangements. Specimens will be forwarded as procured, and, on receipt of manuscript and drawings, each piece of work will be published without delay in a uniform style, so as to form ultimately a complete record of the Cape marine fauna. Authors' copies will be forwarded as soon as published, and a certain circulation will be guaranteed. No money remuneration is offered, but duplicate specimens may be retained by the authors. Unique specimens it is intended to be handed over to the South African Museum in Cape Town. Further information will be supplied to those interested in th work, on application to J. D. F. Gilchrist, Marine Biologist to Cape Government Agricultural Department, Cape Town.

ON Wednesday evening, February 3, the Leathersellers' Company entertained at a Court dinner a considerable number of representatives of the colonies and dependencies of the empire, including Sir Donald Smith (High Commissioner for Canada), Sir Saul Samuel (Agent-General for New South Wales), and many others. The company also included many of the scientific friends of the Master, Dr. W. H. Perkin, F.R.S., himself one of the foremost of British chemists, and popularly known as the discoverer of "mauve," the first of the colours derived from coal-tar. The Leathersellers' Company, like others of the great guilds of London, are now devoting part of their revenues to promoting scientific education with a view especially to its application to industrial pursuits; and, recognising the importance not only of elementary instruction, but the cultivation of the highest branches of scientific work, they have recently established a research scholarship, of the value of £150 a year, in connection with the Central Technical College of the City and Guilds of London Institute (see p. 332).

THE late M. James Lloyd, of Nantes, author of the "Flore de l'Ouest de la France," who died in May last, has bequeathed his fortune and his collections to the town of Angers. The latter consist chiefly of a herbarium and a botanical library, which are to be housed in a special building, and funds are left for their maintenance, and for the payment of a curator, who is to be selected by the Mayor of Angers from a list of three candidates to be nominated by the President of the Botanical Society of France. The names of candidates are to be sent to the President of the Society, 84 Rue de Grenelle, Paris, by March 15, and the post is to be conferred "en dehors de toute considération de grades universitaires," on "un botaniste humble, ami de la nature, voué au progrès de la science que j'ai aimée et cultivée.".

THE Vienna Academy of Sciences has (says the *Lancet*) employed a portion of the Treitl Fund in sending a commission, composed of Dr. Hermann Müller, Dr. Ghon, Dr. Albrecht, and Dr. Pöch, to investigate the nature of the bubonic disease now prevailing in India. The members of the expedition have just left Trieste, and will remain at Bombay for three or four months. The Treitl Fund is so called after the late Herr Treitl, a Vienna citizen, who bequeathed to the Academy all his fortune, amounting to about £100,000.

IN view of the increasing interest now being taken in the subject of aerial navigation, it has been decided to endeavour to place the Aeronautical Society on a more useful footing. The Council propose, should sufficient support be given, to greatly increase the scope of the Society; to issue a journal at least quarterly, containing not only reports of meetings of the Society, but original articles, reprints, and records of all that is going on at home and abroad in the subject of aeronautics, and all news likely to be of interest to members; to hold frequent meetings for the reading and discussion of papers and exhibition of models; to collect a library of books and periodicals for reference of members; and, if possible, to procure the use of a room as library and museum. The Hon. Secretary of the Society is Captain B. Baden-Powell.

WE regret to announce the deaths of the following men of science:—Heinrich Gätke, the ornithologist, whose observations on bird-migration for fifty years are published in his "Heligoland as an Ornithological Observatory"; Prof. Franz Baur, professor of forestry in Munich University; Dr. August Streng, professor of mineralogy in the University of Giessen; Dr. E. A. B. Lundgren, professor of geology in the University of Lund; A. A. van Bemmelen, director of the Zoological Gardens at Rotterdam, and for many years president of the Netherlands Zoological Society; Dr. Hermann v. Nördlinger, formerly professor of forestry in the University of Tübingen; Dr. Salvatore Trinchese, professor of comparative anatomy and comparative embryology in the University of Naples, and the author of many valuable works in general biology; and Galileo Ferraris, the well-known electrician, of Turin.

FIFTY years spent in scientific investigation is a period worth commemorating. We therefore offer our congratulations to Dr. H. C. Sorby, F.R.S., upon the attainment of his jubilee as contributor to the advancement of natural knowledge. From the *Sheffield Daily Telegraph* we learn that a few evenings ago Dr. Sorby inaugurated his year of office, as President of the Sheffield Literary and Philosophical Society, by giving an address upon a half-a-century spent in scientific work. In this interval he has published more than one hundred papers, which have made for the progress of science. His first papers were on animal and vegetable chemistry; the earliest being published in 1847. Very soon afterwards his attention was specially directed to the structures produced by currents during the deposition of stratified rocks, and to the conclusions to be derived from them. In 1849 he prepared what were the first transparent microscopical sections of rocks, and his first paper on thin microscopical structures was published in 1850, in which most of the modern methods were first adopted. That was followed by numerous papers on the structure of rocks and minerals, or on chemical or physical questions connected with them. From the study of the microscopical structure of rocks, he was led to that of meteorites and meteoric iron. In order to throw light on that subject he commenced, in 1842, the microscopical study of iron and steel by new methods and new illuminators. In order to assist in the study of meteorites, Dr. Sorby invented, in 1865, the direct-vision spectrum microscope, and various accessory apparatus. The application of those instruments led to the study of the colouring matters of animals, plants and minerals, and to the publication of about forty papers connected with almost every department of science. Dr. Sorby has also advanced many other branches of knowledge, his researches on marine organisms, and in connection with the archæology of natural history, being especially noteworthy. Nearly thirty years back the value of his work was recognised by the presentation of the Wollaston gold medal from the Geological Society. A quarter of a century ago the Dutch Academy of Sciences made him the first recipient of the Boerhaave gold medal, which is only awarded once in twenty years. Two years afterwards—in 1874—the Royal Society awarded him a Royal medal. Then followed the honorary degree of LL.D., conferred upon him by Oxford University. Dr. Sorby's services to science have thus been recognised by various authorities, and we trust he may still live long to add to the researches which have enriched the storehouse of knowledge.

THE annual general meeting of the Society for the Protection of Birds will be held on Tuesday, February 23, at the Westminster Palace Hotel. The Earl of Stamford will occupy the chair.

THE *Weekly Weather Report*, issued by the Meteorological Office, states that for the week ending the 6th inst. the rainfall was much in excess of the mean over England and the south of Ireland, the fall being in most cases three and four times as great as the average value. Over Scotland and the north of Ireland the amount was less than normal. In most parts of England the rainfall since the beginning of the year is about an inch above the average, while in the north and west of Scotland the deficiency is about four inches.

THE *Rendiconti del Reale Istituto Lombardo* announces the award of the following prizes:—One of the five Cagnola prizes of 2500 lire, and a gold medal, of value 500 lire, to Dr. Andrea

Giulio Rossi, of Padua, for his essay on methods of registering the phases of two alternating currents. The Brambilla prize of 1500 lire and a gold medal are awarded to Prof. Carlo Figini, for his improvements in the weaving industry; and rewards, of 500 lire each, to Signor Sala Salvatore and Signor Scartazzi Antonio. The Fossati prize of 2000 lire is awarded to Prof. Angelo Mosso, of Turin, for his essay on the temperature of the brain. For the Tommasoni prize for an account of the life of Leonardo da Vinci, rewards of 1000 lire each have been awarded to Signor Nino Smiraglia Scognamiglio and Prof. G. B. De Toni. A number of other prizes have been unawarded.

FOR the coming year, the Reale Istituto Lombardo offers the following prizes, which are open to competitors of all nationalities, on condition that the essays are written in Italian, French, or Latin. The prize of the Institution of 1200 lire, for experiments confirming Maxwell's theory of dielectric stresses; six Cagnola prizes of 2500 lire, each accompanied by a gold medal of 500 lire, for essays on various selected subjects, mostly medical; one Brambilla prize, for improvements in some industry in Lombardy; one Secco-Comneno prize of 864 lire, for an essay on uræmia; and prizes founded by the brothers Giacomo and Filippo Ciani, for popular Italian literary works. A number of other prizes are also announced in the *Rendiconti* of the Institution, both for competition in 1897 and later years; but many of these are exclusively open to Italians. A full account of the conditions attaching to the various competitions is given in the journal in question.

AT the ninth annual meeting of the American Physiological Society, held in Boston and Cambridge, December 29 and 30, 1896, Prof. W. H. Howell proposed the following resolution regarding the work of the late Prof. H. Newell Martin :—"The members of the American Physiological Society have heard with profound regret of the death of Prof. H. Newell Martin. In commemoration of his distinguished services, the Society adopts and places upon its official record the following expression of its appreciation and esteem. In the death of Prof. Martin, the Society has lost a member to whom it owes an especial debt of gratitude. He was actively concerned in its foundation and organisation, and during the critical period of its early history he gave much time and thought to its interests. He served for six years as its secretary and treasurer, and strove always with enthusiasm to make a successful beginning of an enterprise which he believed would foster the spirit of scientific research in physiology, and bring its active workers into stimulating fellowship. For its present prosperous condition, and its prospects of future usefulness, the Society feels that it is largely indebted to his wisdom and energy. In a broader field his influence upon the science of physiology has been deeply felt. His own splendid contributions to experimental physiology will have an enduring value, while the stimulus given by him to others has been, and will continue to be, an influential factor in the development of physiological instruction and research in this country. As an investigator and teacher he was distinguished, not only by his originality and ability, but by many noble traits of character. His modesty, his genuine interest in all kinds of biological work, his steady insistence upon the highest ideals of scientific inquiry, his chivalrous conception of the credit due to his fellow-workers, and the generous sympathy and affection always felt and shown by him for the work of younger investigators, are some of the qualities which will endear his memory to those who were so fortunate as to be brought into intimate association with him as teacher or as friend." Prof. H. P. Bowditch, in seconding the resolution, said :—"Probably few of the younger members of the Society are aware of the great debt which we owe to Dr. Martin for establishing the high standard which the Society has always maintained with regard to the qualifications of the members. It was always Dr. Martin's contention that a candidate for admission to our ranks should be required to demonstrate his power to enlarge the bounds of our chosen science, and not merely to display an interest in the subject and an ability to teach text-book physiology to medical students. To his wise counsel in this matter the present prosperity of the Society is, I think, largely to be attributed. I trust that the resolution will be adopted, and placed upon the records of the Society." The resolution was unanimously adopted.

THE manna sent to the Israelites on their journey out of Egypt to the Holy Land is regarded as identical with an edible lichen in Kerner and Oliver's "Natural History of Plants"; and the older view that it was the sap of a tamarisk, exuded under the influence of a parasite, is held to be without foundation. Mr. M. J. Teesdale reviews the subject in the February number of *Science Gossip*, and the evidence he brings forward is opposed to the conclusion to which reference has been made. He shows that an exudation from the twigs of the tamarisk (*Tamarix gallica*) has more points of resemblance with the manna of the Israelites than either the edible lichen or the sweet gums exuded by leguminous shrubs, such as *Alhagi maurorum* or *A. desertorum*—both known to the Arabs as camel's-thorn.

HERR K. RODER gives, in a dissertation presented for a Leipzig degree, the results of an investigation as to the polar limit of true forest-land, as distinguished from tundra. The boundary line reaches its highest latitude in the old world in the Taimyr peninsula (72½° N.), runs eastward to the Tschuktschee peninsula, and there bends rapidly to the southward. On the west coast of America it begins near the Arctic circle, and goes gradually northwards to the Mackenzie delta, where it attains its highest latitude in about 69° N. The most southerly point is in 57° N. lat., on the East Main River, and from thence the limit crosses Labrador, Greenland and Iceland, in a direction trending towards the North Cape.

