THURSDAY, NOVEMBER 30, 1893.

THE MUMMY.

The Mummy. By E. A. Wallis-Budge, LL.D., F.S.A. (Cambridge: University Press, 1893.)

TEN years ago, and even less, the English readers of hieroglyphs might be counted on the fingers of one hand, without the thumb. They may now be reckoned by the score. The reasons for this movement—we can hardly term it a revival—are partly the opening of the Nile to any English tourist who can afford to travel at all. This is chiefly due to the ubiquitous Mr. Cook. But it would not be fair to mention it without also mentioning such authors as Dr. Budge, who have made what used to be a sort of secret knowledge, a sort of occult science, into one of the easiest branches of learning any one, especially an Englishman, can study. Hieroglyphs appeal to several different kinds of minds. People pictorially disposed find the representations of all kinds of common objects easy to remember, and very interesting to copy. The naturalist finds these curious old birds, beasts, fishes, and reptiles well worth learning, if only to find out why they stand for letters. The astronomer must work a little at them, on account of the light they throw upon the stars of a time so remote that α *Draconis* was then the Pole Star, and not α *Ursæ Minoris*. To the ordinary lover of languages the grammar of ancient Egypt is full of delightful surprises, as well as pitfalls, while he unravels a tongue spoken by Aryans, with Semitic inflections and Hamitic roots. We might go through the whole catalogue of 'isms and 'ologies, and yet find none in which hieroglyphs would not give some help; and, above all, they are so absurdly easy. The ancient Egyptian was quite determined that whensoever people did learn to read his inscriptions, there should be no kind of mistake as to his meaning, and one result is that many beginners find it possible, without knowing the pronunciation of more than a dozen words, to ascertain the sense of whole passages. There is one thing more. At the very root of all literary learning lies this marvellous invention of the Egyptians. Hieroglyphs are the parents of the writing of the Phenicians, Hebrews, Syrians, Greeks, and Romans; and consequently they are the by no means remote ancestors of our own alphabet, every letter of which is itself a modified hieroglyph. It is therefore curious to remark that the printing and publishing of Dr. Budge's book is the first effort on the part of any university in the three kingdoms to encourage the study of Egyptology. A kind of exception may be made in favour of University College in Gower Street, which accepted a legacy left by the late Miss Edwards to found the chair now occupied by Prof. Flinders Petrie. But the work now accomplished by the Syndics of the Cambridge University Press, must be followed in the sister universities, and there are signs already of a movement in this direction. Dr. Mahaffy of Trinity College, Dublin, is known to have acquired a share in the wisdom of the Egyptians, and the university of Oxford has given the honorary degree of D.C.L. to Mr. Petrie. Under these circumstances, therefore the appearance of Dr. Budge's book is opportune. Only a few weeks ago a young gentleman was found trying to learn hieroglyphs from Sir Gardiner Wilkinson's six volumes of mingled learning and ignorance. Even in Dr. Birch's great three-volume edition of Wilkinson, there is nothing practical to be gleaned. From this time there will always be a handy work, which can be recommended to the would-be student, a work as profound in linguistic learning as it is easy and simple in communicating it. There are points in which we differ with Dr. Budge, yet we cannot exactly impute them to him as errors. For example, we do not always like his transliterations, in which he is loyal to the system now long in vogue among the best class of scholars on the continent. He has not gone in for the recent French absurdities in this respect, nor, on the other hand, has he followed Herr Erman into his impossible quests after exact pronunciation. This is not the only point on which we are inclined to quarrel with that learned and whimsical German; but it must not for a moment be supposed that there is anything controversial about the calm pages of Dr. Budge's "Mummy." On the contrary, when we consider that there is not a statement in the book that has not at one time or another been called in question, not a chapter that has not been fiercely debated, we must concede to the author a credit for moderation very remarkable. True, he has disdained even to mention the difficulties to which such books as the French catalogue of the Gizeh Museum, or M. Maspero's later works, expose a student. The method pursued by Dr. Budge is the safest. Conceivably, better systems may be constructed, but we must remember that it is by the present system that the great discoveries of Lieblein, Lepsius, Marriette, Birch, and so many others have been made.

Dr. Budge tells us in the preface that this volume was originally written to form the introduction to the *Catalogue* of the Egyptian collection in the Fitzwilliam Museum. It is, however, a complete book in itself, and forms, in a series of condensed, but perfectly clear essays, a very handy encyclopædia of all branches of Egyptology. The first five chapters are historical, and are followed by a list of the dynasties and the dates assigned to them by different authorities. The divergences here are startling. Champollion Figeac placed the first dynasty at B.C. 5867; Wilkinson at B.C. 2320. Dr. Budge evidently prefers the B.C. 4400 of Brugsch. Lists of nomes and of cartouches follow, and then we have one of the most interesting chapters in the book, that on the Rosetta stone and the recovery of the Egyptian alphabet. The priority of Young to Champollion is clearly made out, though Herr Erman is doubtful; and Mr. Renouf prefers the claims of Champollion. But Dr. Budge clearly proves that, though Young has precedence of Champollion, Akerblad, a Swede, has precedence of both. Some fifty pages are occupied by this interesting discussion, and then we come to the "piece of resistance," the title *rôle* of the whole book, namely, the Mummy. An Egyptian funeral is minutely described. Next, we are told how the mummy was prepared; a subject to which we must briefly return when we have described the rest of the contents. Mummy cloth, embroideries, canopic jars and chests, come next. Eight pages are devoted to the Book of the Dead, and then we have a careful description of the different amulets, such as inscribed

scarabs, figures, hearts, and so on, which are found in tombs. The names and figures of forty-six gods are next identified, and after them twenty-eight sacred animals. There are some interesting notes on coffins, followed by accounts of pyramids, mastabas, and tombs. A chapter contains particulars of Egyptian writing; and after some minor articles the book concludes with two lists, one of common hieroglyphic signs, and one of the determinatives most frequently observed. As the determinative is always the beginner's surest guide, this last list will probably be taken first by many readers. The scope and probable usefulness of this remarkably complete treatise will have been gathered from the above summary.

We now turn back to the middle of the volume. Dr. Budge cannot decide whether the art of mummifying was known to the aboriginal inhabitants of the lower Nile valley, or was imported from Asia by the first Aryan settlers. He speaks of the venerable stele of Shera, a dignity of the court of Sent, the fifth king of the second dynasty, whose date is placed at about B.C. 4000. This monument is preserved at Oxford, but Dr. Budge ought to have mentioned here that a portion of it is in the Gizeh Museum. The French cataloguer of that collection omits all mention of the Oxford stele. So they are even; but each portion gives different items of information. On this monument Shera prays the gods "to grant sepulchral meals," from which Dr. Budge infers "that the art of elaborate sepulture had reached a high pitch of perfection in those early times." He notes incidentally that a redaction was made in the reign of this king Sent of a medical papyrus, from which it is clear that the Egyptians were already possessed of anatomical knowledge sufficient to enable them to preserve the human body as a mummy or otherwise. Manetho, the Ptolemaic chronicler, expressly states that Teta, the second king of Egypt, wrote a book on anatomy, and also studied the properties of drugs. His mother, Shesh, invented a hair-wash. Although, then, some form of mummifying must have been in use at a very early period, it does not follow that it was always practised. Bodies were sometimes preserved in honey, as, for example, that of Alexander the Great; and Dr. Budge quotes a gruesome story from Abel el Latif, about the body of a child found in a jar of honey. The body of Mycerinus, now in the British Museum, seems to have been wrapped in cere-cloth—if the Egyptians had honey, they also had wax. Skeletons of this ancient period usually fall to pieces when exposed to the air. The oldest mummy, strictly so called, which has been identified, is that of Seker-em-sa-f, B.C. 3200, a king of the sixth dynasty, which is now at Gizeh. A few fragments of the mummy of Unas, of the fifth dynasty, are in the same collection—part of the skull, only, and a hand. As to mummy cloth, Dr. Budge corrects a prevalent error. Almost all the older writers asserted that mummies were wrapped in cotton. Jomard thought linen was also used; but a learned Fellow of the Royal Society, having obtained, in 1834, four hundred specimens of bandages, ascertained that they were all of linen. A piece of fine texture was found to have five hundred and forty threads to the inch in the warp, and one hundred and ten in the woof. Nobody who has seen the wrappings, of a delicate salmon colour, which were in the coffin of Thothmes III., can forget that they were as fine as the finest lady's handkerchief of the present day. Dr. Budge's views on the subject of pyramids will not tally with those of numerous very worthy persons now, we may hope, of a more reasonable mind. In Cairo, a very short time ago, the only book on pyramids to be had by tourists was that of the late Scottish Astronomer Royal, which was written to prove that the Great Pyramid was erected to embody the truths of revealed religion. Dr. Petrie's book was nowhere to be seen. Now all is changed. Messrs. Cook and Son employed Dr. Budge to write a little book on the Nile voyage, a copy of which is in the hands of every tourist, and the pyramid inch and the great passage theory have become curiosities of history. Dr. Budge says briefly, "the royal tombs of the early dynasties were built in the form of pyramids, and they are, to all intents and purposes, merely mastabas."

ESKIMO LIFE.

Eskimo Life. By Fridtjof Nansen. Translated by W. Archer. 350 pp. (London: Longmans, Green and Co., 1893.)

WHEN Dr. Nansen reached the west coast of Greenland, after his memorable journey across the continent, he found that the last ship of the year had left for Europe, although he had altered his plans and steered for Godthaab instead of the more northerly Christianshaab, partly in order to avoid being detained in the country during the winter. He was, however, compelled to spend the winter among the Eskimos, and his observations and reflections on the character and everyday life of the race are embodied in the book before us.

Dr. Nansen admits the impossibility of attaining a complete and thorough knowledge of so peculiar a people in so short a time as one winter, but his own experiences and impressions have been supplemented by reference to the writings of all the most competent authorities—the Egedes, Crantz, Rink, Holm, and others.

The early history of the Greenland Eskimo is obscure, and anything like certainty dates back no further than 1721, when Hans Egede, the Norwegian missionary, took his wife and children, and settled on the west coast with a view of improving and civilising the native race. From that time to the present, however, the history of the people is well known, and a study of this period affords one of the best examples of the development and changes which so-called lower races undergo, when subjected to the influence of western European civilisation.

The first part of Dr. Nansen's book is concerned with the daily life of the modern civilised Greenlander, and the chapters on the kaiak, or skin-boat, and the weapons used in hunting the seal and other characteristic game of the Arctic seas are excellent.

It is interesting to note that this section of the Eskimo race use the throwing-stick, which enables them to throw the harpoon and bird-dart with greater force and accuracy than with the unaided arm alone. This instrument is only met with among two or three races of men, so widely separated from each other as to preclude the idea of a common origin of the invention.

The character and social life of the people is portrayed in three or four of the succeeding chapters. [Little

acquaintance with the writings of Nansen is necessary before it is seen that he possesses a flexibility of mind and deep sympathies which enable him to enter into peculiar touch with a race of this character.

Chapter xiii. deals with the religious ideas and myths of the Eskimo. This part of the volume is necessarily second-hand; but so far as the facts are concerned, nothing remains to be desired. It seems to us, however, that there is too great a tendency to look upon these legends and tales as matters derived from foreign influence, notably that of the early Scandinavian explorers, from the time of Erik the Red (986 A.D.) to about 1400 A.D. There is some similarity between the legends of the Scandinavian and the Eskimo, but Dr. Nansen, in dealing with the origin of those possessed by the latter, does not apparently allow enough for the possibility of spontaneous growth of the same idea in two widely separated races. The Vikings have had little influence upon the daily life of the Greenlander, and it is very improbable that the latter would borrow recondite philosophy, or lore of any kind, from the former.

If true similarity does exist in such cases, it is more likely to be due to the inherent similarity of the powers of the human mind to invent explanations for incorrectly understood phenomena.

In the concluding chapters are given the results which have been achieved since the introduction of Christianity 150 years ago. The first European settlement found a people who were nearly blameless, full of practical socialistic sentiment, generous and open-hearted, truthful, private property almost unknown, poverty non-existent, able to live peacefully and contentedly in surroundings in which Europeans, with all modern resources, are taxed to the utmost to exist through winter, healthy and full of patience. To-day disease, poverty, and distress are abundant. These changes, which must be looked upon as bad for the Eskimo, whatever the intentions of the settlers may be, are brought about by causes which are to a large extent obvious, and Dr. Nansen's advice to all those who have the welfare of the native race at heart, is to leave the country, and allow the people to make the shortest cut back again to their pristine state.

The translator's work has been admirably done.

J. P.

OUR BOOK SHELF.

La Voie Lactée dans l'Hémisphère Boréal. By C. Easton. With a preface by Prof. H. G. van de Sande Bakhuyzen. (Paris: Gauthier Villars et Fils, 1893.)

THE Milky Way, "that broad and ample road, whose dust is gold and pavement stars," almost defies accurate delineation. Its irregular outlines and indefinite structure tease the eye of the artist, and renders his task most difficult. In all probability the largest amount of information with regard to this celestial zone "powdered with stars" will be obtained from photographs taken by means of portrait lenses having a wide field, similar to that employed by Prof. Barnard for his beautiful pictures. There is much to be gained, however, by the multiplication of maps such as those of M. Easton, in which the aspect of the Galaxy to an observer having normal eyesight is shown. The maps are finely drawn and reproduced, and well show the delicate gradations of galactic light. A detailed description and historical notice give the atlas additional interest, while a catalogue of the patches and streams of luminosity, and the dark regions, will be of use to those who theorise on the structure of the stellar universe. A comparison of the maps with those drawn by Boeddicker reveals many differences, but it cannot be said on this account that either of the observers is wrong. No two observers have eyes exactly alike, or are favoured with precisely the same observing conditions, hence drawings of the Milky Way, like those of nebulæ, simply represent the appearances presented to certain visions, and are only approximations to the truth. M. Easton's maps are published in a very handy form, and may be added with advantage to every astronomical library and observatory.

An Elementary Treatise on Analytical Geometry. By W. J. Johnston, M.A. (Oxford: Clarendon Press, 1893.)

IN these 400 pages Mr. Johnston has ably succeeded in producing a very excellent treatise which leads the beginner by easy stages from the first principles of the subject to the more complicated theorems in trilinear coordinates. In the first ten chapters the student is made thoroughly familiar with the properties of the Ellipse, the Parabola, and the Hyperbola, after having been well exercised in the more preliminary parts of the subject as regards co-ordinates, the straight line, loci, &c. In these chapters it seems that the beginner can hardly fail to obtain a thorough grip of their contents, unless indeed he goes out of his way to do so, for more details could hardly be added. The numerous worked-out exercises should also be valuable, as they show him how to apply the knowledge gained from the various theorems learnt as book work. The next three chapters deal with the general equation of the second degree, confocal conics, and abridged notation, the last-mentioned including a large number of miscellaneous exercises; in these may be mentioned some additional methods of tracing a conic whose Cartesian coordinates are given, and an investigation of the equation of a diameter due to Prof. Purser. The remaining chapters treat of trilinear coordinates, envelopes, and methods of transformation. Here may be noticed Prof. Genese's proof of Feuerbach's theorem, Pascal's theorem, and many others of interest.

As an elementary book one may say that, from a beginner's point of view, we have here a sound and clearly written volume that will be sure to find favour with students and teachers. Perhaps it may be better for those commencing the subject to pursue the limited course recommended to them by the author, but a little more of an insight will show them what to read. Advanced students will also find much of interest in the latter chapters, and to them we can specially recommend the working out of some of the numerous and well-chosen examples.

Zur Kenntniss der Postembryonalen Schädelmetamorphosen bei Wiederkauern. By H. G. Stehlin. (Basel: Benno Schwabe, 1893).

THIS publication deals with a branch of osteology which up to the present time possesses no special literature of its own, and is an attempt to trace the changes which take place in the skulls of ruminants from the time of birth up to adult age. The skulls of Bos, Capra, and Portax are studied in a most exhaustive manner at different ages, and comparisons drawn; elaborate measurements being given in every case. Special attention is paid to the effects produced by the development, final size, and position of the sinuses, teeth, and horns; also, the differences between the skull at birth and at adult age are considered in relation to rate of growth of the animal, and its length of life. In the last chapter the three types, Bos, Capra, and Portax, are contrasted with each other, and a number of other forms described, their relations to these types being indicated.

The plates illustrate most fully the points made out, in many cases a longitudinal section of the skull of the animal at birth being printed in red over a drawing of one of adult age, both drawings having been reduced to scales which render comparisons of form possible.

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.*]

Suggested Nomenclature of Radiant Energy.

HAVING recently had occasion to develop the first principles of the theory of inter-stellar radiation, I soon felt the want of some short and convenient word to express that form of ethereal wave-effect known as "radiant energy," "radiant heat," "light," "rays of the spectrum," &c. Radiant energy is doubtless the most accurate of these expressions, but it is subject to the objection of being a description rather than a name. The nomenclature of the subject has come down from a time when it was supposed that there were three distinct kinds of rays in the spectrum, severally known as light, heat, and actinic rays. It is, I believe, not much more than half a century since several eminent physicists and teachers supposed that the heat rays of the spectrum could be separated from the light rays having equal refrangibility by the absorption of a transparent medium; and that even the light rays of different colours might be separated in the same way. I cannot but think that the general understanding and application of the now received theory of the subject, which recognises in this form of energy no differences of kind except wave-length, has been materially retarded by the want of a corresponding nomenclature.