WE have received the third of the *Arbeiten aus dem Geographischen Institut der Universität Bern*, edited by Prof. Brückner, consisting of an exhaustive discussion, by Dr. Hermann Walser, of the surface changes which have taken place in the canton of Zürich since the middle of the seventeenth century. Dr. Walser takes, as his starting point, the topographical map of J. C. Gyger, published in 1667, and traces the subsequent topographical history of the district by reference to an immense number of papers and maps to the present time. He finds that geological and human agencies have combined during the last 240 years to greatly diminish the number and size of lakes in the canton, that the amount of deforestation has been trifling, and that the area occupied by vineyards has steadily increased.

THE spell of warm weather in the United States, from July 28 to August last, is stated by Prof. H. A. Hazen, in the *Monthly Weather Review*, to have covered a larger area, and given abnormally high temperatures for a greater number of consecutive days than ever before recorded.

A SOLAR halo, with two mock-suns, and a rainbow overhead, was seen by Mr. J. W. Scholes, Huddersfield, at about 12.30 p.m. on January 29. The mock-suns and the rainbow only lasted a few minutes, but the white solar halo remained visible for nearly half an hour.

IT will be remembered that, some years ago, experiments on rain-making were carried on in Texas. In a short *brochure*, Dr. W. Hentschel suggests a plan of artificially producing rain, based on the well-known effects of statical electricity in promoting the formation of drops. The suggestion is to

reverse Franklin's historic kite experiment, and instead of drawing electricity from the clouds, to electrify a balloon by means of a conducting cable connected with a dynamo. In this way, the writer maintains, the rainfall can be increased, or, possibly, even decreased, at pleasure.

IN an article entitled "Fog Possibilities," Mr. A. McAdie, in *Harper's Monthly Magazine* for January, refers to the possibility of dispelling fog from crowded thoroughfares. The experiments of Aitken and others have shown the close relationship between fog, cloud, or haze, and the number of dust particles in the air. If we can remove the dust from the air, we remove the nuclei of condensation. Dr. Lodge has pointed out various methods by which this can be effected in laboratory experiments, the most successful of which is electrification. The author considers that by this means the fog can probably be dissipated and the air clarified. The supply of fog may be such that there would be little appreciable diminution, but as a rule the fog is localised and has well-marked limits.

AN important series of experiments on the absorption of ultra-violet light by crystals, has been conducted at Geneva by M. V. Agafonoff, of St. Petersburg (*Archives des Sciences physiques et naturelles*, iv. 2). Among the 100 different crystalline substances observed, only two were found to exhibit differences of absorption according to the direction of polarisation of the light; these were tourmaline and hemimellitic acid, which gave different absorption spectra for the ordinary and extraordinary rays of a doubly-refracting prism. Isolated absorption bands are rare, and were only found in the seven following substances: sulphate of magnesium, sulphate of ammonium and nickel, ammoniacal alum, nitrate of nickel, nitrate of potassium, dithionate of barium, and anthraquinone. The thickness of the section seems to have very little influence on the limit of wave-length at which absorption commences. The powerful absorption of organic, as compared with inorganic compounds, suggests that highly complex molecules are more absorbent of ultra-violet light than simple molecules; and, if this be the case, the property may afford a test of the relative complexity of different compounds.

FROM Mr. William Barlow we have received a reprint of his important communication to the *Mineralogical Magazine*, entitled "On Homogeneous Structures and the Symmetrical Partitioning of them, with Application to Crystals." The author gives a new definition of homogeneous structure, and describes a method of realising, in a concrete form, the kind of repetition in space which constitutes homogeneity of structure. The total number of types, all of which can be represented in this way, is 230, this being the number of typical point systems described by Federow and Schönflies, derived by their extension of Sohncke's methods. These all fall into the thirty-two classes of crystalline symmetry. The author gives reasons for rejecting Fedorow's arguments in support of his recent attempt to select from among the types of homogeneous structure those which are possible for crystals, and he shows the possibility of so classifying all the conceivable ways of symmetrically partitioning all the types of homogeneous structure as to avoid all reference to the nature of the cell faces. Among the reasons for undertaking this classification, the chief one is the relation of symmetrical partitioning to certain stereo-chemical and other facts.

THE latest evidence as to the occurrence of Man in the Glacial Period has just appeared in the *American Geologist* (vol. xviii. p. 302), where Dr. E. W. Claypole records the finding of a grooved stone axe at a depth of 22 feet in the drift of North-central Ohio. The axe, which was partially imbedded in boulder clay, lay in a bed of coarse gravel 1 foot in thickness; above this was a bed of silt, 13 feet in thickness, and very tough below; interbedded in this were streaks of sand; finally, there were superimposed 8 feet of clay. Dr. Claypole regards these beds as having been "the deposits of the torrents of water and the still pools which characterise the flow from the front of a glacier in a flat country"; he supports his statement by a description of the district, and he also enters into the *bonâ fides* of the discoverer of the implement. The axe was made of a hard, banded green slate, but it was oxidised throughout, owing to the sulphureous character of the water in the gravel; the concentric lines of colour (limonite stains), parallel to the contour of the implement, prove that the change has taken place since it was fashioned by its Neolithic maker, and the rotten state of the stone shows that it must have been imbedded in the gravel for a very long time. It is always a difficult matter to sift the evidence of such finds, but this one appears to be worthy of the critical examination of American geologists and archæologists.

FOSSIL bones of the Pleistocene age have been brought to the Academy of Sciences of Philadelphia from Port Kennedy, Montgomery County, Pa. The fossil deposit seems almost unlimited; and while it contains no complete skeletons, it is, in many respects, the richest ever discovered. Bones form fully one-third of the material in the giant fissure, but most of them are so crushed and distorted as to be of no value. About forty distinct varieties of animals have been found in the mass.

PRESIDENT DAVID S. JORDAN, of Leland Stanford Junior University, Commissioner to investigate the condition of the fur seal, recommends, in his report to the Secretary of the Treasury, that the open season for the killing of females be abolished, to keep the Pribilof herd intact. He estimates the number of seals killed last summer as 440.000. About 27,000 pups died of starvation, and pelagic sealing caused the death of about 30,000. Since pelagic sealing began, more than 600,000 fur seals have been taken in the North Pacific and in Bering Sea, taking into account only those whose skins were brought to market. Many more were shot or speared, and lost. The number reported means the death of 400,000 females, the starving of 300,000 pups, and the destruction of 400,000 pups unborn.

THE January number of the *Quarterly Journal of Microscopical Science* contains only two memoirs, both of which are more than usually suggestive and interesting. Miss Lily Huie describes the results of a very precise and systematic investigation of the changes which take place in the protoplasm and nucleus of the gland-cells in the tentacles of the sun-dew *Drosera rotundifolia*, after the feeding of the leaf with pieces of white of egg. The first effect of the contact of the food appears to be the discharge of secretion from the gland cells. The secretion is formed at the expense of the basophile cytoplasm, which is stained by alkaline stains. The nucleus produces new cytoplasm of the same kind, by absorbing nutriment, converting it, and then "excreting" it. In this process the nuclear chromation takes the form of V-shaped chromosomes, and the nucleolus grows smaller and almost disappears. The nuclear chromation increases in bulk. Thus the changes which occur resemble those to which so much attention has been directed in mitosis or the division of the cell, and the conclusion is drawn that these changes indicate great activity in the nuclear organs, and are not exclusively characteristic of cell-division.

THE second paper in the January *Q. J. M. S.* is by Messrs. J. T. Wilson and J. P. Hill, of the University of Sydney, New South Wales, on the development and succession of the teeth in the marsupial *Perameles*, and in other marsupials. It is well known that only one tooth, the last of the premolars, is observed to be shed and replaced by a successor in

these mammals; and the view once generally accepted was that the other teeth corresponded not to the milk-teeth, but to the permanent teeth of higher mammals. The absence of milk-teeth, with the one exception, in marsupials has been regarded as indicating, not that they have disappeared in the evolution of these animals, but that they first arose in the later evolution of the higher mammals. Other views, however, have been maintained, namely, on the one hand, that the temporary dentition has been lost by the marsupials; and, on the other hand, that the existing anterior teeth are in reality milk-teeth whose successors have ceased to appear. Certain traces of teeth in the jaws of the embryo, precursors of the permanent teeth, have been explained as "prelacteal teeth" by those who advocate the latter view. In this memoir the authors claim to have proved that there is a complete series of these prelacteal teeth or their papillæ, and that they in reality represent the series of milk-teeth in the higher mammals. Thus the peculiarity of the marsupial dentition is that the temporary or milk teeth have become, with the exception of the last premolar, rudimentary, and the permanent teeth are completely developed before the young animal is weaned.

THE Johns Hopkins University Press, Baltimore, publishes a somewhat bulky "History of the Tobacco Industry in Virginia from 1860–1894," by Dr. B. W. Arnold.

DR. V. FATIO has sent us a copy of his guide to the hunting and fishing collection in the Swiss National Exposition of 1896. The volume contains some interesting information on the fishes of Switzerland.

BY the not very happy term "phenological," recent botanical writers speak of phenomena connected with the flowering of plants and other seasonal characters. The American botanist, Prof. L. H. Bailey, sends us a useful paper of "Instructions for taking Phenological Observations."

IN the concluding part of Dr. Bokorny's paper in the *Biologisches Centralblatt*, on the nutrition of green plants, he sums up in favour of the view that the first product of assimilation in green plants is formic aldehyde, from which are afterwards formed either albuminoids by the action of ammonia, or carbohydrates by condensation. Green fresh-water organisms play a very important part in the purification of running water by the oxidation of organic substances in suspension.

THE first number of vol. iv. of the *Bulletin* of the Laboratories of Natural History of the State University of Iowa contains papers about equally distributed between zoology and phytology:—On Plymouth hydroids, by C. C. Nutting; on the mollusks and brachiopods of the Bahama Expedition, by W. H. Dall; on the hymenoptera of the Bahama Expedition, by W. H. Ashmead; on the puff-balls of Eastern Iowa, by T. H. Macbride and Norra Allen; on new species of tropical fungi, by J. B. Ellis and P. M. Everhart; and others.

PROVINCIAL museums are following the lead of the National History Museum in issuing interesting and instructive handbooks on their collections, instead of mere catalogues of specimens. An admirable handbook of this character, referring to the mineralogical and geological sections of the Royal Museum of the County Borough of Salford, has been prepared by Mr. Herbert Bolton, who also re-arranged and named the collections. His little guide will arouse the interest of casual visitors, and will also greatly aid and encourage the study of geology.

A GENERAL meeting of the members of the Federated Institution of Mining Engineers will be held on Wednesday, February 17, at Manchester. The following papers will be read, or taken as read:—Railway nationalisation in relation to the coal trade, by Mr. A. Clement Edwards; the cost and efficiency of safety explosives as compared with gunpowder, by Mr. Henry Hall; description of various types of ropeways, and remarks as to their proper selection, by Mr. W. Carrington; determination of fire-damp in French collieries, by Mr. J. Coquillion; appliances for winding water, by Mr. Wm. Galloway; the detection and estimation of carbon monoxide in air by the flame-cap test, by Prof. F. Clowes; the Lake Superior iron ore region, by Mr. Horace V. Winchell.

THE January number of *Himmel und Erde* is devoted to several articles of general interest. Dr. Hecker, of Potsdam, describes how the small movements of the earth's surface are detected and measured. Two diagrams show clearly the details and general construction of the horizontal-pendulum, the instrument invented by von Rebeur-Paschwitz; while the reproductions from the actual photographic records explain for themselves the continual state of vibrations that is always occurring, and the occasional disturbances of larger amount. Dr. Zenker describes the extraordinary cold climate of Werchojansk (Siberia). The temperatures for each month, as obtained from the mean values up to the present time, are in degrees Centigrade—

Jan.	Feb.	March.	April.	May.	June.
−51·1	−45·8	−33·3	−13·6	2·0	12·6
July.	Aug.	Sept.	Oct.	Nov.	Dec.
15·6	10.2	2·6	−14·8	−39·8	−48·0

Prof. Dr. Fritz Frech concludes his series of articles on "Coral-reefs, and their share in the structure of the Earth's Crust." This series, we may remark, has been illustrated very profusely. "Eine Kulturbewegung in der Naturwissenschaft" is the title of a more brief article by Dr. Hallervorden, in Königsberg. In his concluding sentences he asks, "Why has Kant been forgotten? Ihn, den Schöpfer sittlicher Personlichkeit! Why has his house in Königsberg been long ago destroyed? Was it not like Goethe's, a relic of the nation—the nation?—of mankind, I ought to have said."

THE Zi-ka-wei Observatory, near Shanghai, has published a discussion of the disastrous typhoon which occurred in the Eastern Seas between July 22–25, 1896, in which the German gunboat *Iltis* was lost in the neighbourhood of the south-east Shantung promontory. This storm had first passed in the immediate neighbourhood of Shanghai, and the Rev. L. Froc has been able to collate a large amount of observations, both from ships which rode through the typhoon, and from land stations, which plainly show the extent and behaviour of the disturbance; and he has accompanied these observations with remarks which will be of practical use for the guidance of navigators. The storm took an unusual track, but was otherwise of regular constitution; the wind attained hurricane force, which was continued at some places for at least twelve hours. It is satisfactory to note that warning of its approach was given both by the Manila and Hong Kong Observatories, and that consequently two vessels, the *Pekin* and the *Yarra*, remained in port at Shanghai, and thereby in all probability avoided serious damage. We may mention that Dr. Doberck has also published an independent account of this storm in the *Hong Kong Government Gazette*.

THE additions to the Zoological Society's Gardens during the past week include a Patas Monkey (*Cercopithecus patas*) from West Africa, presented by Mr. A. F. Breysig; a Bonnet Monkey (*Macacus sinicus*, ♀) from India, presented by Mr. E. James; an Egyptian Monitor (*Varanus niloticus*) from the Transvaal, presented by Mr. D. E. Erasmus; a Red-eyed Ground Finch (*Pipilo erythropthalmus*) from North America, deposited; a Tantalus Monkey (*Cercopithecus tantalus*, ♀?) from West Africa, a Black-headed Lemur (*Lemur brunneus*, ♂) from Madagascar, purchased.

OUR ASTRONOMICAL COLUMN.

THE PERIOD OF ROTATION OF JUPITER'S SPOTS.—Herr A. A. Nyland communicates to *Astronomischen Nachrichten* (No. 3401) his observations of Jupiter's markings, made at Utrecht with a refractor of 26 cm., and of focal length 320 cm. The object he had in view was to determine the period of rotation of this planet in different Jovian latitudes, and to accomplish this he observed the transits of eleven different spots across the smaller axis of the planet's disc. The results, as regards two spots, *a* and *b*, is given in the following tables, in which the second column shows the number of rotations, and the third the time of rotation.

Spot a.

1895-6.	No. Rotations.	Period of Rotation. h. m. s.
Nov. 23—Dec. 10	41	9 55 23·7
Dec. 10—Feb. 11	152	32·0
Feb. 11—Mar. 10	68	35·5
Mar. 10—Apr. 25	111	32·1

Spot b.

1895-6.	No. Rotations.	Period of Rotation. h. m. s.
Nov. 18—Dec. 22	82	9 55 28·5
Dec. 22—Feb. 8	116	34·6
Feb. 8—Mar. 13	82	34·7
Mar. 13—Apr. 25	104	38·2

It will be noticed that the spot *b* appeared to have a longer period of rotation than *a*, the former transiting after the latter according to the formula

1h. 45m. 1s. + 7·2s. × (*t* − 1. Jan. 1896 in days).

Observations of the "red spot" gave no indications of a diminution in the time of rotation. In the case of the other spots, it was found that they were too variable in their nature for such a determination to be made, as some split up into two and sometimes three parts, while others varied in their brilliancy and became hard to identify.

THE SPECTRUM OF ζ PUPPIS.—A Harvard College Observatory Circular (No. 16) contains some additional information to that which we gave in this column on November 26 of last year, concerning the spectrum of the star ζ Puppis. It was at first suggested that the second series of rhythmical lines was due to some unknown element, but it has now been concluded that such is not the case. A further investigation has shown that this series is very closely allied to that of hydrogen, and is probably due to that substance under conditions of temperature or pressure as yet unknown. A slightly modified form of Balmer's formula, namely,

$$\lambda = 3646{\cdot}1 \frac{n^2}{n^2 - 16}$$

gives the wave-lengths of the lines of hydrogen if for *n* the even integers 6, 8, 10, 12, &c., be substituted. If in this formula the odd integers 5, 7, 9, 11, &c., be inserted for *n*, then the wave-lengths represent the second series of lines in ζ Puppis. The following brief table shows in the first column the value of *n*, in the second the computed wave-lengths by the above formula, and in the third the mean of two series of measured values.

n	Computed.	Observed Mean.
5	10128·1	—
7	5413·9	—
9	4543·6	—
11	4201·7	4200·4
13	4027·4	4026·8
15	3925·2	3924·8
17	3859·8	3858·7
19	3815·2	3815·9
21	3783·4	3783·4

Comparing the spectrum of ζ Puppis with other stellar spectra, the four lines between Hγ and Hδ have probable wave-lengths of 4472, 4544, 4633, and 4688. The first is a prominent Orion star line, while the second is well-marked, and is the line computed above when *n* = 9. All these four lines appear in 29 Canis Majoris, and three lines of the above series are measurable in the photograph of this star.

THE SPECTROSCOPIC BINARY α^1 GEMINORUM.—In the current January number of the *Astrophysical Journal*, Herrn. A. Belopolsky gives the results of his investigation of thirty-two spectrograms which he has obtained of the binary star α^1 Geminorum. This star required one hour's exposure, and a comparison with the spectrum of hydrogen was photographed at half-time. Using all the available data, Herrn. Belopolsky determined a series of values for the velocity in the line of sight, and after correction for the sun, found a periodic change, having a period of about 2·9 to 3·0 days. In the table which he gives, showing the velocity relative to the sun, he found that the curve of velocities satisfied either the first nine points (taken in January and February of 1896), with the exception of the eighth or the remaining twenty-four points, and that a single curve could not be drawn that would satisfy all the observations. This discrepancy, he remarks, suggested that the 2·91 days' period could not be used throughout the whole time covered by the observations. Applying a correction to the abscissæ for these dates, and drawing a fresh curve, he computed another series of velocities from the new elements. Even then slight discrepancies existed for these points, which, as he says, "cannot be explained with certainty at present." A possible cause is suggested in the rapid motion of the line of apsides in the direction of the orbital motion of the star, as was shown in Duner's analogous investigation of γ Cygni, in which a disturbing force, due to a flattening of the central body, exists.

NANSEN'S ARCTIC EXPEDITION.

A MEETING of the Royal Geographical Society was held on the evening of Monday, February 8, in the Albert Hall, when Dr. Fridtjof Nansen gave an account of the preliminary results of his great drift-journey in the *Fram* across the Polar area, and his sledge expedition northward. The Prince of Wales, the Duke and Duchess of York, and almost all the veteran British Arctic officers were present, while the great hall was crowded with the Fellows of the Society and their friends. Selections of Norwegian national music were played on the organ as the audience was arriving, and the appearance of Dr. Nansen and his companion, Lieut. Scott Hansen, on the platform was received with the greatest enthusiasm. Sir Clements Markham, K.C.B., F.R.S., President of the Society, introduced Dr. Nansen in a few words, and the explorer then addressed the meeting. During the address a large selection of photographs was shown by the lantern on a 40-foot screen; some of the pictures were taken by moonlight during the Arctic winter, and were extremely impressive, others were coloured reproductions of Dr. Nansen's sketches, including some fine sunset and aurora effects. Admiral Sir Leopold McClintock proposed, and Admiral Sir George Nares seconded, a vote of thanks for the address, in which they expressed their unqualified admiration of the manner in which Dr. Nansen had conducted his unique expedition. The Prince of Wales, as Vice-Patron of the Royal Geographical Society, then presented Dr. Nansen with the special gold medal of the Society, bearing the bust of the recipient on one side, and a representation of the *Fram* on the other. A copy of the medal in silver was presented to Lieut. Scott Hansen, and copies will be sent to the other members of the scientific staff of the *Fram*, while bronze replicas are given to the other members of the expedition. In thanking the Society for the medal, Dr. Nansen said that he had succeeded only by following the labours of his predecessors, the British Arctic officers, for whose heroism and resourcefulness he had the highest respect and admiration.

A large part of the address was necessarily occupied by describing the incidents of the journey already published in NATURE (vol. liv. p. 374). The following is a summary of the preliminary scientific results obtained by Dr. Nansen, and referred to during his address:—

Our expedition was intended to be purely a sea-expedition, the object of which was to drift with the drift-ice and keep clear of all land, so that we thought ourselves fortunate in avoiding the discovery of any extensive land. After passing through the Kara Sea the *Fram* skirted the north of Asia from the east of the Yenesei estuary to longitude 115° E. near the mouth of the Olenek. Off the western Taimyr peninsula an archipelago of small islands was encountered, through which it was difficult to find a passage; these I have named Nordenskiöld Islands, after

the man who showed us the way along the coast of Asia. It is difficult to distinguish mainland from island in passing along the coast, the map of which has been considerably altered by the observations on our voyage. The coast of the whole of the Chelyuskin peninsula northwards is very low, but inland we observed mountain ridges partly covered with snow, and probably some small glaciers. Without doubt the most important geographical discovery of the expedition was that concerning the polar basin itself. Formerly it had been supposed to be a comparatively shallow sea, a view in which I had concurred. We found that the sea in 79° N., north of the new Siberian Islands, suddenly became deeper than 100 fathoms, sank to depths of 1800 to 2000 fathoms, and such great depths were found continuously by the *Fram* during her entire drift north-west and west as far as the north of Spitzbergen. The polar basin thus appears to be a deep sea, forming a continuation northwards and eastwards of the depression in the North Atlantic Ocean. This deep sea probably extends further east than the New Siberian islands, as the *Jeannette* found the depth increasing every time the drift carried her to the northward.

I think we can safely say that little or no land can lie on the Asiatic side of the pole, as in the sledge-journey north of the *Fram's* route we found the ice drifting with greater freedom than further south, which would not likely be the case if there was much land to restrict the movement. There is, on the other hand, a probability of the existence of land to a considerable extent on the American side of the pole, where islands, and islands of some importance, may be expected to be found north of the boundary known at present. A closer examination of these parts we must hope will be undertaken in the not too distant future.