The use of the word "light" for ethereal waves having a length between certain definite limits, while there is no corresponding word for other waves, is evidently unscientific. Notwithstanding the great practical usefulness of light, its distinctive property of affecting the optic nerve in a certain way can claim only a secondary place in physics. Indeed, it has long seemed to me that the banishment of the word "light" from physics was a desideratum.

After various attempts I hit upon the very simple term *radiance*, as one which seemed well-fitted to supply the want in question. The vague and poetic idea hitherto associated with it is an advantage, because it enables us to adapt it to the case in hand with greater readiness than we could adapt a word which already had some well-defined meaning. Shakespeare speaks of the "sacred radiance of the sun"; while Milton describes the Deity as "Girt with omnipotence, with radiance crowned." We can thus adopt the word to express scientifically what we now consider to be electro-magnetic waves, or ethereal waves, without that clashing of ideas which might arise from making a new application of an old word, and without the awkwardness of coining a new one.

The necessary derivatives and compounds of the word can be formed with as much ease as we should expect in the case. The verb "radiate" will mean to emit radiance. I do not think any confusion will arise if we use the word "illuminate" to signify the throwing of radiance upon a material body, although in ordinary language it implies light. Possibly the extent to which it is used in a tropical sense may facilitate the widening of its literal meaning. *Radiometry* would mean the measure of radiance, and an instrument for effecting such a measure would naturally be called a radiometer. It is perhaps unfortunate that the instrument in question should then assume the name of Crookes' beautiful little instrument, but an apology may be found in the fact that the latter has not been used for the purpose of exact measurement. The use of the word "radiometry" offers no such difficulty.

I am still a little perplexed for a word which shall express the quality hitherto called transparency, diathermancy, &c. Apparently we have no alternative but to continue the use of one of these objectionable words, or invent some such new word as transradiant, or transradious.

The proper measure of radiance, and the only measure which can be regarded as of real importance in physics, should be the amount of energy radiated in unit time. This measure is equivalent to that of heat generated in unit time in the absorption of radiance by a perfectly black body. If we reflect that this, and this alone, measures the actual loss of internal energy by a radiating body of any kind, whether ball of iron in a laboratory, planet, star, or nebula, the importance of some simple nomenclature of measurement will be evident. I should be much pleased if physicists would find by actual trial whether the use of the proposed words comes as natural to them as it has to me.

SIMON NEWCOMB.

The Postal Transmission of Natural History Specimens.

IT has always been recognised that scientific research is greatly furthered by the exchange of the various objects with which that research is concerned. For the transmission of objects of Natural History from one country to another, the mails have offered a cheap, speedy, and trustworthy means. Heretofore, through the laxity with which the regulations on the subject have been enforced, it has been possible to enter such objects in the mails of the Universal Postal Union as samples of merchandise and under the rates of postage therefor. From official information lately received from the Post Office Department of the United States it appears that such a rating is entirely unauthorised by existing provisions, and that objects of Natural History may be mailed to countries of the Union only, at the rates required for letters. The United States Post Office Department also stated that it had recently submitted a proposition to the countries composing the Postal Union to modify the regulations so that such specimens might be received into the mails at the same rates as samples of merchandise, but that a sufficient number of those countries had voted against the proposition to defeat it.

This Academy has therefore resolved to address the various scientific bodies, with which it is in communication, in those countries whose Governments have voted against the proposition, and to request those scientific bodies to memorialise their respective Governments in favour of the same.

The Governments of Austria, Bolivia, British India, Canada, Germany, Great Britain, Guatemala, Hungary, Japan, Norway, Portugal, Russia, Spain, Sweden, Tunis, Uruguay, and Venezuela having voted in the negative, this Academy respectfully requests the favourable consideration of this question by scientific societies, and begs that they take such steps as they deem advisable to inform the Postal authorities of their respective Governments of the manifest advantages to scientific research which would result from the adoption of the proposed modification, and to request those authorities to take such steps as may result in the adoption of the same.

The letter rate for postage (Universal Postal Union) is ten times that required for samples of merchandise; such a rate for specimens of Natural History is virtually prohibitive.

This Academy would respectfully urge upon scientific societies prompt action in this matter, if it meets with that approval which we so strongly desire.

ISAAC J. WISTAR, *President*.
EDW. J. NOLAN, *Recording Secretary*.

Philadelphia, November 14.

Flame.

HOWEVER thoroughly a B.A. audience may have allowed Prof. Smithells, by means of his beautiful experimental demonstrations, to hypnotise them into unquestioning belief in his conclusions, those who read the account of his lecture in the pages of NATURE will not all be equally disinclined to question the validity of some of his arguments.

To tell us that Dalton, as a matter of fact, long ago *settled* the question as to which has the preference—the carbon or the hydrogen—when a hydrocarbon is burnt with insufficient oxygen, is, after all, but to appeal to the gallery; and this and other conclusions arrived at by Prof. Smithells appear to me to involve the use of that process of circular reasoning which consists in taking for granted that which is to be proved—a method which at the present day finds such favour in certain quarters.

As I discussed this matter somewhat in detail in a correspondence with Sir G. G. Stokes last year (Chem. Soc. Proceedings, 1892, No. 106, p. 22), it is unnecessary to go fully into it now. Any number of analyses showing the presence of hydrogen in the products of combustion may be quoted without materially ad-

vancing the settlement of the question. In my opinion, there is no improbability inherent in the assumption that hydrogen is but a secondary product, resulting from the interaction of the primary products—water and either carbon or carbon monoxide. The rate at which the interactions take place in flames are such, and the conditions are such, that the products *collected* are probably far from being the *products of the initial interchanges*, as indeed Prof. Smithells himself admits to be the case. It is scarcely likely that the settlement of such a question can ever be achieved by direct observation. Our ultimate views on the nature of the changes occurring in flames must depend on the gradual growth of a true understanding of the nature of chemical interchanges in general, and especially in gases.

I am inclined to take the same view with reference to Davy's explanation of the luminosity of flame. If eventually, as is not improbable, we come to regard the expressions *chemical interchange* and *electrolysis* as interchangeable equivalent terms, much more will have to be said on behalf of Frankland's hypothesis. I had the good fortune to attend the philosophic lectures at the Royal Institution in which Frankland, in 1868, first fully stated his views on this subject, illustrating his arguments by a series of most striking experiments. No course of lectures ever impressed me more, and to the present day I have the most vivid recollection of all that passed. An account af the lectures was published in the *Journal of Gas Lighting* at the time of their delivery. It has always appeared to me that Frankland's arguments are of a most weighty character, and that owing to their appearance in an obscure publication they have never yet been sufficiently widely considered.

The study of flame affords problems of the highest interest and importance, but of proportionate complexity and difficulty. There is little doubt, however, that we are inclined to take too narrow a view of this as of many other inquiries—that we have an unreasoning belief in what we are pleased to call facts, forgetting that these same "facts" are but phenomena interpreted by our own limited intelligence. On studying the views that have been taken at various times, it is only too obvious that fashion is not confined only to garments, nor is dogma the exclusive privilege of theologians; and it is time that we realised that very many of our conclusions regarding chemical interchanges are but the crudest dogmas, based on a thoroughly superficial consideration of the phenomena. If we are to deserve the title of scientific workers—workers exact in deed, thought, and word—we must be far more careful in the choice of our language, and guarded in our conclusions.

HENRY E. ARMSTRONG.

"Geology in Nubibus."

SIR HENRY HOWORTH wishes to continue the discussion of glaciation in the pages of NATURE, but I find in his last letter very good reason why this cannot be done. No discussion can lead to definite results unless the parties to it accept as data what they themselves have recently and deliberately admitted. But when I stated that the Rhone glacier *did* reach the Jura, and deposit on it erratic blocks between Geneva and Soleure, I did so because it was one of the data already admitted by Sir H. Howorth. In his "Glacial Nightmare," pp. 169-173, he gives a full summary of Charpentier's first memoir on the erratic blocks of Switzerland, describing the glacial phenomena exhibited along the whole course of the old glaciers from the Alps to the Jura, and showing that they "even climbed that range and went over to the other side of it." Sir H. Howorth then says: "I have quoted at considerable length from this excellent memoir, because I look upon it as having definitely applied *inductive methods to this question* with results which are for the most part *sound and unanswerable.*" (Italics mine.) In the same chapter (pp. 195-202) Charpentier's second memoir is summarised still more fully, and his general conclusion is thus quoted: "It goes without saying that not only all the valleys of the Valais were filled with ice up to a certain height, but that all lower Switzerland, in which we find the erratic débris of the Rhone valley, must have been covered by the same glacier. Consequently all the country between the Alps and the Jura, and between the environs of Geneva and those of Soleure has been the bed of a glacier." Agassiz and other writers are quoted as giving further evidence of the same kind. Nowhere in the whole of this chapter can I find a single objection to the conclusions of the chief writers quoted, and the concluding paragraph, at p. 208, frankly accepts them. It declares that they are supported by "every form of converging evidence," and that—"So far there is no question at issue." Yet, when I take these same conclusions of Charpentier as admitted data, Sir H Howorth says: "This form of dogmatic argument is assuredly incomprehensible!" Charpentier's proof that the Rhone glacier reached Soleure, was, a year ago, "sound and unanswerable," and was an example of "definitely applied inductive methods"; but when I accept these same results as something to reason upon, I am told that I am making use of "hypotheses outside the laws of nature." I have now justified my opening statement that a discussion carried on in this manner can serve no useful purpose.

ALFRED R. WALLACE.

Correlation of Magnetic and Solar Phenomena.

IN Mr. Ellis' letter on this subject (NATURE vol. xlix. pp. 30), he says:—

"To sum up, the points of the matter may be thus stated:—(1) The solar outburst in 1859 was seen independently by two observers: the fact of its occurrence seems therefore undoubted. (2) The corresponding magnetic movement was small. (3) Many greater magnetic movements have since occurred. (4) No corresponding solar manifestation has been again seen, although the sun has since been so closely watched."

Now, in the year 1882, I was acting as assistant to the Solar Physics Committee, and on November 17 there was a dense fog, so that it was not possible to take the usual solar observations. Mr. Lockyer was present in the morning, and then left for some reason; after he had gone, a telegram came for him; he returned late in the afternoon, and sent for me, told me the telegram was from Mr. Preece, of the Post Office, asking him whether there was a solar disturbance, as there was such a violent electrical storm raging, that communication had been cut off from the continent, and that it was difficult to maintain communication in England. I at once went to the instruments, and as the fog cleared just before sundown, was able to ascertain that there was a large group of spots near the sun's meridian, attended with most violent uprushes of luminous matter; indeed, if my memory serves me aright, it was the most violent disturbance I saw during the whole of my observations, extending from 1879 to 1886. On reporting to Mr. Lockyer, he said we should probably see an aurora in the evening; and as soon as it was dark, there was a most brilliant auroral display that exhibited some quite new features (NATURE, vol. xxvii. pp. 82 *et seq.*) Doubtless, had this spot been kept under observation, luminous outbursts similar to those observed by Carrington and Hodgson would have been seen; indeed, Mr. Whipple's letter (*loc. cit.* p. 83) seems to contain such an observation.

I believe, but am not quite sure, as the records of the observations are in Mr. Lockyer's possession, that it was in this spot that he and I first noticed that some of the so-called iron lines in the spot spectrum were in motion, while others were not.

H. A. LAWRANCE.

Gunnersbury, November 19.

New Variable Star in Andromeda.

A STAR that should be added to the list of variables is + 26°43, of the Bonn *Durchmusterung*, in which work its magnitude is given as 8·7. In reply to a letter of mine, in which I expressed a doubt as to this star's existence, Dr. Küstner, of Bonn, informed me that although he had on the 7th of this month looked in vain for the star with the 6-inch refractor of Bonn Observatory, yet it seemed pretty certain that a star had twice been observed in the specified place in September, 1855. I have subsequently been informed by Sir Robert Ball, that the star was twice observed at Cambridge (England) in 1878. The dates and places of the various observations, as well as the estimated magnitudes, are:—

Sept. 7, 1855, Bonn, 9·0 (but perhaps 9·2).
Sept. 10, 1855, Bonn, 8·3.
Nov. 29, 1878, Cambridge, 8·7.
Dec. 11, 1878, Cambridge, 8·7.

The star's mean place for 1894·0 is

R.A.	0h.	16m.	51·3s.
Decl.	+26°	24′	27″

THOMAS D. ANDERSON.

21 East Claremont Street, Edinburgh, November 22.

Protective Habit in a Spider.

MR. R. I. POCOCK'S interesting paper in your issue of November 16, leads me to place on record an observation I made last summer in the island of Arran. Sitting by a little clear pool in the granite of Glen Sannox, I noticed a spider whose web was spun in the heather which partly overhung the stream. On disturbing her, she dropped on to the granite a few inches above the water, and running rapidly down, entered the pool and hid under a tuft of weed. After remaining thus hidden for 2½ minutes, she returned to the surface and, reeling herself up by her thread, regained the web. Disturbed again, she repeated the action, remaining under water 1¾ minutes. A puff of tobacco smoke sent her down a third time, when she remained hidden for 2¼ minutes. In each case she hid in the same place, and in each case regained the nest by her thread.

I have placed the spider in Mr. Pocock's hands. He informs me that the species is *Epeira cornuta*, or possibly *patagiata*.

University College, Bristol. C. LLOYD MORGAN.

THE LOSS OF H.M.S. "VICTORIA."

FOUR weeks ago the Admiralty issued a minute upon the proceedings of the Court-Martial appointed to inquire into the loss of H.M.S. *Victoria;* and also a further minute upon the construction and stability of the ship, and a report by Mr. W. H. White, the Director of Naval Construction, upon such parts of the evidence given at the Court-Martial as throw light upon the causes of the foundering or capsizing of the ship.

In the first-named minute the Admiralty concur with the finding of the Court-Martial, as regards the causes of the collision with the *Camperdown*, and the distribution of blame among the officers concerned:—matters with which we shall not now attempt to deal. The other two relate to the construction, buoyancy, and stability of the ship, and discuss facts and questions relating to these points, which demand the careful attention of all who are interested in the efficiency of the Navy. These minutes deal with matters for which the Admiralty is felt to be responsible, and to be, to some extent, upon its trial. The question of Admiralty responsibility for the efficiency of the *Victoria*, and her power to withstand such a blow as she received, has been hitherto treated and discussed as though it were merely one of who designed the ship. In this case, the circumstances are somewhat peculiar, for her original designer, Sir N. Barnaby, retired from the Admiralty service in 1885, immediately after the vessel was ordered to be built, and before she was even in frame. Many alterations were afterwards made during the progress of construction, and everything considered necessary for safety or efficiency was done by others, during the five years that passed before she was finally completed. Whether the early design were good or bad, the responsibility for the ship as she was completed and commisssioned, and passed into the Navy as a first-class battle-ship in 1890, surely rests with those whose duty it was to watch her construction, and to ultimately certify to her fitness for the class in H.M. service in which she was placed. The question of who was responsible for the design of the *Victoria* as it first stood, has now little more than an historical interest. That of the responsibility for completing and fitting her out for sea, and passing her into the Navy as a first-class battle-ship, is the only one of real practical importance at the present time, if it be thought necessary to discuss the matter.

This being the state of the case with regard to the question of responsibility, we can only regard the minutes relating to the buoyancy and stability of the *Victoria* as the best defence of the ship that is possible. It may be a perfectly good defence, but it is obviously *ex parte*, and can only rightly be judged as such. Had a Committee of Inquiry been appointed, these minutes represent the case that would have been laid before it by the Admiralty, and would have been examined from various points of view, and adjudicated upon. The Admiralty has preferred to treat the public as competent judges, and to lay their case before them in a form which bears the outward semblance of a judicial decision. The minutes are, however, upon some points more in the nature of a pleading than a judgment; while they are, at the same time, much too technical and complex for any but the most competent experts to judge. It is to be regretted, in the interests of the Navy and the country, that the facts and opinions thus put forward are not referred to a competent and impartial body for examination and report.

Mr. White's report summarises the evidence respecting the behaviour and movements of the *Victoria* after she was struck by the *Camperdown*, and gives the results of calculations respecting the effect of filling compartments in the neighbourhood of the blow, which appear to agree, in the main, with the reports of observers. The calculations employed are, as he states, quite simple in character; and no one who knows the Construction Department of the Admiralty, or the men in it who perform this class of work, could doubt their substantial accuracy. An important point in connection with them is, however, the assumptions upon which they are based. Some of these may be more or less open to question; while nothing is said as to the information the officers had respecting the rapidity with which the *Victoria* might be sunk if rammed. It appears evident that no one on board imagined the ship could sink, after such a blow as she received, without giving time to close the water-tight doors; and it appears, also, that some of the water-tight doors could only be closed by going into compartments into which the sea first obtained access.