The drift of the *Fram* showed that a deep sea lay along the north of Franz Josef Land, proving that that land has not the great extension northward which it was hoped to have. This discovery confirms Sir Clements Markham's prediction that "Franz Josef Land seems to be part of the Spitzbergen group, rising out of the same shallow sea, with deeper water to the north." The geological evidence confirms this view, and in those parts which Johansen and I would have visited had we not fallen in with Jackson; the Jackson-Harmsworth expedition will no doubt have many interesting discoveries to make. From the disagreement of our discoveries with Payer's map, we were at first led to believe that our watches must be altogether wrong, and that we had come to a land further west; it was only after comparing our watches with Jackson's, that I came to the conclusion that Payer's map was wrong. Dr. Copeland is now engaged in re-calculating Payer's positions, and finds his work particularly good; the error most probably arose through his mistaking banks of mist on which the sun was shining for a great glacier-covered land. Such a mistake is very difficult to avoid in certain atmospheric conditions.

In the course of the voyage along the coast of Siberia abundant evidence of the former existence of a great ice-sheet was forthcoming, and the appearances could not be explained by reference to local glaciers. For instance, the land on the east side of the Chelyuskin peninsula, where I went reindeer-shooting one day, was a very undulating clay plain, over which was strewn a multitude of big boulders of various rocks, which could with difficulty be explained otherwise than as being material brought by an extensive ice-sheet. The fact that I found an indication of stratification in several places can hardly be regarded as an argument against its moraine-like character, as there are incontestable moraines in the south of Norway which show distinct stratification. The exemption from an ice-sheet, so long claimed for Siberia, can no longer be maintained.

The microscopic examination of the numerous specimens of sea-bottoms obtained by our soundings, proved that they differ essentially from the samples taken from the North Atlantic Ocean, as they are wanting in the characteristic organisms. The arctic deep-sea mud was found to be particularly deficient in carbonates, and appears to consist chiefly of mineral components; but so far only very imperfect examinations of these deposits have been made.

During our journey we had abundant evidence of the reality of the ice-drift across the polar area, on the faith in which the expedition had been planned. Earthy matter was found on the ice as far north as 86°, and driftwood also. I remember one day far north, during Johansen's and my journey over the ice, our astonishment at seeing a large piece of timber projecting from the ice; it hailed, perhaps, from the interior of Siberia, and was on its way to the Eskimo of Greenland. The only thing we could do was to cut our initials on it, with the date and latitude. The cause of the drift is, first of all, the wind, the prevailing direction of which is from the Siberian Sea towards the North Atlantic Ocean. As the wind varies, the drift varies also; but it was always strongest when towards the north and west, and feeblest when it turned towards south and east. Most progress was made in the winter, least in summer, when northerly winds were relatively common. I believe that when the records are worked up it will be possible to demonstrate that there was a slight current in the water under the ice, setting in the prevailing direction, or perhaps a little to the northward of the prevailing wind. The massive ice-cap, which many polar explorers have believed to cover the polar area, has been shattered; instead of it we have the ever-wandering ice-fields, like a link in the eternal round of nature.

The ice does not grow to any great thickness by direct freezing; something under four metres was the greatest seen; but, of course, it becomes very much thicker by the piling up of broken ice-sheets driven together and mounting one above another. The pressure of the ice was found to be largely dependent on the tidal current, especially on the margin of the polar ice-fields. There the periods of great pressure occurred regularly about new moon and full moon, the former being the greater. The worst ice-pressures encountered by the *Fram* were when the wind suddenly changed after having been long steady, when smaller masses of ice would be driven by the wind against the greater masses moving on by their own momentum.

The temperature of the water at various depths beneath the ice was of special interest. Even as far east as the sea north of the New Siberian Islands I found undoubted traces of a warm current. The surface water of the entire polar basin is doubtless very cold, between −1·5° and −1·6° C., the freezing point of sea-water. Beneath this cold layer at depths of 200 metres, I suddenly found warm water, the temperature rising to +0·5°, or even +0·8° C. At a greater depth the temperature varied somewhat, but remained nearly constant to 400 or 500 metres, after which it slowly sank until the bottom was reached, without, however, becoming so cold as at the surface. The air temperatures were, as was anticipated, not so low as in Siberia, doubtless owing to the influence of the deep underlying sea. The minimum we found (−53° C.) is not immoderately low, recollecting that at Verkhoyansk −68° has been recorded. The winds in the far north were not very strong, seldom amounting to a gale; but this climate entirely changed on the southward journey, and in the winter quarters on Franz Josef Land a succession of furious gales howled around us continually.

There were exceptional opportunities of observing the aurora, and amongst other curious phenomena the heavens were often shrouded with a light luminous veil, through which it was difficult to see the Milky Way. The aurora was found to be much more common in very high latitudes than it was formerly supposed to be.

Animal life was abundantly observed both in the form of small marine organisms, especially crustacea, and larger creatures. Narwhal were seen in shoals up to nearly 85° N., and seals were also frequently seen in summer. Bears were shot north of 84°, and fox tracks seen in 85° N. Near Hvitten-land east of Franz Josef Land, the probable nesting-place of the rosy gull was found. The fresh-water pools on the ice in summer swarmed with diatoms and other algæ.

The expedition found much of value in considering future travel. The type of vessel embodied in the *Fram* was found perfect, resisting all ice pressures, and the ship was as sound at the end as at the beginning. Another drifting expedition should enter the ice much further east, entering by Bering Strait, and the ship should be equipped with greater laboratory accommodation. Nothing remains to be done for preserving health; the company on the *Fram* were never seriously ill, and even on the march over the ice I personally increased 22 lbs. in weight. There was never the faintest indication of scurvy.

THE LEGENDARY HISTORY OF FUNAFUTI, ELLICE GROUP.[1]

THE first king of Funafuti was Terematua (? Tilimatua), but who he was or where he came from is not known; it is certain, however, he was here before the arrival of the Kauga, people who swam to this island from Samoa, which means, I

[1] This is the story of Funafuti, so far as I could learn it from the King Erivara and our interpreter, the white trader O'Brian.

take it, Samoans who were wrecked from a canoe and afterwards swam ashore. The Kauga were much respected. Toa, a piece of land in Funafuti, is named after one of them, and the southernmost island, Tuaeriki, after another: after death they were worshipped as spirits.

The only son of Terematua was Kitosuga, and he had one son Tiloa, who likewise had an only son Tilotu. In the time of Tilotu a subordinate king or chief was appointed, by name Paolau. What relationship by blood, or whether any existed, between Tilotu and Paolau the king could not tell me; a very old woman, as he said over 100 years old, who had instructed him in the history of his predecessors, had not informed him on this point.

Paolau became king after Tilotu's death, and Tilotu's children became sub-kings or chiefs.

Paolau was killed by his younger brother Nigi, who aspired to the throne. When Nigi drew near to Paolau the latter said, "Are you going to kill me?" Nigi pointed to the rising moon and said, "My head is there," and then to the place where it would set, adding "your head is there!" and killed him.

Nigi then became king; after his death he was succeeded by Tukalamiti, whose parentage is not known; he was probably a son of either Paolau or Nigi—possibly of Paolau's, for there were two branches of the royal family, and when one king died his successor was generally chosen from the other branch.

It is not known whether this was a friendly arrangement or not. Then another Paolau became head king, and Masaleika, his brother, sub-king; the latter never attained the chief dignity, as he was killed by Tauvasa. Paolau fell sick on the southernmost island, and Tauvasa sent people in canoes to kill him.

Paolau and his people went to see what the canoes had come for, and invited the crews to stay the night with them. This they did, and during the night Paolau's daughter discovered their purpose and warned her father.

The leader of the expedition, Salaiki, a brother of Paolau's, was then set upon and killed. Paolau retained his kingship, and Tauvasi remained chief till the illness of the former proved fatal, as it did soon after the attempt upon his life. Tauvasi then became king. He seems to have been a good ruler, and signalised his reign by dividing the land, which had hitherto been held in common, and fairly apportioning it amongst the people. The history of the kings now becomes mixed up with that of the priesthood. In early times the people worshipped thunder and lightning and the powers of nature, as well as birds and fishes. This was followed by the worship of spirits, one of whom was named Tufakala after a particular kind of seagull. There then arose priests or spirit-masters (vakatua).

One of the earliest, if not the first, was Erivara, evidently a very masterful person. He abolished the ancient worship, taking the dead Firapu, or his spirit, the father of Tauvasi, for his first god. Firapu was a hero whose death is shrouded in mystery—he and his daughter Mumu had left Funafuti in their canoe on a voyage to the Gilbert Islands, and had never returned. As time went on descendants of Firapu after death were added to the list of spirits, and worshipped as subordinate deities.

Besides this worship of spirits there was also a kind of fetish worship, also introduced by Erivara. Erivara in his sleep visited the other world, and made the acquaintance of seven spirits, who showed him a wonderful object and directed him on returning to earth to make a copy after its fashion, giving him full instructions how to proceed. On his return to earth, more prosaically when he awoke, he sent one of the people to dive outside the reef for a red stone. This was procured and brought to him. He wound round it a dress of pandanus leaves—red, white and black, some fathoms long, and placed it inside a cage shaped like a hen-coop. This was called the Teo.

If a parishioner was sick, Erivara took the stone from its wrappings, talked to it, charmed it with rhymes, and applied it to the sick man. Another fetish was a hat, the size and shape of a hogshead cask, made up of red, white and black fandango (Pandanus) leaves, and adorned with white shells. This was called the Puluo, and was said to be the hat of Firapu. I think this was kept in the spirits-house, but the Teo was kept in a separate hut—the charm-house.

When the people wanted to catch fish, the Puluo was brought out of the spirits-house by the king's orders, and the whole community walked three times round the house, bearing the Puluo in front. The women followed, stark naked, and the men, who belaboured one another with sticks; the children completed the procession.

The charm-house was set round with a great number of sharp-pointed stakes, and when a catch of fish was made the people were required to take it to the spirit-master and lay it down in front of the charm-house, not the king's. The charmer then picked out the finest fish, impaling each, as he selected it, on one of the stakes and dedicating it in a loud chant to the particular spirit—Faiologata, Tamaiki, Fijiroa, Tongatumatua, Firapu, Sasaka, or some other to which the post was sacred. When the dedication was complete, the people shared the remainder between them. The sacrifice was divided between the priest and his relations.

This was a pretty fair source of income; but the charmer could not live on fish alone, and so he had other methods by which coconuts, taro, and the rest were added to them.

The spirits would come to him and give him warning that some one was going to be sick; the spirit-master would then send for this person, and take him to the charm-house to be charmed. This house was a square hut with a fire burning in the centre, and on the entrance of the threatened man this was made to smoke so that the spirit should not be able to see him. The spirit-master was provided with two young coconuts and young white leaves of the coco palm. He rubbed oil on one of the nuts, rubbed his nose against one eye, whispered to it, and then turned it away from him. Crossing his hands he gave it a good spin, and watched how it came to rest; if when it stopped it pointed sideways or away from him, the spirit was very angry and the man would be very ill; if, on the contrary, it pointed to him, the spirit was not vexed.

Of course these performances meant taro and coconuts.

In case the man was to be taxed pretty severely the spirit would of course be angry, and there would be other charms required to mollify him, and these had to be paid for. If a man were really ill the spirit-master would come and wave a staff, with a bunch of coloured pandanus leaves at the end, over him, or he would thrust this staff like a spear through a coconut, or he would try the smoking and the Teo treatment.

In any case the medical attendance was very expensive, and the patient's friends and relatives had to gather together a good deal of food to keep the spirit-master and his friends while the case was in progress.

Erivara, the first devil-master, was so fertile in inventions of this kind, that I could not believe he had owed them all to his own unaided powers, and I inquired therefore if he was accustomed to travel much, and was told he had visited at various times Nukulailai, Vaitapu and Nukufetau, neighbouring islands of the group, as well as the Gilberts. This in itself, however, is no proof that he was a plagiarist.

Erivara was, notwithstanding, a great benefactor to the island; the coconut palms were few, and food was scarce, so he organised expeditions to the Gilbert Islands, and brought back in canoes a great quantity of nuts; the people extracted the cotyledon from these for food, which shows they were very hard-up, and then planted them. The whole of the islets of Funafuti were planted in this way under his direction—a great achievement.

On the other hand, Erivara broke up the ancient laws of the kings, and upset the distribution of the land, dividing it afresh between the king (erikitutu) and thirty or more sub-kings of his own creation (erikitabua). Hence arose disputes as to the ownership of the land, which persist even to the present day. There is this excuse to be made for Erivara, that by reason of his planting the land acquired the chief value that it possesses. Still he might have shown a little more consideration for those families which had no man at the head, only old women; he was oppressive towards the weak.

During the time of Erivara Tauvasi died, and his son Sirimiau became king, after him his son Dili succeeded, and after Dili Sukumuni, after Sukumuni Tarafo, belonging to another branch of the Tauvasi family, succeeded to the headship; he was followed by Taturi, his son, and Taturi by his brother Teriki. Teriki was followed by Matavai, who was deposed by reason of the ulcers with which he was afflicted, the evil smell of which made it impossible for people to sit in the house with him. Jacopa, his eldest son, replaced him; then Manu, his second son; and finally Erivara, the reigning monarch, the youngest of Matavai's three sons. Erivara is a very intelligent and dignified old man, say fifty years of age, every inch a king, though shorn of all power. Our High Commissioner is the chief governor, and makes laws for the island; but the true master here is the native missionary Simona, who is a Christian spirit-master of a very friendly disposition. The ancient religion

received its death-blow about thirty years ago, not from a missionary, but from a white trader, O'Brian, now living on the island, who accomplished its overthrow, not from any religious motive, but because the ancient religion took up much of the time which he thought, rightly or wrongly, should be given to collecting copra for him. He told the natives that the captain of the vessel trading with him threatened on his return to shoot every man, woman and child if they did not destroy the spirit and fetish houses. "And do you think he will do it?" they asked. "Undoubtedly," was the reply. So they were terribly frightened, and some wished to destroy the houses, and others, under the leadership of the priest, were opposed. Three men-friends of O'Brian's were in favour. and they went into the charm-house, took down the Teo, polluted it and put it back. There was a great noise when the deed was discovered, and suspicion fell on these three men and O'Brian. The three men left the island and went to Nukulailai, and of course were thus self-condemned. The spirit-master accordingly performed his charms, and told the people that these three men were now dead. One of the three men, Leveri, had a twin brother who remained in Funafuti after the flight of Leveri, and he was terribly grieved over his brother's death; the other men also were much regretted, and the whole population went into mourning—cutting off their hair, they made necklaces of it to wear round their necks, abstained from eating taro, and in other ways showed their grief.

One day, however, Leveri returned in a ship; the people could not credit it, and said it must be his spirit. Leveri, however, cried out to them in his own proper voice, and they had then no doubt that he was alive; they asked him about the other two men, and learnt that they also were alive and well, and meant soon to return. Then there was great uproar, and the people cried, "Burn the devil's house." O'Brian did not wait for further orders, but went off with a half-caste and set both the devil's and the charm house on fire. The spirit-master, or devil-master, seized the Teo and escaped with it in his canoe to the lagoon. But O'Brian took his double-barrelled gun and went after him, and threatened to shoot him if he did not bring it back: knowing well that if this devil-master escaped with the Teo, the people would begin to worship it again on the first opportunity. The devil-master came back, and O'Brian took the Teo, unwound the stone from its wrappings—it was a red stone from six to eight inches long—and dashed it in pieces on the ground. Then he fired his gun through the roof of the burning house and exclaimed, "There goes your devil up in the air! See him!" And all the people said "Tschah!" an expression of great surprise.

The devil-master threatened proceedings from the next world. "Now," said he and his friends, "never more any turtles, no bonitos, no fish in lagoon."

There was a devil's house on the northern island, and O'Brian and Matika went in their canoe to burn that down too; on the way they got hundreds of black fish, and brought them back to the islanders. The people said, "God was sorry for the devil, and gave these fish to atone." So they gave them away (to the devil-master?).

The turtle is taboo to all but the king. When one is caught it is brought to the king, who recites the following formula over it before cutting it up:—

Te ailu o te fonu
The body of the turtle

Te ika mua e soa
The fore paddles are fellows (a pair)

Te ika muti e soa
The hind paddles are a pair

Te vaesiosio e soa
The lungs are a pair

Te alaga mua e soa
The arms are a pair

Te alaga muti e soa
The legs are a pair

Te matua tinae e soa
The breast is a pair

Te puloa e soa
The belly is a pair

Te laukape e soa
The back is a pair

Te matua lua e soa
The small guts are a pair

Te lakau e soa
The great intestine is a pair

Te fatumava e soa
The liver is a pair

Te ate e soa
The fat under the armpits is a pair

Te mama e kiukiu te fua
. . . . .

He then divides it among himself and his relatives.

I have attempted, with the help of the natives, to translate all the lines except the last, which O'Brian told me meant "the eggs are thousands and thousands." The formula as I give it is copied from the writing of a native scribe, who took it down in our presence as the king recited it.

July 19, 1896. W. J. SOLLAS.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The following have been elected to the University Mathematical Scholarships and Exhibition for 1897:—To the Senior Mathematical Scholarship: E. E. Roberts (Corpus Christi College). *Proxime accessit:* E. Lawton (Corpus Christi College), to whom the Examiners have awarded Lady Herschel's Book for Astronomy. To the Junior Mathematical Scholarship: W. M. Roberts (scholar of Corpus Christi College). *Proxime accessit:* R. F. McNeile (scholar of Balliol College).

Mr. C. L. Shadwell, Fellow of Oriel College, has been appointed a Curator of the Botanic Garden, in place of Mr. F. T. Richards.

The General Medical Council has decided not to register as medical students those who have only passed Responsions. They will henceforth require a knowledge of Algebra up to simple equations, and of Euclid, Books I.–III., with easy deductions, in addition to the ordinary subjects of the examination. Steps are being taken to meet these requirements.

The Junior Scientific Club met on February 3, Mr. A. W. Brown (Christ Church), President, in the chair. Mr. Percy Elford exhibited a series of specimens illustrating the evolution of the match. Mr. A. E. Boycott (Oriel) read a valuable and interesting paper on shell colouration in British extra-marine mollusca; and Mr. B. H. Rolfe (Merton) discussed the effect of climate on building-stone. The President announced that the first volume of "Robert Boyle Lectures" would shortly be published.

The Professorship of Geology is still vacant. At present arrangements are being made for the instruction of those who wish to study geology at the Museum. The new Professor will in all probability be appointed in the course of the present term.

Mr. F. F. Fison has been elected to a Casberd Scholarship in Mathematics at St. John's College.

CAMBRIDGE.—The degree of Master of Arts, *honoris causa*, is to be conferred on Dr. A. A. Kanthack, Deputy-Professor of Pathology. The Senate has assigned a stipend of £250 to Dr. Joseph Griffiths while he is discharging the duties of the Professor of Surgery during the vacancy of the chair. The Senate has also made a grant of £50 to the University Lecturer in Geography (Mr. Yule-Oldham) for additional maps and apparatus.

Dr. D. H. Scott, F.R.S., has been appointed an Elector to the chair of Botany; Mr. J. J. H. Teall, F.R.S., an Elector to the chair of Geology; Sir W. H. Flower, F.R.S., an Elector to the chair of Zoology; Dr. A. S. Lea, F.R.S., an Elector to the chair of Physiology; and Dr. J. Sully, an Elector to the chair of Mental Philosophy.

LORD HERSCHELL recently opened new technical schools at Swindon. They are built upon a site generously presented by Major Rolleston, at a cost of £12,000, towards which the New Swindon District Council contribute £7500, the Wilts County Council £3500, and the Science and Art Department £1000.

THE National Association of Manual Training Teachers has issued a circular letter asking teachers of manual training, "Whether the making of apparatus and instruments for physics (as suggested in the Physics' Syllabus, Form 74, of the Science and Art Department) interferes educationally with manual training?"

THE Cornwall Sea Fisheries Committee have resolved to apply to the County Council to sanction a salary of £250 a year, with an additional £100 for travelling expenses, in con-

nection with the post of lecturer to the Committee. There is a difficulty in obtaining a competent man at the salary originally decided upon.

THE Technical Education Committee of the Berkshire County Council have advised the Council to establish four agricultural exhibitions of the value of £35 each, to be open to boys between fourteen and sixteen, and tenable for two years at the Dauntsey Agricultural School, which has been established to give a thoroughly practical instruction in the various branches of farm work.

THE Committee of Graduates of the University of London unanimously resolved, at a recent meeting:—"That the Committee of Graduates of the University of London in favour of the scheme of Lord Cowper's Commission, express the earnest hope that her Majesty's Government will again introduce a Bill for the creation of a statutory commission for the reconstitution of the University of London, and assure the Government that such a measure will have their active support."

THE Chairman of the Leicestershire Technical Education Committee informed the County Council, at their meeting on the 3rd inst., that at the present time there was not a single student from Leicestershire at the Midland Dairy Institute, though there were as many as forty last spring. This is owing to the fact that Leicestershire only interests itself in the practice of cheese-making, which cannot be satisfactorily carried out in the winter. But since there are so many branches of agriculture which can be properly studied during the winter months, it seems a misfortune that Leicestershire should reap no advantage from its contributions to the support of the Dairy Institute during so large a part of the year.

THE following are among recent appointments:—Dr. Johann Rückert to be professor of anatomy in the University of Munich; Dr. Liznar to be professor of meteorology and terrestrial magnetism in the Technical High School at Vienna; Dr. R. Schüssler to be professor of geometry in the Technical High School at Graz; Dr. C. J. Martin to be provisionally the successor to Dr. G. B. Halford as professor of physiology in the University of Sydney; Dr. Arnaldo Maggiora to be professor of experimental hygiene in Modena University; Dr. A. Serafina to be professor of experimental hygiene in the University of Padua. Among recent calls are:—Dr. Felix Auerbach, of Jena, to be professor of physics at Strasburg; Dr. Franz, assistant in the Observatory of Königsberg, to be associate professor of astronomy at Breslau.

IT is announced in the *Lancet*, that the present Lord Rector of the University of St. Andrews—the Marquis of Bute—has undertaken to erect at his own cost, under certain conditions, four new laboratories, lecture-rooms, museums, work-rooms, &c., for the departments of anatomy, physiology, materia medica, and botany. These laboratories will be provided with all modern appliances for teaching and research purposes. They will form a most important addition to the existing natural philosophy, natural history, and chemical departments. As the laboratories are to be built apart from the existing colleges on ground of their own, they will, of necessity, form the headquarters of the extended medical school there, which school will henceforth be known as the "Bute School of Medicine," in commemoration of the generous donour.