These questions, and the more general one of the light that is thrown upon the efficiency of other ships of the same class by this sad disaster, respecting which the Admiralty minutes say nothing directly, though they imply that nothing unsatisfactory is indicated, appear deserving of close and careful consideration. The following remarks will be devoted to an attempt to describe how the matter, and the light thrown upon it by the recent Admiralty minutes, strikes one who is intimately acquainted with the ships of the Navy, and has studied the technical questions which have been raised, from time to time, respecting them.

The subjects treated of in the two minutes now under consideration may be classified as follows:—(1) The nature of the blow received by the *Victoria;* (2) her after-movements and behaviour up to the moment when she capsized and sank; (3) the extent to which water found access into the ship; (4) the effect of the water thus admitted upon the line of flotation and the stability; and (5) the lessons that are taught by various circumstances attending the loss that have come to light.

1. *The nature of the blow received by the "Victoria."*—Before the commencement of the manœuvre that immediately preceded the disaster, the ships of the squadron were steaming in two parallel lines, about 1200 yards apart, at a speed of about 8¾ knots. The course was ordered to be reversed by turning the ships inwards between the lines. The *Victoria's* helm was put hard to starboard, at an angle of 35°, and the *Camperdown's* helm was put over to port, at an angle of 28°. With these helm angles the *Victoria* would turn in a circle of 600 yards diameter, and the *Camperdown* in a circle of 800 yards diameter. A collision was therefore inevitable with both ships continuing at the same speed. When both had turned through eight points, or a right-angle, they were end-on to each other, at a distance apart which was estimated at 400 to 500 yards. It was then seen that a collision was imminent, and the port engines of the *Victoria* and starboard engines of the *Camperdown*

were ordered to be reversed at almost the same instant, about one minute before the collision, in order to make the ships turn more quickly. Orders to go astern with both sets of engines followed immediately in each ship.

The *Camperdown's* speed on striking the *Victoria* was estimated at 5 to 6 knots, and appears to have been rather less than 6 knots. The *Victoria's* speed ahead at the same time was about 5 knots. The blow was struck at an angle of about 10° abaft the beam of the *Victoria*, and at a distance of about 65 feet abaft the stemhead. The vertical portion of the *Camperdown's* stem penetrated 5½ to 6 feet into the side of the *Victoria*, and the point of the ram, which projects 7 feet beyond the vertical portion of the stem, penetrated 9 feet within the bottom plating at a depth of about 12 feet below water. The breach thus made in the side of the *Victoria* appears to have been 220 or 230 square feet in area; of which over 100 square feet was below the water-line. It extended vertically downwards 28 feet from the upper deck, and 18 feet from the water-line, and was 12 feet wide at the upper deck, and 11 feet wide at the water-line. The ships were locked together for over one minute, during which time their sterns swung together through an angle of 20°. As the blow was struck just before a water-tight transverse bulkhead, it appears probable that the water-tightness of the division thus formed was destroyed, either by the first shock or by injuries subsequently received, as the sterns of the two ships swung towards each other, while they were locked together.

2. *The movements and behaviour of the "Victoria" after being struck, up to the moment when she capsized and sank.*—Mr. White gives a clear description of this, which agrees with the evidence of officers on board other ships, who observed carefully what was happening to the *Victoria*. The force of the blow given to the bow of the *Victoria* caused it to move over at first 60 or 70 feet to port. The two ships remained locked together about one minute,[1] and as the *Camperdown* moved astern and cleared the *Victoria* settled down rapidly by the bow, and heeled towards the starboard side. The bow sank 10 feet during the first four minutes after the collision. Two minutes later the water had risen so high on the forecastle, which was originally 10 feet above water, that the men working there had to be called away. In nine to ten minutes after the collision the sea was entering the open turret ports, 100 feet from the bow and 14 feet above the original waterline. The upper deck right forward was then 13 feet below water; the armour-door in the bulkhead at the fore end of the upper deck battery, which was open, was partly under water; and the two foremost gun ports on starboard side, also open, were awash. The forward part of the upper deck was thus submerged for nearly half the length of the ship, and the stern was lifted about 8 feet. Simultaneously with this rapid depression of the bow and elevation of the stern, the ship was continuously increasing her heel to starboard up to about 20°, and when this position had been reached, nine or ten minutes only after the collision, she gave a lurch to starboard, turned bottom up, and sank by the head. When the lurch began the vessel was steaming slowly ahead with both screws, and the helm was hard over to starboard.

The speed ahead, due to an attempt to steam slowly towards the land, and the helm being over to starboard, tended somewhat, as Mr. White points out, to increase both the depression of the bow and the heel to starboard. Even a very low speed would have a serious effect, after the fore end of the upper deck became submerged, in forcing it still deeper below water, and in driving water into the interior of the ship through the openings on and above the upper deck. The helm was kept over because the hydraulic steering gear ceased to act very soon after the collision, when it was in that position. The failure of this steering gear is attributed to the inflow of water consequent upon the collision. Alternative hand-steering gear, which was available in a convenient position abaft the portion of the ship that was flooded, could not be brought into operation, owing to the short time the ship remained afloat.

3. *The extent to which water found access into the ship.*—A very large portion of Mr. White's report is devoted to a detailed discussion of the state of each compartment in the forward part of the ship, and the probability of water finding access into it; and, although the results thus arrived at are, doubtless, right upon the whole, it is not certain that they are correct in every particular. He appears to go too far in asserting that the evidence given before the Court Martial, respecting the compartments which were flooded, is exhaustive; while this is inconsistent with the list, given in Table II. of his report, of "Compartments shown by the evidence to have been probably or possibly filled through doors, hatches, &c." Two items in that list, at least, are quite doubtful, as judged by the published evidence, viz. the water-tight compartment in hold on port side, between frame stations 12 and 22, and the port ejector tank; which would hold 108 and 35 tons of water respectively. Neither does it appear right to claim, with absolute certainty, upon the evidence as it stands, that the submerged torpedo room was flooded, although it is probable that it was. This is a point upon which further examination of the witnesses might have converted reasonable doubt into something approaching to certainty.

There are, however, no scientific or practical questions relating to the case that would be seriously affected by proving absolutely that one compartment, or another, about which there might be any doubt, was or was not flooded. Events proved that sufficient water found its way into the fore-end of the ship to submerge the bow to the extent that was observed, and to ultimately cause her to capsize and sink. She would probably have kept afloat if all water-tight doors and scuttles had been closed, and if the entry of water had thus been limited to the compartments that were directly opened up by the breach made by the collision. The ultimate submersion and capsizing was apparently caused by the entry of water into compartments that were not damaged by the collision, through open doors and scuttles; and the circumstances and causes of the catastrophe can therefore be thoroughly discussed whether Mr. White be right or wrong in his conclusions as to the precise number and positions of the compartments that were flooded.

It thus appears, adopting Mr. White's figures in the aggregate—which must be fairly correct in order to account for the facts—that the weight of water which entered the ship was approximately as follows:—

(1) Into compartments that would have been flooded, in consequence of the collision, if all water-tight doors and hatches had been closed: 75 tons above the protective deck, 330 tons upon the platforms under the protective deck, and 271½ tons in the hold, being 676½ tons in all. (2) Into compartments that were subsequently flooded through doors, hatches, &c., that were left open: 33½ tons above the protective deck, 353 tons upon the platforms under the protective deck, and 47 tons in No. 7 coal bunker and shoot. (3) Into compartments which may have been flooded, but as to which the evidence is doubtful: 322 tons above protective deck,[1] 200 tons upon the platforms under the protective deck, and 143 tons in the hold. In addition to the above about 100 tons of water must have entered the boatswain's and carpenter's stores above the protec-

[1] Some observers thought two minutes.

[1] The compartments into which this 322 tons of water may have entered are the air-compressing room, sail room, chest room, torpedo room, and turret support, and it is pointed out in a foot-note to Mr. White's minute that these compartments are within the limits of the armour belt. We do not understand how this affects any of the points in the case.

tive deck, through the riding bitts on the upper deck, after the tops of these became submerged.

We thus obtain a total of 1,110 tons of water which entered the ship through the breach made by the collision and passed into other compartments, besides those directly laid open to the sea, through open doors, hatches, &c.; a further amount of 100 tons that entered after the tops of the riding bitts became submerged; and 665 tons about which there may be doubt as to the precise positions of the compartments it entered.

4. *The effect of the water thus admitted upon the line of flotation and the stability.*—The 1,110 tons of water above mentioned would, according to the Admiralty calculations, considering its position at the fore-end of the vessel, depress the bow to the extent of 21 feet, and raise the stern 8 feet. This change of waterline is considered to have necessarily flooded the other compartments, respecting which the direct evidence is doubtful; and certainly to have filled the boatswain's and carpenter's stores through the riding bitts. The turret ports, and also the door on starboard side, and the ports, in the upper deck battery, would thus be brought under water, and the position of the ship be rendered hopeless.

Mr. White states, with regard to the stability, that as the *Victoria* floated before the collision, she had a metacentric height of 5 feet—*i.e.* the centre of gravity was 5 feet below the point at which its righting effect would be *nil*—and that after the collision, when the bow had sunk deeply and she had heeled considerably—by how much is not said—the metacentric height was reduced to about eight-tenths of a foot. When water had entered the battery and turret through the open door and ports, as observed when the fatal lurch began, the metacentric height had become altered by the changed condition to *minus* 1·8 feet; and the final capsize was inevitable.

A consideration of the fifth subject treated in these minutes, which is the lessons taught by circumstances connected with the loss—the most important of all for the future—will require an article to itself, and must therefore be postponed till another week. The points mentioned in this connection are: the effect of longitudinal bulkheads upon safety in such circumstances as are those under discussion; whether the closing of the battery doors and ports would alone have been sufficient to save the ship; whether the closing of all water-tight doors and scuttles would have done so; whether the water-tight doors fitted to the ship were the best for the purpose; the value of an armour-belt at the ends for the purpose of resisting damage; and whether the blame rests wholly upon the officers of the *Victoria* for not knowing how rapidly the ship would be likely to sink when damaged as she was, and for not taking steps sooner to close the water-tight doors and scuttles and prevent the final catastrophe.

FRANCIS ELGAR.

JUPITER AND HIS RED SPOT.

JUPITER is now, with his northern declination of 18° and an equatorial diameter of 48″, a very fine object visible above our horizon during more than 15 hours at a time. Thus, on December 1 he rises at 3h. 7m. and sets at 18h. 23m., shining nearly throughout the long nights now prevailing from a position about 6° south-south-west of the Pleiades.

As an object for telescopic study Jupiter is undoubtedly the most interesting planet of our system. The activity apparent everywhere on his surface, the number and variety of the forms displayed, and the comparative ease with which they may be observed, attest that this object is practically without a rival, and that the investigation of his phenomena is certain to be productive.

The present time is eminently a suitable one for studying his surface markings, and redetermining their proper motions. As the planet's rotation period is less than 10 hours, the times of transit of the same spots may sometimes be obtained twice on one night, for if a marking crosses, say, 3 hours after the planet's rising, the same object will again reach the central meridian about 2½ hours before the planet sets.

It is well known that the visible surface of Jupiter consists of a number of light and dark zones interspersed with irregular forms which exhibit great differences in their rates of velocity. Certain white spots, bordering the equator, move very swiftly, and complete a rotation in considerably less time than the red spot. Some dark spots, which have appeared at various times on a double belt about 25° N. latitude, have moved more rapidly still, and shown a rotation in seven minutes less time than the red spot. But it is a peculiar feature of the different markings that they do not maintain the same rate of motion during their existence; in fact, a lengthening of period seems to generally affect them. Thus the red spot in 1880 gave a rotation of 9h. 55m. 34s., while in recent years it has been about 9h. 55m. 41s. The equatorial white spots, which thirteen years ago had a period of 9h. 50m. 6s., have been gradually moderating their speed until in the last few years their period seems to have been 9h. 50m. 30s. It is certain that the various markings are carried along in atmospheric currents, and are subject to remarkable differences, of which we do not comprehend the cause, though we may readily trace the effects.

The red spot situated in Jupiter's S. hemisphere, and on the boundary of the tropical and temperate zones of the planet, is still perceptible, and it is highly probable that the spot existed long before it first came conspicuously into notice in July, 1878. During the last fifteen years there has been little change either in its oval shape or in its dimensions, though its colour and visibility have suffered some trying viscissitudes. It has been successively presented as a brick-red spot, as a faint pink ellipse, as a grey shading, and it is now so feeble that only the outline of its following side can be distinguished, the preceding part of the spot having apparently lost its definite outline. In fact, there seems a prospect of losing the object temporarily if further decadence goes on, but in view of past experience and the probability of recurrence in the Jovian markings, we may certainly expect the spot to reappear, and to present a more conspicuous aspect than it does at the present time.

The following are some eye-estimates of the transits of the spot during the present apparition; they were made by Mr. A. Stanley Williams, of Brighton, and by myself at Bristol:—

Date, 1893.	Red spot at transit. h. m.	Marth's zero meridian. h. m.	Red spot precedes, m.	Observer.
Aug. 9	14 5	14 13·6	8·6	W. F. D.
14	13 15·5	13 22·1	6·6	A. S. W.
16	14 52·2	15 0·6	8·4	,,
16	14 55		5·6	W. F. D.
Sept. 4	15 31	15 41·8	10·8	A. S. W.
14	13 52·2	13 57·5	5·3	,,
Oct. 8	13 35·8	13 43·6	7·8	,,
18	11 50·4	11 58·0	7·6	,,
30	11 45	11 50·0	5·0	,,
Nov. 6	12 29·2	12 34·9	5·7	,,
23	11 25	11 33·9	8·9	W. F. D.

The spot therefore transits a few minutes before the zero meridian based on the daily rate, 870·27° (=9h. 55m. 40·65s. for one rotation), System II. in Mr Marth's ephemerides (*Monthly Notices*, May, 1893).

Mr. Williams writes me that he has recently been able to make out the whole outline of the red spot except the preceding end, and on one very favourable night

November 6, he glimpsed the spot in its entirety, and describes it as of a pinkish colour. The following and south following part of the spot had quite a dark and definite outline.

On October 31 the red spot was seen with the 16-inch refractor at the Goodsell Observatory, Northfield, U.S.A. It was not a difficult object, though the colour is stated as being very faint. "The S. side of the spot and a belt of similar tint appeared to merge into one another without the slightest change in intensity of colour."

On November 23 I observed the spot with an 8½-inch reflector belonging to my friend, Mr. J. Harvey Jones, of Bristol; but the night was not very good. The red spot was faintly seen, and must have been central at about 11h. 25m. Other details were also noticed as follows:—

A faint, narrow, dark belt, like an irregular pencil-line, on the equator. A similar belt running from about the *p.* end of the red spot to W. limb of the planet. The shouldering of the S. equatorial belt N. of the ends of the red spot was distinctly seen, though that part N. of the *p.* end was very faint. The *f.* shoulder shows a much more gentle slope than formerly. Numerous reddish spots were seen on the N. side of the N. equatorial belt. These were large and conspicuous, as were a series of bright spots *p.* and S. of the red spot. A remarkably brilliant spot on the N. side of N. equatorial belt was central at 10h. exactly.

The general appearance of the planet betokened a more disturbed condition than usual, the belts being full of irregularities.

The great size, durableness, and special character of the red spot have naturally attracted much discussion, and a number of theories have been broached to explain the nature of the spot, and to account for its long endurance. Some writers have regarded it as part of the solid material of Jupiter, but this theory is practically negatived by the fact that it has shown an irregularity of motion. Unless we admit that the rotation period of Jupiter is extremely variable, and has experienced considerable retardation in recent years, we cannot allow that the red spot forms a portion of the sphere. Others believe the spot to represent a condensation of material floating or suspended above the surface of the planet, and that variations of motion and tint are impressed upon it by the action of the Jovian atmosphere, which is constantly in a state of turmoil. Another idea has been mooted to the effect that the spot may possibly be an opening in the atmosphere, through which the surface of Jupiter has been exposed, and that the recent feebleness of the object is occasioned by the filling in of the cavity with highly reflective vapours.

The Rev. E. Ledger remarks that at one time he felt inclined to believe that the permanency of the spot "seemed to indicate that it might be something which, while coagulating or solidifying, in some way caused a gap or break in the cloudy regions above it, or by its cooling condensed the vapours incumbent upon it, and thus increased its own visibility; in fact, that we might be watching in it the gradual formation of a huge continent upon Jupiter."

The theory has also been advanced that the spot was originally formed by ejecta from a volcanic region immediately underlying it, but it must be admitted that no hypothesis appears to be entirely satisfactory in its application, and certainly we cannot regard any one of them as capable of being definitely proved. In a word, it must be avowed that though we have become familiar with the red spot, its motion, shape, and variable tints, during observation extending over more than fifteen years, we are yet far from understanding the mystery it involves. Its production was doubtless the outcome of the energy and activity prevailing above, and possibly on, the planet's surface, but in what particular way the spot was generated it is impossible to say. Nor is the specific date of its first apparition known; it may be a modern resuscitation of the spot which delighted Hooke and Cassini about two centuries ago, or it may only have been initiated into existence just before those memorable nights in July, 1878, when it exhibited an intensely red colour, and struck observers, instantly, as being a most anomalous feature.

But though the spot forms an unsolved mystery, it will continue to be watched with interest by telescopic observers, who will much regret if its present faintness is but the prelude to final dissolution. It can be justly said that no planetary marking visible in modern times has encouraged as much observation, and incited the same amount of interest as the familiar "red spot on Jupiter." Possibly the further study of this remarkable formation may yet enhance our knowledge of the physical condition of the "giant planet," and throw some light upon the singular variations so rife upon his expansive surface.

W. F. DENNING.

THE PREPARATION AND PROPERTIES OF FREE HYDROXYLAMINE.

A CONSIDERABLY improved method of isolating hydroxylamine is described by Prof. Brühl, of Heidelberg, in the current *Berichte*, by which a tolerably large quantity of the pure substance may be prepared without danger in a short space of time, and which may therefore be of general interest on account of its suitability for lecture and demonstration purposes. It may be remembered that M. Lobry de Bruyn, who first isolated solid hydroxylamine two years ago (*vide* NATURE, vol. xlv. p. 20), prepared it from a mixed solution of the hydrochloride and of sodium methylate in methyl alcohol. This solution, after removal of the precipitated common salt, was first concentrated over a water bath, under the diminished pressure of 100 m.m., and afterwards subjected to fractional distillation over a flame at the still lower pressure of 40 m.m. A continuous fractionating vacuum-apparatus was considered unsuitable, and the change of receivers could only be conveniently effected by temporarily arresting the distillation. This mode of operating frequently led to violent explosive decomposition of the heated hydroxylamine, and, moreover, the yield rarely exceeded 17 per cent. of the theoretical. Prof. Brühl, desiring to obtain a considerable quantity of the pure base for spectrometric purposes, has been led to devise the following much more convenient method:—

The methyl alcohol solution is first separated from the precipitated salt, and then immediately transferred to a slightly modified form of the well-known apparatus of Prof. Brühl for fractional distillation *in vacuo*. This apparatus consists essentially of a distilling flask, provided with thermometer and entrance tube furnished with tap, a condenser, and a receiving arrangement which provides for the repeated and rapid change of receiver without impairing the vacuum and without arresting the distillation. This receiving arrangement consists of a short but wide cylinder of stout glass, into which the end of the condensing tube is introduced through a tubulus fitted with bored caoutchouc stopper; inside the cylinder is a circular stand carrying six receiving tubes, which are capable of rotation by means of a rod passing, gas-tight, through a tubulus and its caoutchouc stopper in the top of the cylinder, and terminating in a handle outside. By suitable manipulation of the handle, each of the six receivers may be brought beneath the end of the condensing tube in turn while the distillation is proceeding. The distillation of the methyl alcohol solution contained in the distilling flask is effected by reducing the pressure to the lowest possible amount, and supplying the necessary heat by immersing the flask in a bath of hot water. On

account of the explosive character of hydroxylamine, it is dangerous to employ even a small naked flame, which is liable to effect local superheating. The temperature of explosive decomposition lies in the neighbourhood of 130°; by uninterrupted distillation in the manner indicated, and at a pressure not exceeding 22 m.m., the hydroxylamine passes over entirely at a temperature of 56–57°, and by maintaining the water bath at only a few degrees superior to this temperature all danger of explosion is avoided. The methyl alcohol is practically entirely removed by the pump. Instead of leading the distillate through a warmed condenser, as recommended by M. de Bruyn, a practice which materially diminishes the yield by decomposition of a portion of the product, Prof. Brühl finds it much more advantageous to feed the condenser with a constant supply of iced water; for although the melting point of hydroxylamine is 33°, it does not resolidify even at temperatures only a few degrees above zero, so that stoppage of the condensing tube does not occur. It solidifies instantly, however, in contact with a vessel immersed in ice and salt. The cylinder containing the receivers is therefore immersed in such a mixture, so that each drop of hydroxylamine solidifies the moment it enters the receiver. The hydroxylamine thus obtained in one operation is substantially pure. From thirty grams of the hydrochloride about ten grams of the base may be obtained in one hour, a yield of 66 per cent. of the theoretical, which is four times that obtained by the method of M. de Bruyn. In the case of hydroxylamine becoming a commercial preparation, on account of its extraordinarily great antiseptic power, it would be quite easy, by introducing suitable additional condensers, to recover the whole of the methyl alcohol employed.

The pure white crystalline hydroxylamine melts according to the mode of heating and the size of the containing tube at 32–34°, and its boiling point for a pressure of 22 m.m. is 56–57°. It may actually be cooled below 0° without solidifying, if allowed to remain at rest; but, like most other substances which exhibit the property of superfusion, it solidifies the moment it is agitated. In the solid state it does not appear to be liable to decomposition. Even in the liquid state at 0° indications of decomposition have not been observed. At 10°, however, bubbles commenced to form in the liquid, and at 20° a continuous evolution of gas, mainly nitrogen, occurs, becoming more and more violent as the temperature rises, until sudden explosion takes place. Hence in a warm summer hydroxlamine cannot be preserved in sealed glass tubes. Thus a specimen, after keeping for eight days in July, was found to be no longer capable of solidification even at −6°, although there was sufficient of the base left undecomposed to explode with a certain amount of violence upon heating, less, however, than in the case of freshly-prepared hydroxylamine. When just prepared one drop warmed in a test tube over a flame explodes with a report equal to that of a gun-shot. It is suggested that hydroxylamine might be safely preserved in metallic vessels, for it appears likely that the notable action of the liquid upon glass causes the commencement of the decomposition.

At the temperature of 23·5° the relative density of pure liquid hydroxylamine is 1·2044. Its refractive index at the same temperature varies from 1·4375 for light of the wave-length of the red lithium line to 1·4514 for light corresponding to the blue hydrogen line Hγ. The substance thus exhibits a small refractive power and a surprisingly small dispersion. Indeed, its molecular dispersion is about the same as was found by Prof. Brühl for nitrogen itself in triethylamine, so that the atom of oxygen and the three atoms of hydrogen would appear to exert no dispersive action if the same value for nitrogen be assumed to be equally operative. The only possible explanation is that the nitrogen here united to oxygen and hydrogen possesses a lower spectrometric constant than when attached to carbon in triethylamine. From a systematic study of the spectrometric constants of the free base, and of the methyl derivative $CH_3NH.OH$ prepared by his assistant Dr. Kjellin, an account of which was given in the Notes of NATURE of November 9, Prof. Brühl has been enabled to prove two important facts. The first is that the constitution of hydroxylamine can be none other than $\begin{matrix} H \\ H \end{matrix}\!\!>\!N-O-H$. The second is that the molecular refraction and dispersion of the nitrogen present in these compounds is the same as that of the nitrogen in ammonia gas, much lower than that of the nitrogen in triethylamine, and that the probable values of these constants of nitrogen linked in this manner, for sodium light, are respectively 2·495 and 0·072. This addition to our knowledge of the spectrometric constants of nitrogen will be of invaluable aid in unravelling the intricate subject of the constitution of the class of nitrogenous organic substances known as "oxims," a subject upon which Prof. Brühl is now concentrating his attention. A. E. TUTTON.

NOTES.

IT is with much regret that we announce the death of Baron von Bülow, at Kiel. Von Bülow's Observatory, better known, perhaps, as Bothkamp Observatory, was the first in Germany devoted to astro-physical researches, and it stands as a splendid monument to his interest in astronomy. By his death astronomical physics has lost one of its most enthusiastic supporters.

THE meeting of the Vienna Academy of Sciences was adjourned on November 16, as an expression of regard for Dr. Alexander von Bach, who died on November 12.

THE memorial to Sir Richard Owen is to take the form of a full-length marble statue, executed by Mr. Thomas Brock, and placed in the Natural History Museum, South Kensington.

A BOTANICAL section has been added to the Zoological Station at Naples, with a small laboratory for algological studies and researches in vegetable physiology.

DR. OSWALD KRUCH has been appointed to the Conservatorship of the Royal Botanical Institute of Rome, recently resigned by Dr. A. Terracciano.

A REUTER'S telegram from Montreal announces that the worst earthquake ever experienced in Canada occurred there at noon on November 27. As far as has been ascertained, no lives were lost, but considerable damage has been done to property, and the walls of many buildings have been cracked.

A SEVERE earthquake was felt at Peshawur, and other places in the Punjab, about nine o'clock on the morning of November 5, but fortunately no very serious damage was done. The wave apparently extended over a large area, including the Tamrud plain and Nowshera.

AN international Photographic Exhibition will take place at Milan from May until October next year. There will be a section for professional photography, another for amateur photography, and a third for technical and industrial applications of photography.

THE Department of Science and Art has received, through the Foreign Office, a dispatch from her Majesty's Minister in Chili calling attention to an exhibition which it is proposed to hold next year at Santiago, dealing with the subjects of mining and metallurgy. The exhibition will be opened in the second

fortnight of April, 1894, but the exact date is not yet known. The eight sections of the exhibition will comprise electricity, mining machinery, mechanical preparation of minerals, metallurgy, chemical industries, statistics and plans, and mining and metallurgical products respectively.

THE Municipal Council of Lausanne has been considering a scheme for the electrical transmission of power (says *La Nature*). It is proposed to obtain work to the extent of about 1200 horse-power from the Grand-Eau river, at a distance of forty kilometres from Lausanne This energy will be utilised to supply about 5000 lamps and 16 arc-lights during the night, while in the day it will furnish the motive power for electric trams, and motors for domestic use, besides pumping the town's water-supply to the proper level.

THE new examination laboratories of the Institute of Chemistry will be opened on Friday, December 8.

THE last of the Gilchrist lectures, in connection with the Bethnal Green Free Library, will be given on Thursday, December 7, by Dr. Andrew Wilson, on "Brain and Nerve and their Work."

PROF. BORNMÜLLER has returned from his extended botanical journey in Persia.

A COMMITTEE has been appointed by the Italian Botanical Society for the study of the flora of Italy, both phanerogamic and cryptogamic. The reports from the various members will be collated by Prof. Arcangeli, and published in the *Bulletino* of the Society.

Bulletin No. 38 of the Experiment Station of the Kansas State Agricultural College is occupied by a preliminary report on rusts of grain, accompanied by three plates illustrating the mode of development of *Puccinia graminis*, *P. rubigo-vera*, and *P. coronata*. In Kansas the two former of these are found chiefly on wheat, while the last is apparently confined to oats.

EVIDENCES of the existence of man in Nicaragua during the early Neolithic age were discovered by the Spaniards about the beginning of the sixteenth century. They mainly consist of flint-heads of arrows and spears, stone statues of men, and numerous fragments of pottery made of clay, containing fragments of volcanic rocks, unadorned and originally unburned. Of these evidences, those indicating the geological time or epoch in which they were made are, according to Mr. J. Crawford (Proceedings of the Boston Society of Natural History, vol. xxvi. p. 49, 1893): (1) Several well-executed stone statues found in the same locality, and all of the same brachycephalic type, carefully sculptured from blocks of hard rock, with brittle tools of flint, jasper, and felsite; (2) oblong blocks of partly metamorphosed rocks, in their natural state or but slightly shaped by man, apparently forming the foundations for an oblong temple or observatory extending east and west; (3) fragments of unadorned pottery found near the stone images, cemented in the débris of a well-marked subsidence, all discovered in the small valley on the west face of the mountain island of Momotombito. This island is situated near the volcanic cone Momotombo, and an unobstructed view of the Pacific Ocean, about twenty-seven miles to the westward, can be obtained from the observatory or temple. Mr. Crawford's examination of the locality and the handiwork leads him to believe that "the aborigines of the sculptors of the stone images found on the island came from Polynesia, over the land route or chain of almost connected islands then existing across the Pacific Ocean, and that the latest subsidence of twenty-five feet, as recorded on the island and the western part of Nicaragua, and the consequent synchronous activity of all the volcanoes in that region, both occurring during the time when the sculptors were carving stones into images of types of their own people, caused the sculptors and their tribe to migrate eastward (the only safe route) and seek a home on the side of the very fertile and non-volcanic Amerrique mountains, where their probable descendants—the Amerriques—now reside."

THE first of the three articles in the current number of the *Internationales Archiv für Ethnographie* (vi. parts 4 and 5) is by Prof. H. H. Giglioli. It is entitled "Notes on the Ethnographical Collections formed by Dr. Elio Modigliani during his recent Explorations in Central Sumatra and Engano." Dr. Modigliani published in 1890 a valuable book, "Un Viaggis a Nias," giving an account of his anthropological investigations in that little known island. Giglioli's communication, which is fully illustrated, appears to be a preliminary notice of a forthcoming work by Modigliani, and it gives to English readers a foretaste of the extremely interesting and important investigations made by that skilled observer and excellent collector. Modigliani was not allowed by the Dutch colonial authorities to remain long among their foes the Battaks of Lake Toba, but he made good use of his time, and also discovered a magnificent waterfall. Giglioli gives an admirable summary of the arts and crafts, habits and superstitions of these literally cannibals. The islanders of Engano remarkably resemble the Nicobarese, but the faces of some of them recall Polynesian and especially Micronesian types. Like other islands, the old order is rapidly changing, and the population of about 8,000, ten years ago, is now reduced to 840. Prof. A. C. Haddon has a paper on "The Secular and Ceremonial Dances of Torres Straits," illustrated by woodcuts and four admirably executed coloured plates. This is the first time that any Papuan dances have been adequately described. The dances are classified into festive dances, war dances, ceremonial dances (including initiation and seasonal dances), turtle processions, and funeral ceremonies. The descriptions of the dances and the decoration of the performers are given in great detail; the initiation and funeral ceremonies were carefully built up, so to speak, from the accounts of the natives. Here also so much change has taken place, that in a short time it will be impossible to gather any further information of any value. Prof. W. Joest has an illustrated paper on various toys ("Allerlei Spielzeug"). There are also the usual notes, reviews, and bibliography.

WE have received from Sgr. Arcidiacono a pamphlet containing the results of observations of the geodynamic phenomena which preceded, accompanied, and followed the Etna eruptions of May and June, 1886, carried out under the direction of the late Prof. Orazio Silvestri, of the University of Catania. This work forms a valuable addition to geodynamic literature, and contains a detailed account of the movements, both microscopic and sensible, observed in the various seismological stations around Etna from May 18 to June 11, a table of all the shocks recorded, with their general character, direction, and intensity, and a reproduction of the seismograph diagram in the form of a curve about 15 feet long, which shows the course of the phenomena as recorded between the dates May 8 and June 16. The general aspect of calm was first broken on May 12, where slight and slow perturbations are recorded. These were repeated more emphatically on May 14 and 15. The 17th was calm, but at 10.30 a.m. on the 18th the explosion of the central crater occurred, which threw the barometer stile right off the scale. This was followed by a continued succession of violent shocks during the same day, and by the eccentric explosion of the southern flank on May 19. The eruption then followed a regular course until May 26, the disturbances being much smaller and of nearly constant average amplitude for each hour. A steady diminution of the eruptive

force took place until May 31. This and the following day were visited by two considerable shocks, followed by another strong concussion on June 5, which marked the close of the eccentric eruption. The 9th witnessed some disturbances accompanying a mild eruption of the central crater, and calm was finally re-established on June 14. A coincidence worth noticing is that of the highest barometric pressure observed during all that time, a pressure of 771 mm., with that of the great central eruption on May 18. The greatest disturbances were produced along a line passing through the focus in a direction from east-north-east to west-south-west, this being at right angles to a radial line which was the seat of the 1883 eruption.

MEASUREMENTS of the amount of light absorbed by thin metallic films of various thicknesses are incapable of affording a true measure of the absorptive power of these films unless the films compared have the same reflecting power at normal incidence. M. Salvador Bloch has been for some time experimenting with collodion films coloured with fuchsine, and thus made to exhibit a metallic aspect. According to an account published in the *Comptes Rendus*, he has succeeded in obtaining films of different thicknesses and of equal reflecting powers. Two pellicles formed by pouring layers of different thickness over glass plates, and evaporating under the same conditions, show, if all goes well, a strong resemblance as to reflecting powers. This was tested by studying with a Babinet compensator the ellipticity of the green rays near the E line reflected from the pellicle. The employment of sunlight enabled the observer to measure differences of phase down to $\frac{1}{250}$ of a wave-length. For two such pellicles no difference of phase exceeding or even approaching that limit was observed in any portion of the films. Three such films, called A, B, and C, and of thicknesses 744, 1921, and 1964$\mu\mu$, respectively, were used for determining the index of absorption for the yellow D rays. The index of absorption was taken as defined by the fact that a vibration progressing in the absorbing medium through a length $\frac{\lambda}{2\pi}$ has its amplitude reduced in the ratio $1 : e^{-\gamma}$, where γ is the index of absorption. From A and C combined, γ was found to be 0·088, and from A and B 0·084. Films of such thickness were opaque to green, but another set of films, of thicknesses 353, 504, and 627$\mu\mu$, respectively, were found thin enough for measurements in the case of green light. The two corresponding values found were 0·529 and 0·505. The spectrophotometer used was analogous to a half shadow polarimeter. A polarised beam of sunlight fell normally upon a biquartz. The light then passed through an analyser with divided circle, and then through a lens, which projected an image of the biquartz upon the slit of a spectroscope provided with an eye-slit. The spectrum then consisted of two superposed portions, each corresponding to one of the quartz plates. The film was then cut half off the glass, and placed so that the edge coincided with the junction of the biquartz, with the result that the light suffering absorption passed through one of the quartzes only. Equality was established by turning the analyser. A special advantage of this arrangement is that it requires only one source of light.