AT a recent meeting of the Senate of the University of Wales, the question of fellowships, scholarships, exhibitions and prizes, to be established in connection with the University, was again discussed. The Senate recommended that there should be four fellowships of at least £100 per annum, tenable for two years, with possible renewal for a third year in recognition of exceptional merit. The prizes will be open both to graduates and undergraduates, and will be awarded for excellence of attainment in departments of study recognised by the University. The fellowships, scholarships, and exhibitions will be confined to graduates of the University. Fellowships will be only conferred for very distinguished merit, and will be tenable on condition of residence at some approved seat of learning or research, and on the active pursuit of original investigation. They will be awarded by the Court on the recommendation of the Senate, the Senate acting on the recommendation of a small Standing Committee specially appointed for this purpose. The Standing Committee will require information as to the subjects of research or advanced study to which candidates propose to devote themselves, and (in the event of their election) receive from time to time reports as to their work and progress.

WE are glad that the Prince of Wales has again shown his interest in the excellent work of the Technical Education Board of the London County Council, by presiding at the distribution of prizes and certificates on Friday last. The magnitude of the work of the Board is shown by the fact that the number of scholars and exhibitioners who were elected in 1896 is 893, made up as follows:—5 senior county scholars; 70 intermediate county scholars; 588 junior county scholars; 18 schools of art scholars; 21 artisan art scholars; 95 junior artisan evening art exhibitioners; 85 evening science exhibitioners; 2 horticultural scholars; 9 domestic economy training scholars. The total pecuniary value of these scholarships and exhibitions amounts to about £40,000. The amount placed at the disposal of the Board for the coming year is £150,000. In the course of an address at the close of the presentation of the certificates, the Prince of Wales pointed out that the Technical Education Board has made grants to University College, King's College, and Bedford College, under such conditions as are calculated to place the highest technical teaching of these institutions within the reach of those students who could not otherwise afford to devote several of the best years of their lives to a course of University study. Under these conditions evening classes in certain subjects, especially in those connected with mechanical and electrical engineering, have been conducted on precisely the same lines as the day classes, and by the same professors and lecturers; and on Saturdays the professors have undertaken to give instruction in several classes to teachers, who thus enjoy the advantages of all the resources of the best University institutions.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 21.—"Experiments on Examination of the Peripheral Distribution of the Fibres of the Posterior Roots of some Spinal Nerves, Part II." By C. S. Sherrington, F.R.S., Holt Professor of Physiology, University College, Liverpool. Received November 12, 1896.

This paper is in continuation of one brought before the Society in 1892, and published in *Phil. Trans.*, vol. 184, B. The communication is divided into four sections. In Section I. the field of peripheral distribution of each root is described from the Vth cervical to the lower end of the brachial region. Particular attention was paid to the question of the skin-fields of the several divisions, ophthalmic, maxillary, and mandibular of the cranial Vth, in order to see if the fields possessed the characters of segmental skin-fields, or those of peripheral nerve-trunk skin-fields. They were found to conform with the latter, not with the former. A curious relation of the posterior edge of the field of the Vth to the external ear is found to exist, indicating that the position of the visceral cleft is still adhered to as a boundary line for the field of the trigeminus. The sense of taste as well as of touch is found to be destroyed in the anterior two-thirds of the tongue after intracranial section of the Vth; this makes it extremely doubtful whether the corda tympani can have gustatory functions in the monkey, as has been believed in some cases in man. No loss of eye-movements, or interference with them, has been found to result from intracranial section of the Vth.

After cranial Vth and all the upper cervical posterior roots have been severed, there still persists a small field of sentient skin, which includes the external auditory meatus and a part of the pinna. This field, although not corresponding to the situation given by anthropotomists to the distribution of the auricular branch of the vagus, may come either from it or the glossopharyngeal. It presents interest as being the only field representing the whole cutaneous distribution of a nerve, which does not conform with the rules of zonal distribution holding good in the case of each of the other nerve-roots examined, and these now include the whole craniospinal series. The posterior root of the Ist cervical nerve has a skin-field in the cat, which includes the pinna. The posterior root of the same nerve in Macacus has no skin-field at all, its skin-field having apparently been included in the IInd cervical of Macacus, not in the cranial Vth. The root fields contributing to the surface of the brachial limb are IIIrd, IVth, Vth, VIth, VIIth, and VIIIth cervical,

and Ist, IInd, and IIIrd thoracic. Of these, the VIIIth cervical is the only one which includes the whole of the surface of the free apex of the limb; its distribution in this respect closely resembles that of the VIth lumbar sensory root in the pelvic limb.

The IInd section of the communication deals with the degree of conformity between the distribution of the spinal ganglion fibres in the skin and their distribution in the underlying deep tissues of the limb. It is shown that, although the *skin* fields of the ganglia are in the middle of the limb region dislocated from the median line of the body, the fibres of the root ganglion are nevertheless, when their deep distribution is taken into account, distributed to a complete ray of tissue extending in an unbroken fashion from the median plane of the body out along the limb to (in the case of the nerves, extending furthest into the limb) the very apex of it. This distribution conforms, therefore, with that shown in a previous paper to be typical of the distribution of the ventral (motor) root. The distinction is not, therefore, as between *afferent* and *efferent*, but as between *cutaneous* and *muscular*. A detailed analysis of the distribution of the deep sensory fibres is in this paper carried out for the VIth lumbar spinal ganglion of *Macacus rhesus;* this ganglion was chosen because its skin-field, occupying the free apex of the lower limb, is one as far dislocated from the median line of the body as any in the whole spinal series, and presents, therefore, the greatest apparent discrepancy between the distribution of its afferent and efferent roots. A comparison of the distribution of the afferent and efferent roots in this (VIth lumbar) nerve was made by means of the Wallerian method; the results show the peripheral distribution of the two to be minutely similar. From this, and from other observations given, the rule is put forward as a definitely established one that the sensory nerves of a skeletal muscle in all cases derive from the spinal ganglion (or ganglia) corresponding segmentally with that (or those) containing the motor cells, whence issue motor nerve-fibres to the muscle. The reflex arc, in which the afferent and efferent nerve-cells innervating a muscle are components, need not, therefore, as far as anatomical composition is concerned, involve irradiation through more than a single spinal segment.

Section III. deals with general features of arrangement recognisable in the distribution of the roots.—Comparison between the human brachial plexus and that of Macacus is made, and it is pointed out that the human plexus is slightly prefixed, as compared with that of Macacus.

Finally, in Section IV., various spinal reactions are examined, especially with reference to their effects upon the size and other features of the areas of the root-fields, &c., and the results collated and discussed.

"Cataleptoid Reflexes in the Monkey." By C. S. Sherrington, F.R.S., Holt Professor of Physiology, University College, Liverpool. Received December 29, 1896.

The reflex movements, the subject of this note, are of extremely prolonged duration, and absolutely devoid of clonic or alternating character. If the cerebral hemispheres be removed *e.g.* from a monkey, and if a finger of one of the monkey's hands be stimulated, for instance, by dipping it into a cup of hot water, there results an extensive reflex reaction involving movement of the whole upper limb. The wrist is extended, the elbow flexed, the shoulder protracted, the upper arm being drawn forward and somewhat across the chest. The movement occurs after a variable and usually prolonged period of latent excitation. The movement, although it may be fairly rapid, strikes the observer each time as perfectly deliberate; it is of curiously steady and "smooth" performance. Sometimes it is carried out quite slowly, and then, as a rule, the extent of it is less ample. The most striking feature of the reflex is, however, that when the actual movement has been accomplished *the contraction of the muscles employed in it does not cease or become superseded by the action of another group, but is continued even for ten and twenty minutes at a time.* The new attitude assumed by the limb is maintained, and that too without clonus or even tremor. In the instance cited, namely, that of the fore limb, the posture assumed suggests the taking of a forward step in quadrapedal progression, and in that posture the animal will remain for a quarter of an hour at a time.

The degree of, for instance, flexion assumed in the new posture seems much dependent on the intensity and duration of the stimulus applied. If the degree is extreme, the attitude of the limb may not be maintained to its full extent for the time mentioned; thus, the elbow, at first fully flexed, will in the course of a minute or so be found to have opened somewhat. This opening can be often seen to occur *per saltum*, as it were, but the steps are quite small, and recurrent at unequal intervals of between perhaps a quarter of a minute and a minute. After some relaxation from the extreme phase of the posture has taken place, the less pronounced attitude, *e.g.* semiflexion at the elbow, may persist without alteration obvious to inspection for ten minutes or more. Apart from the occasional step-like relaxations, the contraction of the muscles is so steady as to give an even line when registered by the myograph. A renewed stimulation of the finger excites further flexion, which is maintained as before in the way above described. The posture can be set aside without difficulty by taking hold of the limb and unbending it; the resistance felt in the process of so doing is slight; the posture thus broken down is not reassumed when the limb is then released.

Analogous results are obtainable on the hind limb. Hot water applied to a toe evokes always, so far as I have seen, flexion of ankle and knee; usually of hip also. This movement is "deliberately" executed, and always institutes a maintained posture.

Not the least interesting part of the reflexes under consideration is a remarkable glimpse which they allow into the scope of reflex inhibition as regards the coordinate of movements of the limbs. Although the posture taken up by the right fore limb consequent upon excitation of a finger is symmetrically duplicated by the left limb when both hands are simultaneously stimulated, the effect of excitation of the two hands does not lead to symmetrical posture if the excitation be not synchronous but successive. If when the right arm has already assumed its posture in response to an excitation of the right hand, the left hand be stimulated, there results, while the left arm in obedience to the excitation is lifted and placed in the flexed posture, an immediate and, if the stimulus be at all more than slight, complete relaxation of the right arm. The right arm drops flaccid, while the left is raised and maintained in the raised attitude. Similarly, excitation of the right foot breaks down the posture assumed by the right arm, and conversely, and even more easily, stimulation of the right hand breaks down a posture assumed by the right leg. Again, a nip of the right pinna causes relinquishment of a posture assumed by the right arm or by the right leg. If the right pinna is pinched when both arms are in this cataleptoid posture, complete inhibition can be readily exerted on the right arm, but usually only partial relinquishment can be induced in the left arm. To exert complete inhibition upon the posture of the left arm, the pinna pinched must be that of the left side. Similarly the posture reflexly evoked by appropriate stimulation of either hind limb can be inhibited by excitation of either pinna or of either fore limb, but predominantly by pinna and fore limb of the same side as the limb to be inhibited. The inhibition of the hind limb is much more easily elicited from the opposite hind limb than from the opposite fore limb or opposite ear. I have never yet seen it obtained diagonally upon the fore limb from the opposite hind limb.

February 4.—"On Lunar Periodicities in Earthquake Frequency." By C. G. Knott, Lecturer on Applied Mathematics, Edinburgh University (formerly Professor of Physics, Imperial University, Japan). Received November 4, 1896.

General Conclusions.—The conclusions are summarised under eight heads.

(*a*) There is evidence that the earthquake frequency in Japan is subject to a periodicity associated with the lunar day.

(*b*) The lunar half-daily period is particularly in evidence, both by reason of its relative prominence and the regularity with which, in each of two groups of the several seismic districts, its phase falls in relation to the time of meridian passage of the moon.

(*c*) There is no certain evidence that the loading and unloading due to the flow and ebb of ocean tides have any effect on seismic frequency.

(*d*) Hence we must look to the direct tidal stress of the moon, in its daily change, as the most probable cause of a range in frequency which does not exceed 6 per cent. of the average frequency.

(*e*) There is distinct evidence, both as regards amplitude and phase, of a fortnightly periodicity associated with the times of conjunction and opposition of the sun and moon.