THERE exist at present numerous arrangements for "turning down" an electric light, the chief peculiarity of them all being that nearly as much electrical energy is consumed when the lamp is only glowing feebly as when it is giving its normal amount of light. An arrangement to which this objection does not apply is described in the Proceedings of the American Institute of Electrical Engineers for September, by Mr. F. Moore. In the circuit of the lamp there is placed an automatic interrupter, consisting of a small electromagnet and an armature held back by a spring; the contacts being so arranged that as the armature vibrates the current is interrupted during part of the oscillation. By this means different amounts of current can be passed through the lamp, for by moving the electromagnet nearer to or further from the armature, the speed with which the latter vibrates can be varied. To avoid the destructive effect of the sparks at the contacts the whole armature is enclosed in a glass globe from which the air has been exhausted. Under these conditions it is found that platinum contacts remain good for a considerable time. When the interrupter is at work the sparks produce in the exhausted globe a phosphorescent glow which the author thinks may possibly be made use of for the purpose of giving light. Another application of the above is for running lamps on circuits of much higher voltage than they are intended for.

Wiedemann's Annalen der Physik und Chemie for November contains an interesting paper by R. Hennig, on the magnetic susceptibility of oxygen. The method employed, namely, the measurement of the displacement in a magnetic field of a short column of liquid in a slightly inclined capillary tube, due to the difference in the susceptibility of the two gases (oxygen and air) at the two ends of the liquid column, would hardly seem at first sight capable of giving very accurate values. The author, however, has obtained very fairly consistent results, and finds the value $0{\cdot}0963 \times 10^{-6}$ for the difference between the susceptibility of oxygen and air at a temperature of about 26° C., and at pressures varying from 75 cm. of mercury to 328 cm. In order to measure the strength of the magnetic field a small coil was suspended by a bifilar-suspension close to the capillary tube, and from the deflection, when a known current was passed through this coil, the strength of the field was calculated. The results obtained by this method were also compared with those found by the rotation of polarised light in a piece of heavy glass, and by means of a small induction coil which could be rapidly moved out of the field.

SOME interesting investigations on the vitality of the cholera organisms on tobacco have been made by Wernicke (*Hygien. Rundschau*, 1892, No. 21). Small pieces of linen soaked in cholera broth-cultures were rolled up in various kinds of tobacco, and the latter made into cigars. At the end of twenty-four hours only a few bacilli were found on the linen, and none on the leaf. On sterile and dry tobacco leaves, the bacilli disappeared in one-half to three hours after inoculation. On moist, unsterilised leaves they disappeared in from one to three days, but on moist and sterile leaves in from two to four days. When introduced into a five per cent. tobacco infusion (10 gallons of leaves to 200 gallons of water), however, they retained their vitality up to thirty-three days; but in a more concentrated infusion (one gallon of leaves to two gallons of water) they succumbed in twenty-four hours. When enveloped in tobacco smoke, they were destroyed, both in broth-cultures as well as in sterilised and unsterilised saliva, in five minutes. Tassinari, in his paper, "Azione del fumo di tabacco sopra alcuni microrganismi patogeni" (*Annali deli Istituto d'Igiene*, Rome, vol. i., 1891), describes a series of experiments in which he prepared broth-cultures of different pathogenic microbes, and conducted through them the smoke from various kinds of tobacco. Out of twenty-three separate investigations, in only three were the cholera organisms alive after thirty minutes' exposure to tobacco fumes. But in actual experience the apparent antiseptic properties of tobacco have not unfrequently been met with; thus, during the influenza epidemic in 1889, Visalli (*Gazetta degli Ospedali*, 1889) mentions the remarkable immunity from this disease which characterised the operatives in tobacco manufactories; that in Genoa, for example, out of 1200 workpeople thus engaged, not one was attacked; whilst in Rome the number was so insignificant that the works were never stopped, and no precautions were considered necessary.

THE *Deutsche Seewarte* has published No. xi. of the results of observations taken in the North Atlantic on ships supplied with instruments either belonging to that institution, or verified by it. Each part contains all the observations made in a ten-degree square, which is again subdivided into 100 one-degree squares, grouped in such a way that anyone can make use of them as they are, or they can be eventually combined with the observations made by any other institution. The tract now covered by these volumes extends from latitude 20°–50° N., and longitude 10°–50° west (with the exception of one square), and this district joins on to that for which the data were discussed some years ago by the Meteorological Council, and extending from 20° N. to 10° S. latitude; so that for nearly all that part of the North Atlantic which is traversed by long-voyage ships a large amount of useful data is available, either for scientific inquiry or for the purpose of navigation. The winds are tabulated under sixteen points, and storms under four quadrants, while the mean values of pressure, temperature, &c., are deduced from the total number of observations in each sub-square. This work is quite independent of the synoptic weather charts of the North Atlantic, which are regularly prepared by the Seewarte, in conjunction with the Danish Meteorological Institute.

THE *Kansas University Quarterly*, vol. ii. No. 2, contains three articles by Prof. S. W. Williston. In one of these, entitled "Kansas Pterodactyls," a previous article is referred to, in which the opinion was expressed that the genus *Pteranodon* occurs in Europe. Since then Prof. Williston has seen papers by Prof. Seeley, in which the same view is held, and an attentive examination of the evidence leads him to say: "I am satisfied that there can no longer be any reasonable doubt of the congenerousness of our species with those included in the genus *Ornithostoma*. Seeley, a generic name antedating *Pteranodon* Marsh by some five years."

MR. R. L. JACK, the Government Geologist at Brisbane, has prepared a report on the progress of the geological survey of Queensland during 1892. Attention has been confined to detailed mapping of small areas of economical importance. For a general colony map it is thought that the scale of sixteen miles to an inch permits sufficient detail to be shown. As visiting the different mines will occupy some considerable time, it is intended to publish, in the meantime, a map showing the geological features, which will also be useful in the hands of miners and the general public for its topography. On the map, which is now being drawn on stone, are shown the outcrops of most of the reefs, as at present understood. A subsequent edition will show the actual or inferred outcrops of all the reefs, the underground workings, and the geological information acquired in the course of the underground survey by the Geological Staff. On the completion of the work, it is in contemplation to construct a glass model, the surface of which will be coloured, and the outcrops of the reefs shown in the same way as in the geological map, and the extension of underground geological boundaries, so far as ascertained, will be represented. Its main advantage, however, will be that the exact position of the reefs with relation to the surface features and artificial boundaries will be understood at a glance, and the depth at which any given reef would be met with in any position could be ascertained by a simple calculation.

A PAPER read by Dr. V. Ball, before the Royal Irish Academy on January 23 of this year, has been reprinted from the "Proceedings" (3rd Ser. vol. iii. No. 1, pp. 151–169). The title is "On the Volcanoes and Hot Springs of India, and the Folk-Lore connected therewith." Dr. Ball shows how the evidences of past volcanic activity in India—the metamorphism of sedimentary rocks by the Deccan traps into porcellanic shales, the agates, cornelians, &c. produced, the peculiar appearance of old craters, the "Lonar Lake," the natural caves and pillared temples of basaltic rock, &c.—have formed a nucleus of truth around which the religious spirit of the people has wrapped coil upon coil of myth and the marvellous. Sometimes undue credence has been given by travellers to native tales of smoke emanating in present times from peaks in Western Bengal and the Central Provinces. For these no better foundation could be discovered by Dr. Ball than the ordinary atmospheric effects of mist and cloud. Bhawani Patna, in the Central Provinces, is an example of a "mythical volcano." Hot springs have more especially appealed to the superstition of the people, and served the purposes of the native priesthood. Dr. Ball stated that the total number of recorded sites where hot springs occur in India is about 300. He gave then a concise account of the most important scientific phenomena associated with the hot springs, and details, in some cases, of the particular virtues, medical and spiritual, ascribed to them by the people. He called attention, in concluding, to the local character of the vegetation near hot springs, and of the fauna which are sometimes present in their waters, *e.g.* the famous Magar Pir, seven miles north of Karachi, with its numerous crocodiles.

THE August number of the *Records of the Geological Survey of India*, vol. xxvi. part 3, has been sent us. An important paper is the "Geology of the Sherani Hills," by Mr. T. D. La Touche, with a geological map of part of the Sulaiman Range and several sections and sketches (pl. i.–v.). The first part of the paper is devoted to the physical features. The stratigraphical geology of the Sherani Hills is not complicated; the deposits in the area examined range from Cretaceous to recent and sub-recent time, and a complete table of the succession and the relative thicknesses of the rocks is given on p. 82. Dr. Fritz Noetling describes "Carboniferous Fossils from Tenasserim"; good specimens of *Lonsdaleia salinaria*, and new species of Lithostrotion and of Schwagerina are figured on the accompanying plate. Details are given by Mr. R. D. Oldham, Superintendent Geological Survey of India, of a deep boring at Chandernagore, and a "Note on Granite in the Districts of Tavoy and Mergui" (with plate), by P. N. Bose. Especial comment is made in the "Tri-Monthly Notes of the Geological Survey of India Department" upon the completion of the second edition of the "Manual of the Geology of India," by Mr. Oldham.

THE calendar for the year 1893–4 of the University College of North Wales has just been issued.

WE note with pleasure that the Oxford University Press has published two more editions of the "Oxford Bible for Teachers," containing the excellent "Helps to the Study of the Bible" reviewed in NATURE of October 5.

WE have received a "Record" of results of observations in meteorology and terrestrial magnetism made at the Melbourne Observatory and at other localities in the colony of Victoria, Australia, from July to December, 1892, under the superintendence of Mr. R. L. J. Ellery, the Government Astronomer. In the future this "Record" will be issued quarterly instead of monthly.

MESSRS. WILLIAM WESLEY AND SON have issued their 118th "Natural History and Scientific Book Circular." The catalogue includes a number of works from the library of the late Sir G. B. Airy, in addition to transactions of scientific societies, periodicals and serials, Government reports, and works dealing with the history of science. It should be in the hands of every bibliophile.

THE sixth edition of a book known to most chemists, viz. "Laboratory Teaching," by the late Prof. C. L. Bloxam, has

been published by Messrs. J. and A. Churchill. Mr. A. G. Bloxam, the editor of the new edition, has made several important additions and alterations, and these changes will doubtless enable the book to retain its high position among the many works that now exist on practical chemistry.

WHAT are happily termed "Drum-and-trumpet Histories" have not been so numerous since the publication of the late Mr. Green's famous narration of the development of the English people. A more pretentious work of a similar kind is "Social England," edited by Dr. H. D. Traill, and published by Messrs. Cassell and Co. In this history a section of each epoch is devoted to a description of the conditions of science and learning, and another to trade and industry. The departure cannot be too highly commended, for the truest epic of a nation's life is that in which the interests of all classes are recited.

LANTERNISTS will be glad to learn that Messrs. Perken, Son and Rayment have introduced a new oil-lamp, possessing three times the candle-power of those hitherto used for lantern projection. This gain of brilliancy is obtained by dividing the oil reservoir, so as to provide central air-shaft. The combustion is thus rendered more perfect, and the odour that usually accompanies ordinary lamps is correspondingly decreased. For small audiences the lamp will suit a lecturer's purpose quite as well as the lime-light. Doubtless the recent fatal result of the breaking of an oxygen cylinder at Bradford will considerably increase the demand for perfected lamps of this kind.

THE success of Sir John Lubbock's book on "The Beauties of Nature" has induced Messrs. Macmillan to issue a cheap edition, without illustrations. Though the book possesses a good table of contents, its value would be increased by the addition of an index. The author will be glad to have his attention called to one or two slips. On p. 207, Jupiter is said to have *four* satellites, whereas Prof. Barnard's discovery has brought the number up to five. Nitrogen should be removed from the list of elements in comets (p. 213), and *Clarke* (p. 223) should be Clerke. These slips, however, are but spots on the sun, for there are few books that will enlighten the general reader more than the one before us.

A REMARKABLE new substance, isocyanogen tetrabromide, $Br_2C=N-N=CBr_2$, has been obtained by Dr. Thiele in the laboratory of the Munich Academy of Sciences, and an account of it is contributed to the current *Berichte*. It was prepared by the reduction of azotetrazine, a new substance very rich in nitrogen (concerning which Dr. Thiele promises a further communication), and by treatment of the reduction product, hydrazotetrazine, with bromine. Isocyanogen tetrabromide is readily volatile in steam, insoluble in water, but soluble in organic solvents, particularly in ether. It crystallises from glacial acetic acid in large prisms, which rapidly lose their brilliancy, however, upon removal from the mother-liquor. The crystals melt at 42°, emitting a most pungent, irritating odour. The crystals normally in the cold evolve the same odour, although not so strongly as when warmed. Concentrated sulphuric acid, at the temperature of a water-bath, rapidly dissolves them with production of hydrazine and evolution of carbon dioxide, hydrobromic acid, and smaller quantities of free bromine and sulphur dioxide. Water precipitates from this solution a large quantity of hydrazine sulphate, which may easily be identified by its melting-point (256°), its reduction of silver solutions, and its formation of a difficultly soluble double sulphate with copper sulphate. The reaction for the decomposition by sulphuric acid is probably as follows :

$$Br_2C=N-N=CBr_2+4H_2O=4HBr+2CO_2+N_2H_4.$$

Dilute hydrochloric and sulphuric acids only attack the tetrabromide after long-continued heating to 300°, the former then converting it into nitrogen and ammonia, and the latter oxidising it. Its reaction with alkalies is specially interesting. It dissolves readily in them, and upon subjecting the alkaline liquid to distillation another new compound, which is probably isocyanogen oxide $OC=N-N=CO$ or a polymer of that substance, passes over with the last portion of distillate. If a reducing agent, such as alcohol, a ferrous, manganous or stannous salt, is added to the alkaline solution, a powerful odour of the well-known isonitrile kind is at once emitted. This same odour is produced when the alcoholic solution of the tetrabromide is decomposed with zinc dust and a little chloride of zinc. It appears most probable that the odour is due to the hitherto unisolated isocyanogen, $C=N-N=C$. The supposition is further justified by the fact that the strongly odourous substance is expelled by boiling in a current of carbon dioxide, and is capable of absorption by hot dilute sulphuric acid with formation of a solution of just such powerfully reducing proclivities as might be expected from a solution of hydrazine and formic acid.

THE first results of an important research in connection with the melting-points of the more refractory inorganic salts are likewise communicated to the current *Berichte* by Prof. Victor Meyer and Dr. Riddle. The observations have been made with the object of ascertaining the relations of the melting-points of definitely connected salts, those already investigated being the chlorides, bromides, and iodides of sodium and potassium, and the sulphates of those metals. The method adopted in order to measure such high temperatures with accuracy was essentially as follows :—The salt was heated considerably above its melting-point in a capacious platinum crucible, by means of a Perrot furnace. The crucible was then removed from the furnace, and an air thermometer, constructed of platinum and on the compensating principle, was inserted into the liquid salt. As soon as solidification of the latter commenced the temperature remained constant for some little time, quite sufficient to enable the air, or in the cases of very high melting-points, the nitrogen contained in the thermometer, to be displaced by hydrochloric acid gas, and its volume measured over water. The results obtained are the following :—The chloride, bromide, and iodide of sodium melt at 851°, 727°, and 650°, respectively ; the analogous salts of potassium fuse at 766°, 715°, and 623°. In each case a lowering of the melting-point accompanies the increase of the atomic weight either of the halogen or of the metallic element. Potash (presumably the oxide) melts at 1045°, and soda at 1098°, the same rule again applying. In the cases of the sulphates, however, sodium sulphate is found to melt at 843°, and potassium sulphate at the much higher temperature of 1073°, a result contrary to the rule for the halogen salts, but which is quite in keeping with other well-known differences which the oxy-salts of sodium and potassium exhibit.

THE additions to the Zoological Society's Gardens during the past week include a Chacma Baboon (*Cynocephalus porcarius*, ♂) from South Africa, presented by Mr. W. S. Cox ; two Common Marmosets (*Hapale jacchus*) from Brazil, presented by Dr. S. Steggall ; a Pallas' Goat (*Capra cylindricornis*, ♀) from the Caucasus Mountains, presented by Mr. H. H. P. Deasy ; a Duyker Bok (*Cephalophus mergens*, ♂) from South Africa, presented by Miss Gertrude A. Winly ; three Palm Squirrels (*Sciurus palmarum*) from India, presented by Mrs. S. W. MacIver ; a Meyer's Parrot (*Pœocephalus meyeri*) from South Africa, presented by Mrs. B. Searelle ; a Great Eagle Owl (*Bubo maximus*) from China, presented by Major Boyd Bredon ; two Puffins (*Fratercula arctica*) British, presented by Mr. E. Hamond ; a Brown Capuchin (*Cebus fatuellus*, ♂) from Brazil, a Rhesus Monkey (*Macacus rhesus*, ♀) from India, six Meyer's Parrots (*Pœocephalus meyeri*), an Alario Sparrow (*Passer alario*) from South Africa, deposited; two Redshanks (*Totanus calidris*), British, purchased.

OUR ASTRONOMICAL COLUMN.

OTTO STRUVE'S DOUBLE-STAR MEASURES.—The most important addition to double-star astronomy during the last year is without doubt the work which we owe to Otto Struve, and which is entitled "Mesures Micrométriques des Étoiles Doubles" (Observations de Poulkova Tome IX. (avec un supplement) et Tome X.). The period which the observations cover is very large when one considers that it is for one observer, commencing as it does with the observations made in the year 1837, when Otto Struve was only seventeen years old. Readers who are unable to approach these volumes themselves will find that M. Bigourdan, in the October number of the *Bulletin Astronomique*, gives a general summary of the whole of the contents. As one would expect, the introductions to the volumes contain a mine of important information, both with regard to the measures and to the puzzling question of the "personal equation," a question on which even to-day astronomers hold different views. Otto Struve busied himself especially in this direction, making, in the years 1853-1876, a series of measures of artificial double stars. The expressions for the corrections which he obtained assumed considerable proportions, as will be seen below, the first being that for angles of position, and the second that for distance :—

Position angle

$$\text{Corr.} = + \frac{5^\circ\cdot2}{1 + 0\cdot20g^2} + \frac{4^\circ\cdot4 \sin(2\phi - 27^\circ\ 13')}{1 + 0\cdot14(3\cdot3 - g)^2} + \frac{5^\circ\cdot6 \sin(4\phi - 25^\circ\ 0')}{1 + 0\cdot20g^2}.$$

Distance

$$\text{Corr.} = + \frac{0''\cdot050(g - 2\cdot0)}{1 + 0\cdot09(4\cdot2 - g)^2} + \frac{0''\cdot15 \cos(2\phi - 28\cdot4)}{1 + 0\cdot06(5\cdot2 - g)^2}.$$

when g represents "l'angle visuel du couple considéré experimé en prenant pour unité celui qui correspond au grossessement de 708 fois," and ϕ is the angle of the line between the two stars and the vertical.

Whether such corrections as these, made under non-observational conditions, should be applied to measures actually made in the sky is still open to much doubt. Otto Struve discusses also the observations made at Pulkova with those made at the same epoch by different observers ; the comparison, to take an example, shows that Dawes's position angles in his early measures appear free from systematic error, while those made later require a correction of + 1°·8 ; his distances up to 8″ seemed all to be desired. Dembowski's measurements of angles also required no correction, but his distances, especially about 6″, demand a small positive correction (0″22). In the second volume one finds the measures of W. Herschel's classes V. and VI., couples with large proper motion, including measures for the determination of parallaxes, and for the determination of the relation of the number of optical to physical binary, stars discovered by M. Burnham and other astronomers, and a continuation of W. Struve's and O. Struve's measures. Double-star astronomy is already possessed of two fine monuments in the works of W. Struve's "Mensuræ Micrometricæ" and of Baron Dembowski's "Misure Micrometriche," and to-day we may, as M. Bigourdan adds, name a third in the "Mesures Micrométriques des Étoiles Doubles" of M. Otto Struve.

METHOD OF PIVOT TESTING.—By means of interference fringes, employed by M. Fizeau in his researches on crystals, M. Maurice Hamy describes a method of studying the form of pivots of a meridian instrument (*Comptes Rendus*, No. 20, Nov. 13th), which indicates errors not discernible by the ordinary course adopted. The great advantage to be gained by it is that the state of the pivots can be very easily, and with the expenditure of a very little time, ascertained. The arrangement consists in placing a metallic block astride a pivot, the block being supported further by a pointer fixed to a part of the telescope. The extremity of this pointer fits into the bottom of a horizontal groove, parallel to the meridian, in the pier. Contacts between the pivot and the pointer is thus ensured by the pressure of several weights, while displacements of the whole arrangement against slipping are totally eliminated. On the block rests, at one of its extremities above the centre of the pivot, a lever which is movable about an axis on the pillar on a vertical plane ; this carries a small horizontal piece of glass, fixed in a certain manner. Between this mirror and the front of the lens of a fixed collimator are produced the interference fringes, the source of light (monochromatic) being placed at the focus of the lens. Turning the telescope on its axis, the block remains still, but movements of a small nature in the vertical direction were observed which were sufficient to indicate the imperfectness of the pivot. To obtain at a glance the order of the magnitude of such errors, a plane mirror was fixed at some distance from the axis of the lever, so determined that the fringes were displaced by a row when the inclination of the telescope experienced a perturbation of 0·01s. by the action of one of the irregularities. The method of observation consists simply in counting the number of fringes which exceed a fixed limit when the telescope is turned, the number thus obtained expressing in hundredths of a second in time the order of the error. A trial of the above method shows that irregularities on the surface of pivots can be easily observed, and, moreover, the errors "ne sont pas complètement négligeable au point de vue des observations."

A BRIGHT METEOR.—The following are a few facts about a bright meteor which Prof. Schur, of Göttingen, has been good enough to send us :—The meteor was observed on Monday, November 27, at 5h. 54m. mean time, and the direction of its path lay between ζ Perseii and towards α Piscium. At first it appeared as bright as α Tauri, and then quickly excelled Jupiter in brilliancy, the light gradually fading away afterwards. The duration of the phenomenon was estimated at about ten seconds, and the trail was observed to be of a yellowish-red colour. Curiously enough, three minutes later a fainter meteor shot across the heavens from the zenith, its direction being nearly at right angles to that of the preceding one.

ASTRONOMICAL PHOTOGRAPHY.—Mr. H. C. Russell, F.R.S., President of the Astronomy, Mathematics, and Physics Section of the Australasian Association for the Advancement of Science, traced the history of astronomical photography in his presidential address at the recent Adelaide meeting. "In many departments of astronomy," he declared in the opening paragraph, "the observer must stand aside while photography takes his place and works with a power of which he is not capable, and I feel sure that in a very few years the observer will be displaced altogether, while his duty will be done by a new sensitive being—a being not subject to fatigue, to east winds, to temper, and to bias, but one above all these weaknesses, calm and unruffled ; with all the world shut out, and living only to catch the fleeting rays of light, and tell their story."

"VIERTELJAHRSCHRIFT DER ASTRONOMISCHEN GESELLSCHAFT."—The third part of this year's publication gives an account of the work done at the observatories usually included in this list, each director, as has been done in former numbers, summing up in a few words, and stating the work being, and about to be, accomplished. We must refer our readers to the publication itself for individual information.

GEOGRAPHICAL NOTES.

L'Afrique gives a brief account of the last exploring journey of the late M. Georges Muller in Madagascar. He had returned to Antananarivo from a successful visit to Antsirabe, where he went to collect bones of *epiornis*, and in June he set out for Lake Alaotra, which, in company with Father Roblet, he explored, adding a number of features to the maps of the district. Parting from his companion, Muller pushed on with the view of reaching Mojanga on the west coast, but near Mandritsara he was attacked and murdered by a party of Fahavalos, one of the independent tribes who still contend against the Hova supremacy of the island.

THE *Madras Mail* says that the Indian Marine Survey vessel *Investigator* has proceeded to the Laccadives to continue the survey of those islands, which has been in course of preparation during the last two years. From the Laccadives the *Investigator* will go to Madras, and will be engaged for a few weeks in completing the East Coast Marine Survey from Pulicat Lake, where work was left off last year, to Madras Harbour. Finally in February the *Investigator* will proceed to Palk Straits, and a thorough survey of the dividing sea between India and Ceylon will be made, ostensibly with the object of testing the practicability of constructing a canal and a railway. The distance from the Indian mainland to Ceylon is sixty miles, of which twenty constitute Adam's Bridge proper. The bridge is said to consist of an irregular ridge formed of rock and sand partly dry at low water, but intersected by small intricate channels navigable only for native boats of very light draught. Average

spring tides rise only about two feet, so that the construction of the railway works and their future maintenance would be greatly facilitated. It is thought that the works required would consist of an iron and steel viaduct of considerable length, but in short spans, no large span being required except over the existing navigable channel, where a swing bridge would probably be necessary. Until a detailed survey of the strait has been made, however, it is impossible to speculate upon the details of the railway or the canal project with any degree of certainty; and the Government of India is determined to settle the question once for all by making a thorough survey of the coast and dividing sea.

FULL particulars have lately been received of the death by drowning, in September last, of Mr. H. M. Becher, while on his way to visit the mountain known as Gunong Tahan in the province of Trengganu in the Malay peninsula. He had come within sight of the mountain, which had never before been seen by a European, and roughly estimated its height at between 8,000 and 9,000 feet, when his camp on a low island in a river was submerged by a sudden flood, and the boat in which he attempted to reach the shore capsized. His companion, Mr. H. Quin, escaped, but did not continue the journey.

A LONG letter just received from Mr. Astor Chanler, who is travelling in East Africa, is published in the December number of the *Geographical Journal*. It contains the unfortunate tidings that his companion, Lieutenant von Höhnel, whose previous successful travels in East Africa are well known, had been seriously wounded by a rhinoceros, which rendered his immediate return to Europe necessary. Mr. Chanler, although he has suffered greatly from loss of men and animals, is determined to push on to the north in the hope of reaching Berbera or Zeïla. At the time of writing, September 20, the party had returned to Daicho, near Mount Kenia, after a visit to the Rendile tribe, who live in the country to the north. These people appear to have strong Somali affinities, and were more intelligent than the Masai, but equally fierce and intractable. The loss of von Höhnel's services will detract from the geographical value of the expedition, as he is an accomplished surveyor.

IN our last issue we gave, without comment, an abstract of one of the rumours regarding the Nansen expedition, published by an evening newspaper. It is right to add, however, that the report of high land north of the New Siberian Islands is no new thing, and that Nansen has no thought of taking up winter quarters on any land, his intention being to get fast in the ice, and drift wherever it carries him. His only object in touching at the New Siberian Islands was to send letters home; but if the sea was as favourable as we believe it to have been, he would probably strike straight northward without calling anywhere.

ANTARCTIC EXPLORATION.

AT the meeting of the Royal Geographical Society on Monday evening Dr. John Murray, of the *Challenger* Expedition, read a paper on the renewal of Antarctic exploration. He sketched the history of voyages to the far south, and of the notions which prevailed as to the nature of the South Polar region from the earliest time down to the present day. He showed that while the huge southern continent believed in by the geographers of past ages had been vastly diminished by increased knowledge, the probability is that around the South Pole a land area of about 4,000,000 square miles actually exists. He indicated the present state of our knowledge of the region, which is extremely meagre, and then went on to show that until this knowledge was greatly increased many problems in science must remain unsolved. Until we had a complete and continued series of observations in the Antarctic area the meteorology of the globe could not be understood. Important problems in geology, in biology, in physics, in oceanography, demanded the renewal of research on an adequate scale in the South Polar area. Dr. Murray concluded as follows:—

Within the past few months I have been in communication with geographers and scientific men in many parts of the world, and there is complete unanimity as to the desirability, nay, necessity for South Polar exploration, and wonder is expressed that an expedition has not long since been fitted out to undertake investigations which, it is admitted on all sides, would be of the greatest value in the progress of so many branches of natural knowledge.

To determine the nature and extent of the Antarctic continent; to penetrate into the interior; to ascertain the depth and nature of the ice-cap; to observe the character of the underlying rocks and their fossils; to take magnetic and meteorological observations both at sea and on land; to observe the temperature of the ocean at all depths and seasons of the year; to take pendulum observations on land, and possibly also at great depths in the ocean; to bore through the deposits on the floor of the ocean at certain points to ascertain the condition of the deeper layers; to sound, trawl, and dredge, and study the character and distribution of marine organisms. All this should be the work of a modern Antarctic expedition. For the more definite determination of the distribution of land and water on our planet; for the solution of many problems concerning the Ice Age; for the better determination of the internal constitution and superficial form of the earth; for a more complete knowledge of the laws which govern the motions of the atmosphere and hydrosphere; for more trustworthy indications as to the origin of terrestrial and marine plants and animals, all these observations are earnestly demanded by the science of our day.

A dash at the South Pole is not what I now advocate, nor do I believe that is what British science, at the present time, desires. It demands rather a steady, continuous, laborious, and systematic exploration of the whole southern region with all the appliances of modern investigators.

This exploration should be undertaken by the Royal Navy. Two ships, not exceeding one thousand tons burthen, should, it seems to me, be fitted out for a whole commission, so as to extend over three summers and two winters. Early in the first season a wintering-party of about ten men should be landed somewhere to the south of Cape Horn, probably about Bismarck Strait at Graham's Land. The expedition should then proceed to Victoria Land, where a second similar party should winter, probably in Macmurdo Bay near Mount Erebus. The ships should not be frozen in, but should return to the North, conducting observations of various kinds towards the outer margins of the ice. After the needful rest and refit, the position of the ice and the temperature of the ocean should be observed in the early spring, and later the wintering parties should be communicated with, and, if necessary, reinforced with men and supplies for another winter. During the second winter the deep-sea observations should be continued to the north, and in the third season the wintering parties should be picked up and the expedition return to England. The wintering parties might largely be composed of civilians, and one or two civilians might be attached to each ship; this plan worked admirably during the *Challenger* expedition.

It may be confidently stated that the results of a well-organised expedition would be of capital importance to British science. We are often told how much more foreign governments do for science than our own. It is asserted that we are being outstripped by foreigners in the cultivation of almost all departments of scientific work. But in the practical study of all that concerns the ocean this is certainly not the case; we have to acknowledge no superiors nor equals in this branch of investigation, and if we be a wise and progressive people, British science will always lead the way in this direction. Twenty or thirty years ago we were in profound ignorance as to the condition of all the deeper parts of the great ocean basins; now we have a very accurate knowledge of the conditions which obtain over the three-fourths of the earth's surface covered by the waters of the ocean. This is the most splendid addition to earth-knowledge since the circumnavigation of the world, and is largely due to the work and exertions of the British navy in the *Challenger* and other deep-sea expeditions.

This country has frequently sent forth expeditions, the primary object of which was the acquisition of new knowledge—such were the expeditions of Cook, Ross, and the *Challenger*; and the nation as a whole has always approved such action, and has been proud of the results, although they yielded no immediate return. Shall it be said that there is to be no successor to these great expeditions?

A preliminary responsibility rests on the geographers and representatives of science in this country. It is necessary to show that we have clear ideas as to what is wanted, to show that a good workable scheme can be drawn up. When this has been done it should be presented to the Government with the unanimous voice of all our scientific corporations. Then, I have little doubt, that a Minister will be found sufficiently alive to the spirit of the times, and with sufficient courage to add a few

thousand pounds to the navy vote for three successive years, in order to carry through an undertaking worthy of the maritime position and the scientific reputation of this great empire.

An animated discussion, in which the Duke of Argyll, Lord Charles Beresford, Sir Joseph Hooker, Sir George Nares, Sir Vesey Hamilton, Capt. Wharton, Sir W. Turner, Sir W. Flower, Dr. Buchan, and Mr. W. S. Bruce took part, followed the reading of the paper. All the speakers strongly expressed their conviction that the time had come to make a vigorous attempt to resume the long-interrupted line of advance into the south polar regions by means of a Government expedition.

PHENOMENA OF THE TIME-INFINITESIMAL.[1]

SCIENCE consists in the extension of our knowledge of the external universe, and it brings about this extension in great part by reinforcement of our senses. To bring into the field of observation the very distant and the very small, are therefore regarded as important scientific achievements, and the telescope and the microscope, by means of which this widening of the realm of knowledge has been made, as important implements of research.

Man's relation to time is such that it is difficult to conceive of an instrument which should bring distant events to hand in like manner for inspection. Our time vision turns chiefly in one direction—towards the past—and is obscured by the intervention of something very like a medium or atmosphere, through which we see dimly. As to the future, our thoughts are necessarily confined to matters found by experience of the past to be periodic, or to changes already begun and known by the observation of analogous processes to be likely to run some definite course. In the interpretation of the future by the past, there is much of interest to the physicist; but it is not of this that I would speak to-day. Let us turn our attention rather to the study of minute time intervals in physics—to a consideration of the methods by which we may record what takes place during infinitesimal elements of time. The interest of the physicist in time is confined really to a study of phenomena. He ascribes no property to time itself, beyond defining it after Riemann, as a complexity of the first order.[2]

As between the study of the infinitely great and the infinitesimally small, whether of space or of time, there is a peculiar value to be attached to the latter, because the only methods which have proved the least fruitful in the analysis of the more complex changes which are going on around us, are those which begin with the infinitesimal. We consider an element of mass or of volume, or sometimes merely the element of a surface or line, proceeding then to extend our statements so far as our powers of mathematical expression will permit.

Now the element of time is, of course, purely relative. In certain phenomena the time infinitesimal is so short as compared with any time interval with which we are able to cope experimentally as to be out of reach, just as in special relations the dimensions of the molecule and atom are such that we dare not hope to render these ultimate particles of matter visible even under the microscope. There are periodic phenomena, on the other hand, the periods of which are so great that a lifetime, indeed the entire era covered by history and tradition, affords us a glimpse of but a single time element. Lying between these two there is a great range of phenomena for which the element of time is within our reach. It is by the study of what takes place in such time elements, and the extension of the results thus obtained by analytical processes, that much of our knowledge of physics has been gained. It is to the extension of our powers in the observation of the phenomena of the time interval that we must look in great part for further progress. It has seemed worth while, therefore, to bring together for purposes of comparison some of the methods which have proved fruitful in this respect, and to consider along what line they may be further developed. It is an investigation which will lead us into all departments of science; for phenomena into which the element of time does not enter are unknown.