(*f*) No definite conclusion can be drawn from the apparent monthly and fortnightly periodicities which seem to be

associated with the periodic changes in the moon's distance and declination, for the simple reason that fully as prominent harmonic components exist when the statistics are analysed according to the periodic change in the moon's position relative to the *ecliptic*, and with this particular period no tidal stresses can be directly associated.

(*g*) Nevertheless, the value of the phase lends some support to the view that there is a real connection between the change in the moon's distance and earthquake frequency, since the maximum frequency falls near the time of perigee.

(*h*) These conclusions have, in comparison with previous similar investigations, a peculiar value, inasmuch as they are based upon accurate statistics of fully 7000 earthquakes occurring within eight years in a limited part of the earth's crust, throughout which the seismic conditions may be assumed to be fairly similar from point to point.

February 4.—"Some Experiments on Helium." By Morris W. Travers. Communicated by Prof. W. Ramsay, F.R.S. Received December 30, 1896.

Geological Society, January 20.—Dr. Henry Hicks, F.R.S., President, in the chair.—On glacial phenomena of Palæozoic Age in the Varanger Fiord, by Aubrey Strahan. The Gaisa beds of the Varanger Fiord consist of slightly altered quartz-grits, with red sandstones and shales, and rest upon a deeply denuded surface of the metamorphic rocks. In a section, first noticed by Dr. Reusch, a heterogeneous mixture of grit and clay with boulders of granitic and other rocks is seen to be intercalated between the quartz-grits, the bedding of the overlying grit proving that this boulder-rock was contemporaneously formed, and not subsequently wedged in. The surface of the grit below the rock is characteristically glaciated. Proof was given that the striated surface is not the floor of a thrust-plane, and that the boulder-rock is not a fault-breccia or a crush-conglomerate, but a "till." In the absence of fossils the Gaisa formation was doubtfully assigned to an early Palæozoic age. It exhibits the same sedimentary characters as the rocks of later date in other parts of the world in which glacial phenomena have been observed. The glacial episode was attributed to a temporary change of climate rather than to the high latitude in which the section lies.—The raised beaches and glacial deposits of the Varanger Fiord, by Aubrey Strahan. The raised beaches range up to nearly 300 feet above the sea. Though a number of impersistent shingle-banks occur at various heights, the highest is constant, and can be traced along the same level either as a shingly terrace or by a zone of wave-worn rocks. Evidence is furnished by the relative size of different parts of the beach that the prevalent wave-action was from the west, and by the greater abundance of erratics on or below the beach than above it, that floating ice was at work. At the head of the fiord a blue clay dotted over with stones is now being formed, and the raised beach there consists of a similar material. Both here and elsewhere this clay stimulates a boulder clay; but for reasons given it was believed to be a marine fiord-deposit, into which many stones have been dropped by floating ice. Deposits of true glacial age, in the form of mounds of gravel, were described, and shown to have yielded the material out of which parts of the raised beaches were formed. The glaciation of the fiord was attributed to floating ice, and was shown to have taken place before the formation of the raised beaches, at a time when the sea surrounded this part of Finmark, by way of the Varanger Fiord, the Tana Valley, and the Tana Fiord. In the discussion upon the two papers, the President congratulated the author on the admirable manner in which he had worked out the evidence produced from the Varanger Fiord, and on his being able to show so conclusively that the views put forward by Dr. Reusch were substantially correct. Sir Archibald Geikie referred to one or two difficulties in the interpretations adopted by the author, one of the most obvious being the striated pavement of quartzite below the boulder-bed. This difficulty, however, was not insuperable. With regard to the age of the Gaisa series, Sir Archibald Geikie remarked that he was inclined to adopt the view of Dr. Reusch, who compared this series with the sparagmite of Central and Southern Norway. He himself had seen the sparagmite *in situ*, and had been much struck with its general resemblance, both in scenery and in lithology, with the Torridonian rocks of north-west Scotland. It was, like those rocks older than the Cambrian system. Dr. J. W. Gregory pointed out that the previous failure to discover traces of glacial action in high northern latitudes in pre-Pleistocene times gave wide interest to Reusch's paper; and the corroboration of his views by Mr. Strahan was of great value. He thought the deposits of special interest, as similar conglomerates occupying identically the same stratigraphical position occur all round the Polar basin, and in places where their age can be proved. In Spitzbergen the occurrence of the conglomerates was discovered last summer, and they are there pre-Devonian. Evidence seems to show that the conglomerates are probably part of a circumpolar belt. Mr. Hudleston corroborated the author's statements as to the nature of the country and of the arenaceous quartzite system prevailing in Eastern Finmark. Beyond the region shown in his map, on the eastern side of the Tana Fiord, the Stauganes Fjeld rises rather steeply to heights probably reaching 3000 feet. This is a quartzite wilderness, almost as white as snow, having a strong external resemblance to the quartzite-mountains of the North-western Highlands; the system might thus include both Torridonian and basal Cambrian beds. The importance of the author's verification of Reusch's statements was very great. The late Dr. Croll had been desirous of obtaining evidences of glaciation in the several formations anterior to the great Ice Age. His failure to do so he attributed to the circumstance that the evidences of glaciation are to be found principally on land-surfaces, and that the transformation of a land-surface into a sea-bottom would in most cases obliterate all traces of glaciation. A striated bed-rock went much further in this direction than mere boulders and striated stones; and, as far as he (the speaker) knew, these occurrences on the Varanger Fiord were the only ones as yet established in the northern hemisphere, with some possible exceptions in the case of the Talchírs. For a grander exhibition of striated bed-rock they must look to the southern hemisphere: Prof. Edgeworth David had recently brought before the Society such evidence from Southern Australia, referred to the Permo-Carboniferous period.

Chemical Society, January 21.—Mr. A. G. Vernon Harcourt, President, in the chair.—The following papers were read: Observations on the properties of some highly purified substances, by W. A. Shenstone. The author shows that oxygen is far more readily ozonised when moist than when dry; the conversion of ozone into oxygen is greatly retarded by the presence of moisture. Carefully purified and dried chlorine combines readily with mercury, but is not condensed by a silent electrical discharge.—The action of diastase on starch, by A. R. Ling and J. L. Baker. Starch, when hydrolysed by diastase, is converted into a series of maltodextrins of gradually decreasing molecular weight and rotatory power and of increasing cupric reducing power.—The solution density and cupric reducing power of dextrose, lævulose and invert-sugar, by H. T. Brown, G. H. Morris, and J. H. Millar.—Derivatives of maclurin, Part II., by A. G. Perkin. Although maclurin yields no definite acetyl-derivatives, a triacetyl-derivative of maclurin-azobenzene can be prepared; similarly the azobenzene of phloroglucin yields a monacetyl-derivative.—Halogen-substituted acidic thiocarbimides and their derivatives; a contribution to the chemistry of the thiohydantoïns, by A. E. Dixon. By the action of primary or secondary amines on halogen-substituted thiocarbimides a number of substituted thiohydantoïns have been prepared.—The amyl (secondary butyl-methyl) derivatives of glyceric, diacetylglyceric, and dibenzoylglyceric acids, active and inactive, by P. Frankland and T. S. Price. The authors have prepared a number of inactive and active amyl salts of substituted glyceric acids, and investigated the effect of temperature on their rotatory powers and the relations between the rotations.—The refraction constants of crystalline salts, by A. E. Tutton.—The refraction constants of crystalline salts: a correction, by W. J. Pope.—On the wide dissemination of some of the rarer elements and the mode of their association in common ores and minerals, by W. N. Hartley and H. Ramage. Out of 168 ores and minerals examined, 68 contained gallium, 30 contained indium, 17 contained thallium, and 70 probably contained rubidium; conclusions are drawn respecting the formation of beds and lodes of ore, and relations are found to exist between the periodic classification and the distribution of the elements.

Zoological Society, February 2.—Prof. George B. Howes in the chair.—Mr. Sclater exhibited a collection of bird-skins that had been formed by Mr. W. A. Churchill, H.B.M. Consul at Mozambique, during various shooting-excursions along the shores within twenty miles of the island of Mozambique.—Mr.

R. E. Holding, on behalf of Sir Douglas Brooke, Bart., exhibited a head and two pair of shed horns of a fallow deer. The latter showed curious deformities in consequence of disease of the frontal bone.—Mr. G. E. H. Barrett-Hamilton gave a short general account of his expedition to the Fur-Seal Islands of the North Pacific during the summer of 1896, in company with Prof. D'Arcy Thompson. This journey had been undertaken on behalf of the Foreign and Colonial Offices, with a view to the investigation of the natural history of the northern fur-seal (*Otaria ursina*), with special reference to certain disputed points which had a distinct bearing on the industry connected with the skins of the animal. A detailed report of Mr. Barrett-Hamilton's investigations would be issued as a Parliamentary Blue Book.—Mr. G. A. Boulenger, F.R.S., read a paper entitled "A Catalogue of the Reptiles and Batrachians of Celebes, with special reference to the collections made by Drs. P. and F. Sarasin in 1893-1896." This memoir gave a complete list (with descriptions) of all the reptiles and batrachians, with the exception of the marine species, known to occur in the Celebes. The number of species of reptiles enumerated was 83, and of batrachians 21.—Mr. Martin Jacoby contributed to our knowledge of the African fauna by describing 43 species of Phytophagous Coleoptera, 37 of which were new, based on specimens contained in collections sent home to him from Natal and Mashonaland by Mr. Guy A. K. Marshall, and from Madagascar by M. Alluand, of Paris.

CAMBRIDGE.

Philosophical Society, January 25.—Mr. F. Darwin, President, in the chair.—Some results obtained by staining the brain with the chrome-silver method (illustrated by photomicrographs), by Dr. A. Hill. Dr. Hill showed a granule of the olfactory bulb with a looped axis-cylinder, and also certain forms of granule of the cerebellum not hitherto described. He also exhibited sections and photographs showing the variations in the form of the "thorns" on the dendrites of nerve-cells, which can be produced by varying the hardening process: (1) The thorns may be absent; (2) they may be long or short; (3) they may have the typical form of a minute rod with a dot at the end, or the dots may be divided and lie on the course of the rod; (4) they may be replaced by long filaments.—A possible explanation of the quinqueloculine arrangement of the chambers of the microspheric forms of triloculine and biloculine shells of the miliolidæ (foraminifera), by Mr. J. J. Lister. It was suggested that the quinqueloculine mode of growth in the young microspheric forms of the miliolidæ may be ancestral and archaic.—On the theory of osmotic forces, by Mr. J. Larmor (will be printed in full).

MANCHESTER.