[1] An address delivered by Prof. E. L. Nichols before Section B (Physics) of the American Association for the Advancement of Science. Madison meeting, August, 1893.

[2] "Eine einfach ausgedehnte Mannigfaltigkeit." (Riemann: Ueber die Hypothesen welche der Geometrie zu grunde liegen. Werke p. 257.)

Since all study of phenomena involves the time element, th consideration of all dynamical problems must begin with th *phenomena* of the *time-infinitesimal*. There are two cases of chief importance:—(1) The study of the time elements of periodic phenomena; (2) the study of beginnings of changes which result from a sudden variation in the condition of equilibrium.

The methods which have been found most useful in the investigation of the phenomena under consideration may be classified as follows:—(1) Visual methods: (*a*) vision by instantaneous exposure, (*b*) vision by periodically interrupted exposure, (*c*) vision by the aid of the revolving mirror. (2) Photographic methods: (*a*) instantaneous exposure of a stationary film, (*b*) photography by the aid of the revolving mirror, (*c*) continuous exposure of a moving plate, (*d*) successive short time exposures of a moving plate. (3) Indirect graphical and electrical methods.

Much of the most important work which has been done in the domain of sound falls within the scope of our present inquiry, and it is in that field that many of the methods just indicated have been developed. The revolving mirror, for example, is a favourite tool of the acoustician; its usefulness is too well known to need mention here, but I wish to remind you that this instrument, chiefly used for the separation of images representing phenomena covering intervals of thousandths of seconds, has been found capable of rendering much briefer events subject to inspection and analysis.

The inventor of the revolving mirror (Wheatstone) found it possible to study time intervals down to within a millionth of a second ("Philosophical Transactions," 1834). He obtained a rate of revolution never since greatly exceeded, I think, of eight hundred revolutions a second. It is evident that he stood at the very threshold of the discovery of the oscillatory discharge, and that it was merely an accident of the relation of resistance and capacity in the circuits which he employed, which prevented him from observing that important form of the electric spark. That he was fully aware of the wide range of investigations to which the revolving mirror is adapted is also clear. He says in the memoir which Faraday presented for him before the Royal Society in 1834: "But this instrument is not confined to observing merely the intermittedness of electric light; whenever a rapid succession of alterations occurs in an object which does not change its place, they may be separately examined by this means. Vibrating bodies afford many instances for investigation; one among these is perhaps worthy to be mentioned. A flame of hydrogen gas burning in the open air presents a continuous circle in the mirror, but while producing a sound within a glass tube regular intermissions of intensity are observed, which present a chain-like appearance, and indicate alternate contractions and dilations of the flame corresponding with the sonorous vibrations of the column of air" (*l.c.* p. 586).

In a later paragraph of the same paper he noted the applicability of the spark in the study of the phenomena of the time-infinitesimal, suggesting a method the importance of which is even now but imperfectly appreciated. "The instantaneousness of the light of electricity of high tension affords the means of observing rapidly-changing phenomena during a single instant of their continued action."

In the hands of Foucault ("Recueil des travaux scientifiques," Paris, 1878), Michelson ("Proc. A.A.A.S.," 1879) also "Papers of Amer. Ephemeris," vols. i. and ii. 1882), and of Newcomb ("Astro. Papers of Amer. Ephemeris," vol. ii.) the revolving mirror has given us our best determinations of the velocity of light; in those of Feddersen ("Beiträge zur Kenntniss des electrischen Funkens, 1857.") Also *Pogg. Ann.* 103, 113, 116 (1859 to 1862), Rood (*Amer. Journal of Science*, vol. ii. 111, p. 160), Trowbridge (*Amer. Journal of Science*, vol. xlii. 111, p. 223), and Boys (*Philosophical Magazine*, vol. xxx. 111, p. 248) and others it has made it possible to resolve the oscillatory spark into its elements.

Feddersen's experiments are especially noteworthy because he succeeded (in 1862) (*Pogg. Ann.* 116, p. 132) in photographing the discharge of the Leyden jar, securing an excellent record of the images seen in the revolving mirror. We are apt at the present day to look back to the introduction of the dry plate as the step necessary to the application of photography to the study of fleeting phenomena, but certainly the results obtained by this early investigator, who used the ordinary wet-plate process of his time, are not inferior in definition or in detail to any which have been published in recent years. Feddersen's researches are indeed worthy of all admiration. He used a concave mirror,

giving excellent images when driven at a speed of one hundred revolutions a second. The velocity was under the regulation to within two per cent., and the millionth of a second represented not merely an appreciable distance upon the negative, it was an *easily measurable* quantity.

More than thirty years ago this German physicist stood, as Wheatstone had done nearly half a century before him, in the very gateway of the domain in which such activity has shown itself of late—the domain of electrical resonance. He was not only the discoverer along experimental lines, of the oscillatory discharge and the demonstrator of the existence of effects which had already been embodied in the analytical work of Helmholtz, Thomson, and Kirchhoff; he anticipated also many of the discoveries of later investigators, and worked out quantitatively the dependence of the rate of oscillation upon capacity, induction, and resistance. Two of Feddersen's photographs have been brought to general notice by reproduction in the fourth volume of Wiedemann's "Electricität." There is another set which I consider even more significant, showing the increase in the number of oscillations with diminishing resistance. It is copied in *fac simile* from the original plate in Fig. 1.

Another forerunner in the development of the methods which it is my privilege to consider, was Prof. E. W. Blake, of Brown University. His results, too, have become classical; but I refer to them because they are related in ways not always

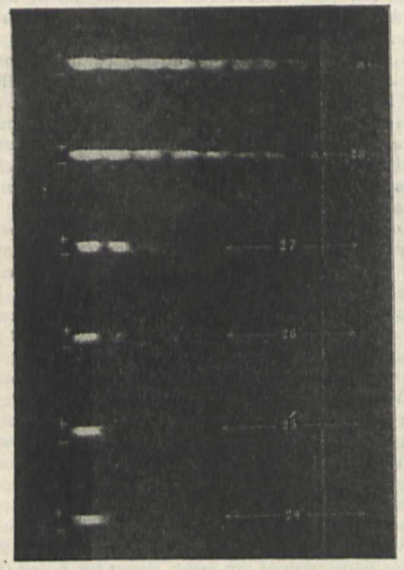

FIG. 1.

recognised in later work. We are all familiar with his interesting photographs obtained by speaking into the mouthpiece of a Bell telephone (Blake, *Am. Journal of Science*, vol. xvi. (3) p. 57), to the diaphragm of which was attached a rocking mirror. Records obtained in a variety of other well-known ways, of some of which I shall have occasion to speak, indicate that these photographs do not give a complete trace of the vibrations which go to make up the articulate utterances by means of which they were excited, but the method is of interest in three particulars:—

(1) It is one of the earliest attempts to substitute photography for vision in the study of the transient phenomena of the sound wave.

(2) It substitutes a moving sensitive plate for the revolving mirror.[1]

(3) It is a distinct forerunner of the method applied some years later with somewhat better success by Froehlich to the analysis of alternate current phenomena.

Throughout the history of the study of the phenomena of the time-infinitesimal we find the tendency to be to supplant visual methods by methods of photographic record. One of the most noteworthy achievements in experimental acoustics, for example, is the application of the manometric flame to the study of sound waves. The drawings made by Kœnig (*Annalen der Physik*, vol. cxxii. p. 666; also in his "Experiences d'Acoustique," pp. 47–84) in illustration and verification of the phenomena of the organ-pipe and of the analysis of complex sounds, have been admired by all of us; and the repetition of his experiments has delighted an entire generation of demonstrators in physics. In how many minds the question of the feasibility of photographing the manometric flame has arisen I do not know, but quite recently it has been shown by Doumer (*Comptes Rendus*, 103 and 105), and independently by Ernest Merritt (Proc. A.A.A.S. 41, p. 82; also *Physical Review*, vol. i.) in a paper read before this section, that by surrounding the sensitive flame with a mantle of free oxygen (after the method of what was once known as the "Budde" light), sufficient actinic intensity may be obtained to ensure an excellent photographic record on a rapidly moving plate. The results of such photographs applied to the analysis of vowel sounds give evidence of the extraordinary fidelity of the sketches published by Kœnig. They also afford a basis for the study of timbre of the sounds to which they correspond, which is open to one objection only, viz. to the uncertainty as to the influence of the inertia of the diaphragm upon the character of the image. Of this source of error I shall have more to say in connection with some other researches.

Other interesting examples of the study of the time-element might be drawn from this field; indeed, the science of sound is of necessity largely made up of such work. The beautiful photographs of vibrating strings by Menzel and Raps (*Annalen der Physik*, *N.F.* 44, 1891, p. 623), which are so fitting an appendix to the earlier labours of Helmholtz (*Die Tonempfindungen*, p. 137), may serve to illustrate the usefulness of the method of photography on a moving plate.

In the study of periodic phenomena two distinct methods of investigation have been established. The first of these consists in the isolation of a desired element of the cycle at each repetition for as long a time as may be necessary to obtain a satisfactory record of the existing conditions. By the selection successively of many neighbouring elements, we get in this way at last the data from which to construct a complete diagram of the cycle.

This principle has been most fruitful in enabling us to analyse periodic processes not easily approachable by more direct means. The most notable application has been that which is commonly spoken of as the "method of instantaneous contact," well known to the student of alternating current phenomena.

It is to Joubert[1] (1880) that we owe this ingenious adaptation of the device of properly timed repetitions of instantaneous observations of periodic phenomena (a principle which underlies the phenakistoscope and similar well-known instruments). He made use of it in the study of the changes of potential in the circuit of the alternating current dynamo, and between the terminals of the Jablochkoff candle.

In the same year the method was discovered independently, and applied to the study of the Brush arc-lighting dynamo by B. F. Thomas.[2] Joubert pointed out the method of using the quadrant electrometer in alternating circuits, also that the galvanometer might be utilised. ("On peut mesurer cette intensité par l'electromètre mais on peut aussi employer le galvanomètre puisque les contacts successive correspondent toujours a une même phase du courant.") He discovered the retardation of phase in the current curves of the alternating dynamo, and the peculiar distortion of the curves in the circuit containing an arc lamp, a matter more fully investigated at a later day by Tobey and Walbridge.[3] Thomas during this first period in the history of the Joubert method used a ballistic galvanometer and condenser.

The periodic phenomena of the alternating current circuit have been among the most important to which the study of the time-element has been applied, and it is to the method of instantaneous contacts that we owe much of the progress of the last thirteen years. It is interesting to note the extension of

[1] Stein, in a paper cited by Prof. Blake, *Pogg. Ann.* 159 (1876), describes a similar device, but it is difficult to ascertain from his paper to what extent he succeeded with his experiments.

[1] "Sur les Courants alternatifs et la force electromotive de l'arc electrique." *Comptes Rendus*, vol. xci. p. 161, July 19, 1880.

[2] "Observations on the electromotive forces of the Brush dynamo-electric machine." (title only.) Proceedings A.A.A.S. vol. xxix. p. 277 (1880). Prof. Thomas gave the results obtained, and described the method eleven years later in a communication to the Institute of Electrical Engineers, entitled "Notes on Wiping Contact Methods for Current and Potential Measurements," Translations of the American Institute of Electrical Engineers, vol. ix. p. 263.

[3] "Investigations of the Stanley Alternate Current Arc Dynamo." Trans. Am. Inst. Electrical Engineers, vol. vii. p. 367.

this method in the study of a variety of allied phenomena. After the publication of Joubert's papers the method seems to have come into common use in the physical laboratories, particularly in the exploration of the fields of continuous current dynamos and motors.

In 1888 it was applied by Duncan, Hutchinson, and Wilkes ("Experiments on Induction Coils," *Electrical World*, vol. ii. p. 160, 1888) to the study of induction coils and transformers. To them we owe the first set of complete diagrams relating to the performance of this class of alternating current apparatus. In the same year Meylan ("Sur les Appels Magnetiques," *La Lumière Electrique*, xxvii. p. 220, 1888) used an interesting modification of the method in the investigation of the vibratory magnetic call-bell of Abdank.

In the same year appeared the first definite data with reference to the Westinghouse alternating dynamo, at the hands of Messrs. Searing and Hoffmann ("Variation of the Electromotive Force in the Armature of a Westinghouse Dynamo," *Journal of the Franklin Institute*, vol. cxxiii. p. 93), of Stevens Institute. Then followed in the order named the researches of Ryan and Merritt ("Transformers," Trans. Am. Inst. Electrical Engineers, vol. vii. p. 1, 1889), Humphrey and Powell ("Efficiency of the Transformer," *Ibid*, vol. vii. p. 311), Tobey and Walbridge (*Ibid*, vol. vii. p. 367), of Marks (*Ibid*, vol. vii. p. 324), of Herschel (*Ibid*, vol. vii. p. 328), of Fortenbaugh and Sawyer (*Ibid*, vol. vii. p. 334).

In all these investigations the methods under consideration have been used with varying accessories in the problem of the transformer.

In 1890 it was applied under much more difficult conditions to the analysis of the "ball and point effect" by Archbold and Teeple (see Nichols, "On Alternating Electric Arc between a Ball and Point," *American Journal of Science*, vol. xli. p. 1).

In 1891, Thompson ("Study of an Open Coil Arc Dynamo," Trans. Am. Inst. Electrical Engineers, vol. viii. p. 375) determined the intricate changes of induction in open coil arc lighting machines by means of the same method, and Ryan ("Relation of the Air Gap and the Shape of the Poles to the Performance of Dynamo-electric Machinery," *Ibid*, p. 451) utilised it in his investigations of the influence of the air gap upon the performance of dynamos and motors. In 1892, Duncan ("Note on some Experiments with Alternating Currents," *Ibid*, vol. ix. p. 179) described modifications of the method of instantaneous contacts by means of which the rapidity of reading is greatly enhanced.

During the present meeting, you will doubtless have the pleasure of listening to a description of the applications of the same device to the study of electrostatic hysteresis. (Reference is here made to the paper presented by Messrs. Bedell, Ballantyne, and Williamson: "Alternate Current Condensers and Dielectric Hysteresis," *Physical Review*, vol. i. p. 91. Subsequent note.)

Such has been, in brief, the history of a method by means of which in greater degree than of any other we have been able to extend and complete our knowledge of alternating current phenomena.

To the practical electrician and to the theorist alike, the domain has been one of the most attractive of those which have been developed in recent years. To the electrical engineers of the younger generation the very complexity of alternate current theory has proved a benefit. It has forced them to increased mathematical proficiency and to more rigorous thinking; it has, indeed, served as an excellent source of discipline. What the problems of submarine telegraphy did for the English electricians who served their apprenticeship during the early days of the cable-laying industry, compelling the development of those sturdy qualities which have been so highly serviceable in every branch of electrical progress since, the intricacy of alternate current practice is unquestionably doing for the younger school which is growing up to-day in this country. The difficulties which have to be met and overcome in this field of work will have an excellent influence upon the manner in which the problems of the future will be approached.

Another investigation, which owes its existence to a most ingenious application of this same principle of instantaneous contacts periodically repeated, is well known to all of you. I refer to Prof. E. H. Hall's[1] study of periodic heat-flow in the cylinder walls of the steam-engine by means of thermo-elements embedded within the metal and connected momentarily during a selected time-element in the course of each stroke with a sensitive galvanometer. To my mind no more interesting example of the indirect method of studying the phenomena of the time-element could be found than this suggestive memoir.

The method of instantaneous contacts has been a fruitful one, and productive of high results, but it does not yield a knowledge of any individual time-element, nor the picture of any single completed cycle. Numerous attempts to record single cycles have been made, the results of which are of considerable interest, because they deal with the more direct study of the time-infinitesimal.

The device which lay nearest to hand, and which by its performance seemed to promise success in this direction, was the magneto-telephone. The investigations of Mercadier (*Journal de Physique*, vol. ix. pp. 217 and 282) had already paved the way to some extent, when Froehlich described his experiments upon the optical representation of the movement of the diaphragm of the telephone, followed almost at once by Thomson.

Froehlich[1] reported his preliminary results to the Electrotechnische Verein of Berlin, in 1887. Elihu Thomson ("An Indicator for Alternating Circuits," *La Lumière Electrique*, vol. xxvii. p. 339 (1888) brought out his indicator for alternating circuits, an instrument in which the movement of a diagram was amplified by levers, and then made visible by optical means (or photographed) in the same year. Froehlich's method in its complete form, including the photography of the images from the involving mirror,[2] was first described in the year 1889. Some of the curves published in the papers just cited, and particularly the experiments shown in the exhibition of the method at the Frankfort Electrical Exposition of 1891, are most striking, but considering the method by which they are produced, the question inevitably arises as to the part played by the inertia of the moving masses.