Literary and Philosophical Society, January 26.—Prof. H. B. Dixon, F.R.S., in the chair.—On a convection scope and calorimeter, by A. R. Bennett. Mr. Bennett described how he had devised a small and exceedingly sensitive motor which begins to revolve the moment it is exposed to daylight in the open air, whether the sun is shining or not, and which will also work all night in clear weather. The delicacy of the motor is such that it is affected by the radiant heat of moonlight. The motive power is due to convection currents caused by the radiant heat of daylight striking through a glass shade with which the instrument is covered; the glass is not heated, but the metal surfaces of the instrument are, and air is consequently expanded on the motor surfaces and condensed on the glass, the resulting difference of temperature setting up a convection current which does not cease so long as the instrument is exposed to the radiant heat due to visible rays. Descriptions were given of modifications by which surplus heat is automatically stored during the day and employed to drive the instrument at night. During the months of May, June, and July last, such a storage instrument continued in motion without stopping day or night; and in fine climates, like Egypt, much longer periods of continuous movement could undoubtedly be secured. The speed of the instrument is affected by barometrical pressure and hygroscopic conditions. It is capable of marking the dew-point, and works well even when its glass shade is completely coated with ice or half buried in snow. Mr. Bennett has succeeded in adapting the instrument to act as a calorimeter by first cooling the whole of the instrument to a given temperature, when rotation ceases, and then suspending pieces of heated metal inside. In this way the specific heats of substances can be accurately compared, since the number of rotations caused is in direct proportion to the amount of introduced heat. The instrument can also be used to measure the comparative heat-retaining power of textile fabrics, boiler compositions, &c., and the relative heat conductivities of thin threads and wires. Mr. Bennett has also instituted a series of experiments, as yet incomplete, into the comparative sensitiveness to convection effects of various gases, which promise interesting results, since the differences already noted are unexpectedly great, and, moreover, do not bear any direct relation to the densities or other known physical properties of the gases tried.

PARIS.

Academy of Sciences, February 1.—M. A. Chatin in the chair.—The election of M. Filhol in the Section of Anatomy and Zoology, in the place of M. Sappey, was approved by the President of the Republic.—On a mode of inversion of multiple integrals, by M. Paul Appell.—On the integration of certain differential equations by series, by M. Émile Picard.—Further details on an apparatus for producing acetylene, by M. H. L. Lechappe.—On a scheme of night signalling on railways by phosphorescence, by M. A. Boullerot.—On a new instrument designed to show the upward or downward movement in balloons, by M. Aug. Coret.—Distance of the solar system, by M. E. Roger. A discussion of the two laws enounced by M. Delauney. It is stated that the first law may be attributed to chance agreement, and that the second is a particular case of a more general law.—On the quadratic integrals of the equations of dynamics, by M. P. Painlevé.—On the laws of interest, by M. Enrico de Montel.—Generalisation of the formulæ of electromagnetism, by M. Vaschy.—On the molecular conductivity of salts in dilute solution, by M. P. Joubin.—On the radio-photography of the soft parts of man and animals, by MM. Remy and Contremoulin. Silver chromate is deposited by a preliminary chemical treatment on the surface, and in the tissues of the muscles. In this way photographs can be obtained by means of the Röntgen rays in which not only the muscles, but even the muscular bundles are clearly visible.—Structural isomerism and rotatory power, by MM. Ph. A. Guye and J. Guerchgorine. The results of an experimental study of the rotatory power of the amyl isovalerates, derived from the three isomeric valeric acids; of the propyl and butyl valerates, obtained from the active valeric acid; and of the propyl and butyl caproates, prepared with caproic acid obtained synthetically by the decomposition of active amyl-malonic acid. It is found that in all cases the normal propyl group behaves as though it were heavier than the isopropyl group, but that the isobutyl group appears to be heavier than the normal butyl group, whilst the latter, again, is heavier than the secondary butyl group.—Constitution of the combinations of antipyrin with phenols, by M. G. Patein. It is shown that monomethylphenyl-pyrazolone does not combine with phenols, and that the phenol is probably joined, in the case of the combination with antipyrin, to one of the nitrogen atoms.—On the estimation of lipase, the saponifying ferment in the blood, by MM. Hanriot and L. Camus. The estimation was carried out by measuring the amount of sodium butyrate formed by the saponification of butyrin during a fixed time. The activity of lipase prepared from the blood serum of the horse was shown by preliminary experiments to be unchanged after nearly two months' preservation; the temperature, however, exerts a considerable influence upon the results, and has to be kept constant during the determination.—On a new method of preparing anatomical specimens, by M. N. Melnikoff-Rasvédenkoff. The specimen is treated successively with a solution of formaline, alcohol (60 to 80 per cent.), and a solution made up of water (100), glycerine (20), and potassium acetate (15).—Separation of glycerine in wine by means of a current of steam, by MM. F. Bordas and Sig. de Raczkowski. Test analyses are given showing the accuracy of the method.—Contribution to the study of the action of zinc upon red wines, by M. L. A. Levat. The amount of zinc taken up by the wine is sufficient to make the latter poisonous, and this metal should not be used for taps, or for containing vessels of any kind in which wines are stored.—Structure and mechanism of the bulb in the Mollusca, by M. Alexandre Amandrut.—On a method of mounting rotifers, by M. Nicolas de Zograf. The rotifers are narcotised with a solutioc of cocaine hydrochloride, and then treated with osmic acid. This is removed and replaced by weak crude wood vinegar, then the animals washed with water and dried by alcohol. The rotifers fixed in this way do not contract their abdominal appendages, cilia, or tentacles.—The *castoreum* of the roach, by

M. Jules Gal.—New researches on the *Amylotrogus*, by M. E. Roze.—The forms of the parasite of the black rot from autumn to spring, by M. A. Prunet.—On the effects of oil at sea, by M. Baretge. An account of the successful use of oil in breaking up large waves during a storm. It was found that for the oil to produce its maximum effect, the vessel must have a certain speed depending upon the state of the sea. For the case described a speed of eight knots was found to be the most favourable.—Relations between the masses of the solar system, by M. Delauney.—Note on some questions in celestial mechanics, by M. J. Mortij.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 11.

ROYAL SOCIETY, at 4.30.—The Oviposition of *Nautilus macromphalus*: Dr. A. Willey.—Report to the Committee of the Royal Society appointed to investigate the Structure of a Coral Reef by Boring: Prof. Sollas, 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.—A Theorem in Non-Euclidean Geometry: F. S. Macaulay.—On some General Theorems relating to Conics analogous to Simson's-Line Theorem: H. M. Taylor.

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.—Note on the Use of very small Mirrors with Paraffin Lamp and Scale: Dr. H. H. Hoffert.—On the Thermoelectric Properties of Liquid Metals: W. Beckett Binnie.

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.

MONDAY, FEBRUARY 15.

SOCIETY OF ARTS, at 8.—The Industrial Uses of Cellulose: C. F. Cross.

IMPERIAL INSTITUTE, at 8.30.—Sixty Years of Submarine Telegraphy: Prof. W. E. Ayrton, F.R.S.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Adjourned Discussion on Mr. W. J. Dibdin's Paper on the Character of the London Water Supply.

VICTORIA INSTITUTE, at 4.30.—Are Acquired Characters Inherited?

TUESDAY, FEBRUARY 16.

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

SOCIETY OF ARTS, at 8.—The Progress of Canada during the past Sixty Years of her Majesty's Reign: Joseph G. Colmer, C.M.G.

ZOOLOGICAL SOCIETY, at 8.30.—On Echidnocephalus, a Halosauroid Fish from the Upper Cretaceous Formation of Westphalia: A. Smith Woodward.—On a Specimen of Acanthocybium solandi from the Arabian Sea: G. A. Boulenger, F.R.S.—Remarks on the Existing Forms of Giraffe: W. E. de Winton.

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

ROYAL STATISTICAL SOCIETY, at 5.30.—English Vaccination and Small-pox Statistics; with special reference to the Report of the Royal Commission, and to recent Small-pox Epidemics: Noel A. Humphreys.

ROYAL PHOTOGRAPHIC SOCIETY, at 8.

WEDNESDAY, FEBRUARY 17.

SOCIETY OF ARTS, at 8.—Light Railways: Everard R. Calthrop.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Report on the Phenological Observations for 1896: Edward Mawley, President.—Results of Observations on Haze and Transparency near Haslemere, Surrey: Hon. F. A. Rollo Russell.

ROYAL MICROSCOPICAL SOCIETY, at 8.—On a Simple Method of Micro-photography: G. M. Giles.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY, FEBRUARY 18.

ROYAL SOCIETY, at 4.30.—The following Papers will *probably* be read:—On the Iron Lines present in the Hottest Stars (Preliminary Note): J. N. Lockyer, F.R.S.—On the Significance of Bravais' Formulæ for Regression, &c., in the case of Skew Variation: G. U. Yule.—Mathematical Contributions to the Theory of Evolution. On a Form of Spurious Correlation which may arise when Indices are used in the Measurement of Organs: Prof. K. Pearson, F.R.S.—Note to the Memoir of Prof. Karl Pearson, F.R.S., on Spurious Correlation: F. Galton, F.R.S.

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

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

LINNEAN SOCIETY, at 8.—On certain Points in the Anatomy and Morphology of the Nymphæaceæ: D. T. Gwynne Vaughan.—The Adhesive Discs of Ercilla spicata, Uog.: T. H. Burrage.

CHEMICAL SOCIETY, at 8.—The Oxidation of Sulphurous Acid by Potassium Permanganate: T. S. Dymond and F. Hughes.—Sodamide and some of its Substitution Derivatives; also Rubidamide: Dr. A. W. Titherley.

CAMERA CLUB, at 8.15. Practical Use of X-Rays: Sydney Rowland.

FRIDAY, FEBRUARY 19.

ROYAL INSTITUTION, at 9.—The Approaching Return of the Great Swarm of November Meteors: Dr. G. Johnstone Stoney, F.R.S.

GEOLOGICAL SOCIETY, at 3.—Annual Meeting.

EPIDEMIOLOGICAL SOCIETY, at 8.

SATURDAY, FEBRUARY 20.

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

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Is Natural Selection the Creator of Species?: D. Graham (Digby).—Everybody's Guide to Photography: "Operator" (Saxon).—Everybody's English Song-Book: "Basso" (Saxon).—Star Atlas: Prof. W. Upton (Ginn).—Calendar, &c., of the Department of Science and Art, 1897 (Eyre).—Bacteria of the Sputa and Cryptogamic Flora of the Mouth: Dr. F. Vicentini, translated by Rev. E. J. Stutter and Prof. E. Saieghi (Baillière).—Les Succédanés du Chiffon en Papeterie: V. Urbain (Paris, Gauthier-Villars).—Projectiles de Campagne de Siège et de Place. Fusées: E. Vallier (Paris, Gauthier-Villars).—L'Éclairage: Éclairage aus Gaz, &c.: Prof. J. Lefèvre (Paris, Gauthier-Villars).—A Text-Book of Histology: A. Clarkson (Bristol, Wright).—Annales de L'Observatoire Météorologique du Mont Blanc, Tome ii. (Paris, Steinheil).—Bulletin of the Philosophical Society of Washington, Vol. xii. (Washington).

PAMPHLETS.—First Records of British Flowering Plants: W. A. Clarke (West).—Casa Grande Ruin: C. Mindeleff (Washington).—Some Analogies in the Lower Cretaceous of Europe and America: L. F. Ward (Washington).—Aboriginal Remains in Verde Valley, Arizona: C. Mindeleff (Washington).

SERIALS.—Scribner's Magazine, February (S. Low).—Journal of the Institution of Electrical Engineers, No. 125, Vol. xxv. (Spon).—Strand Magazine, February (Newnes).—Bulletin of the American Mathematical Society, January (New York, Macmillan).—Proceedings of the Royal Society of Edinburgh, Vol. xxi. No. 3, Pp. 161–248 (Edinburgh).—Physical Review, Part xxii. (Macmillan).—Geographical Journal, February (Stanford).—Proceedings of the Academy of National Sciences of Philadelphia, 1896, Part 2 (Philadelphia).—Bulletin of the U.S. National Museum, No. 47, Part 1 (Washington).—Iowa Geological Survey, Vol. v. (Des Moines).—Journal of the Academy of Natural Sciences of Philadelphia, second series Vol. x. Part 4 (Philadelphia).

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