Froehlich himself points out the necessity of great care in the matter of the adjustments, and of distinguishing the natural oscillation of the plate, which are frequently superimposed upon those to be recorded. Some experience with Froehlich's method has convinced me that not only is extraordinary skill necessary in order to obtain, by means of a mirror attached to the diaphragm of a telephone, curves which should represent, even with a fair approximation, the law of whatever periodic changes we may desire to record, but that the attainment of the proper adjustment is a matter so entirely fortuitous, and its maintenance so uncertain, as to deprive the method of much of its usefulness. One may indeed hope to get, by means of successive adjustments, curves which correspond to a known type, but whether in passing to new and unknown types the apparatus retains its faithfulness, is always a question.

By way of illustration, I introduced three of an extended series of curves obtained by this method with a telephone in circuit with an alternating current dynamo. The character of the cycle had been determined by the method of instantaneous contacts. The true cycle was represented by a curve of sines, but with the apparatus under consideration complex curves of the kinds shown in figures 2 and 3 were the rule; curves even approximating to simple sinuosity were the rare exception.

The difficulties of the method lay not merely in the tediousness of adjustment, but rather in the tendency to reyert to complex forms under changes of condition so slight as to be entirely beyond control. The remedy clearly consists in the elimination of mechanism and the reduction of inertia of the moving parts. Following the suggestion of an assistant, Mr. E. F. Northrup, I tried the following experiments:—

A mercury stream flowing from the contracted nozzle of a funnel (Fig. 4) was made to pass between two metal terminals which were attached to the poles of a large Holtz machine. A portion of the falling column of mercury within the electrostratic field was illuminated by means of an arc lamp, and so much of it as could be seen through a horizontal slit was photographed by transmitted light. The sensitive plate was given rapid vertical motion through the field of the camera. When the machine was out of action there resulted a vertical trace running the length of the developed plate. As soon as the machine was put

[1] "A Thermo-Electric Method of Studying Cylinder Condensation in Steam-Engine Cylinders." Trans. Am. Inst. Electrical Engineers, vol. viii. p. 236.

[1] "The Optical Representation of the Movements of a Telephone Diaphragm." *La Lumière Electrique*, vol. xxv. p. 180 (1887).

[2] Froehlich: "Ueber eine neue Methode zur Darstellung von Schwingungskurven." *Electrotechnische Zeitschrift*, bd. x. pp. 345, 369 (1889).

into operation, deflection of the mercury stream occurred. It was the object of the experiment to determine the performance of the stream under the sudden fluctuations of the field which occurred when the Holtz machine was under rapid discharge. Fig. 5 is from a photograph taken when nearly one hundred sparks a second were passing between the poles.

Other photographs were obtained in a similar manner, the deflecting forces, however, being due to the action between the

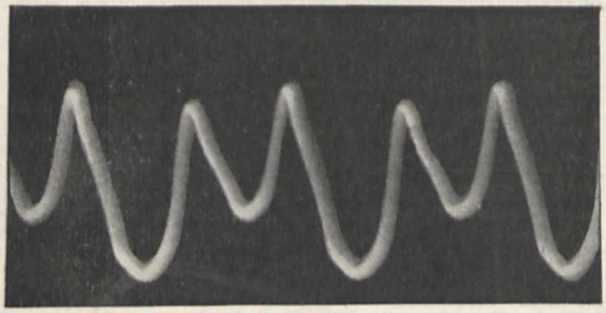

FIG. 2.

lines of a stationary magnetic field and those of an alternating current traversing the mercury column. The arrangement of the apparatus is shown in Fig. 6. The mercury stream was introduced into the circuit of the alternating current dynamo, already made use of in the experiments upon Froehlich's method. It flowed through a strong magnetic field with horizontal lines. The transverse oscillations of the mercury under these con-

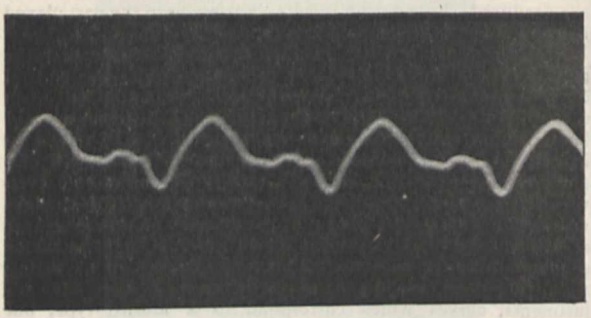

FIG. 3.

ditions were very apparent. When photographed by means of a camera with optical axis parallel to the lines of force, the stream strongly illuminated from behind and viewed through a narrow horizontal slit, as in the previous experiment, a sinusoidal trace was obtained. All the complexities of the telephonic trace disappeared in these records, and curves corresponding to those of the method of instantaneous contact were always pro-

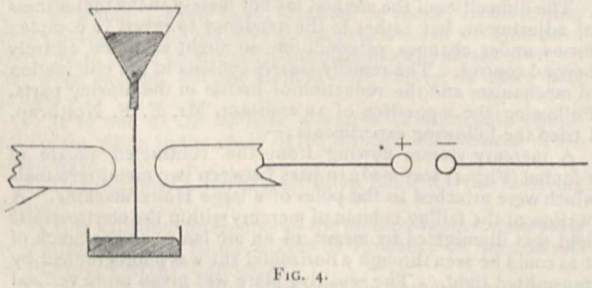

FIG. 4.

duced. The experiment was made by Mr. Henry Floy, to whose efforts the photographs by Froehlich's method are also due. This method has not been further developed. I introduce it here to show that increased accuracy of record may be looked for as the result of reducing in any practicable manner the mass of the indicating device.

Another attempt to record single periods in dynamo-electric work should be mentioned here. It is described by Moler[1] in a recent paper. By means of a D'Arsonval galvanometer with a period of vibration of a few thousandths of a second, curves of varying potential are traced, which show excellent agreement with measurements by the method of instantaneous

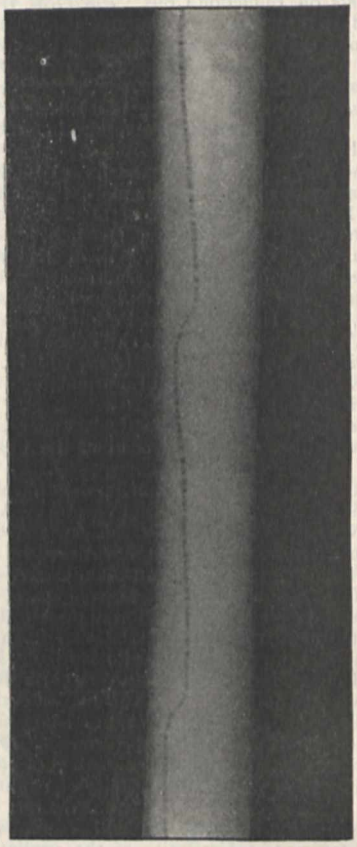

FIG. 5.

contacts. The instrument is not free from the errors due to inertia. It is reliable only in recording changes of period considerably greater than its own, but its use is a step in a direction along which progress may he looked for.

Thus far I have dealt with methods of studying periodic changes, the time-elements of which are easily within reach

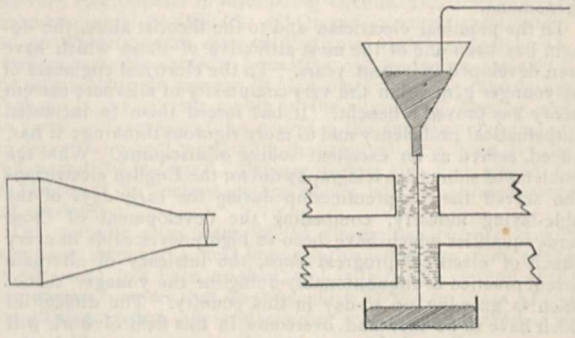

FIG. 6.

through experimental devices. I might have devoted myself with as good reason to the consideration of recent advances in the study of electrical oscillations of a higher order of frequency. This is a department of physics in which much has been done of

[1] "A Dynamo-Indicator, or Instantaneous Curve-writing Voltmeter." (Trans. Am. Elec. Engineers, vol. IX., p. 223.)

late, but so much has been written at second-hand, as well as in the way of original treatment, that further reiteration is uncalled for. The work of Hertz and of his host of followers is familiar to us all. In the study of electrical oscillations even of very high frequency, photography has been used with success, and details of the phenomena of time-elements truly infinitesimal have been secured. By the labours of Wiener[1] waves of a still higher order than those which have occupied the attention of the electrician have been photographed, and a new field of the greatest promise has been thrown open to the optician. The isolation of a single light vibration may indeed still be as far from us as is the inspection of the molecule by means of the microscope, but in the meantime we have in the photography of a system of standing light-waves, an achievement well worth celebrating.

In the investigation of the phenomena of the time-infinitesimal, so far as periodic changes are concerned, we see that the experimenters of the present time are gaining much of detailed knowledge. There is another field equally important, in my opinion, which is as yet for the most part unexplored. The study of the beginnings of changes brought about by abrupt shifting of the conditions of equilibrium is one from which very much may be expected. Already suggestive beginnings have been made, but the researches have not been pushed to the limit of the experimentally possible. Oftentimes interesting observations of what might be termed "startling phenomena" have been recorded, but quantitative results are lacking. Take for example the brilliant work of Becquerel (*Comptes rendus*, 96, pp. 121, 1215, 1853) with the phosphorescope. What a mass of fascinating and suggestive material that savant has gathered into the first volume of his book on light! (*La Lumière*, i. pp. 206-422.) What a world of interesting material these preliminary observations present to him who shall undertake to determine quantitatively, wave-length by wave-length, the changes which the radiations from the numerous luminescent materials undergo, beginning with the instant of exposure and following the vanishing light until it is gone.

Of a few isolated cases which have been forced upon us by their practical importance we have some complete knowledge already. With the phenomena in cables when current is suddenly introduced or circuit is broken, we are reasonably familiar. The case of the charge and discharge of condensers has been treated analytically under assumptions the precise truth of which is still to be verified. The detailed study by experiments carried to the utmost refinement, of the very cases which seem to have been most completely covered by theory, is especially important; since in this way only can the assumptions upon which our analysis is based be rigorously determined, and the necessity of modifications be ascertained. For some of this work methods already in use in the study of periodic phenomena will suffice. The curve-writing voltmeter, for example, may be made to give records running to within a thousandth of a second of the instant when a process such as electrolysis, electrolytic polarisation, voltaic action, or the charge and discharge of a condenser begins. Instruments such as the von Helmholtz pendulum, for the isolation of definite small time intervals, may also be applied to a great variety of progressive phenomena, enabling us to approach by successive steps almost to the very beginnings of the changes to be analysed. Concerning known methods let me point out, in conclusion, that photography with the moving plate is a means, the limitations of which have not yet been discovered. It is equally applicable to periodic and to progressive phenomena, often with results of unexpected beauty and significance.[2]

The remarkable experiments of Mach (*Wiener Sitzungsberichte*, 95, p. 764, also 97, p. 41) and of Boys ("On Electric Spark Photographs," &c., NATURE, vol. xlvii. p. 415) indicate that the dry plate is still abundantly exposed within intervals so short that the swiftest of modern projectiles give images as of a body at rest.

The laws of electrical resonance have already been so far determined that we can construct condensers, the duration of the discharge of which is a matter of computation, and the precise moment of the discharge of which after a given event is quite within control. This single device, consisting of the exposure of the photographic plate by means of a properly timed spark, brings under observation a set of time intervals of a new and higher order of brevity. Much is destined to be learned by means of it concerning the nature of matter, and much more, I think, from other, possibly still more powerful, methods which will doubtless be developed when the importance of the study of the time-infinitesimal is more generally recognised.

[1] "Stehende Lichtwellen und Schwingungsrichtung des polarisirten Lichtes." *Annalen der Physik N.F.* vol. xl. p. 203.

[2] In photographing the alternate current arc a single exposure of a continuous current lamp upon the moving plate, by way of check, brought out the seat and precise nature of the hissing of the arc in a manner scarcely to be reached in any other way. For the method used, see "A Photographic Study of the Electric Arc," Trans. Am. Inst. Electrical Engineers, vol. viii. p. 214, 1891.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—At a meeting of the Ashmolean Society, held at the Museum on Monday, 27th inst., Prof. Odling was elected President for the ensuing year, and Messrs. F. J. Smith and G. C. Bourne were re-elected Secretaries. Mr. E. J. Stone read a paper on the rainfall at Oxford during the last seventy-eight years, and Prof. E. Ray Lankester read a paper on fresh-water jelly-fishes.

At the meeting of the Junior Scientific Club, on Friday, 24th inst., papers were read by Dr. Ritchie, on anthrax spores and bacilli; by Mr. G. B. Cronshaw, on explosions in coal-mines; and by Mr. A. L. Still, on plants and their standing army.

CAMBRIDGE.—The Special Board for Physics and Chemistry report that the Cavendish Laboratory, founded and equipped by the munificence of the late Duke of Devonshire, has become incapable of accommodating the large number of students desiring tuition in Physics. In the present term no less than 135 students are at work in a disused galvanised iron dissecting-room, which, on its vacation by the Professor of Anatomy, has been placed at the disposal of the Professor of Physics as a temporary laboratory. Its site will, however, soon be required for the Sedgwick Memorial Museum of Geology, and the Board feel that the time has come for the permanent extension of the Cavendish Laboratory. An adjoining site is available between it and the Engineering Laboratory; but the problem of funds for building and equipment is less easy to solve, unless a benefactor as generous as the late Chancellor should make his appearance. The high position deservedly held by the Cavendish Laboratory, entrusted as it is with much work of national importance, makes it reasonable to hope that Prof. J. J. Thomson will be able to obtain the means for the desired extension.

Mr. W. Gardiner and Mr. A. C. Seward have been re-appointed University Lecturers in Botany, and Dr. Hill, Master of Downing College, Lecturer in Advanced Human Anatomy, for five years. Dr. Hill has also been appointed Chairman of the Examiners for the Natural Sciences Tripos.

The Local Examinations Syndicate report that the work done in the scientific branches of the Higher Local Examinations during the past year was on the whole satisfactory. Imperfect experimental work in chemistry, and lack of practical instruction in zoology, are among the weaker points revealed.

The Examinations in Sanitary Science seem to be increasingly appreciated by medical men. During the present year eighty-seven candidates have presented themselves, and of these fifty-eight received diplomas in Public Health.

THE *Times* correspondent at Paris says that an International University alliance is in course of formation there. Its object is to facilitate the passing of students from one University to another, to promote travelling scholarships and the exchange of information, to multiply periodical celebrations, and to "draw the attention of the Universities to the question of introducing greater justice into international relations."

SCIENTIFIC SERIALS.

Wiedmann's Annalen der Physik und Chemie, No 11.—On the speed of electrolytic ions, by F. Kohlrausch. This is a compilation of tables of absolute velocities, of mobilities, and of coefficients of electrolytic friction according to the latest and most reliable data.—Contributions to the knowledge of the absorption and branching of electric oscillations in wires, by Ignaz Klemencic.—The resistance which causes evolution of heat during the passage of very rapid oscillations depends upon the magnetic permeability of the wire, but in a different

manner from that in the case of a constant current. The amounts of heat developed in wires of iron, German silver, brass, and copper 6 cm. long and of 0·018 cm. radius, were in the proportion of 10·5 : 1·75 : 1 : 1, the last being probably a little too large. The branching of the oscillations is only affected by the self-induction of the wires, not by their resistance. —The emission of hot gases, by F. Paschen (see p. 82).—A simple method of testing the conductivity of dielectric liquids, by K. R. Koch. The apparatus used for this method is a modified Dewar capillary electrometer, in which a drop of the substance to be examined takes the place of the drop of sulphuric acid usually employed for determining differences of potential. Any electrolytic polarisation is indicated by a movement of the drop of liquid, which should not be more than 0·5 mm. long. The conductivity of various dielectrics has thus been studied, and has in many cases been found to be due to impurities. Benzol, carefully cleaned and freed from moisture, ceased to show any polarisation.—On the magnetic susceptibility of oxygen, by R. Hennig (see Notes).

SOCIETIES AND ACADEMIES.

LONDON.

Chemical Society, November 2.—Dr. Armstrong, President, in the chair.—The following papers were read :—The action of bromine on azobenzene : a correction, by H. E. Armstrong. The colourless bromination product of azobenzene is tetrabromobenzidine, and not a tetrabromazobenzene, as stated by Werigo.—The origin of colour. X. Coloured hydrocarbons, by H. E. Armstrong.—The formation of the hydrocarbon "truxene" from phenylpropionic acid and from hydrindone, by F. S. Kipping. On heating hydrindone with dehydrating agents, a hydrocarbon of the constitution

$$C_6H_4 . C : C . CH_2$$
$$\dot{C}H_2 . \dot{C} : \dot{C} . \dot{C}_6H_4$$

is formed ; it is identical with truxene, to which the molecular formula $C_{27}H_{18}$ has been erroneously assigned by Liebermann and Bergami. Further, Gabriel and Michael's "tribenzoylenebenzene" in all probability has the molecular formula $C_{18}H_8O_2$ instead of $C_{27}H_{12}O_3$, as has previously been supposed.—The action of aluminium chloride on heptylic chloride, by F. S. Kipping. A crystalline ketone of the composition $C_{14}H_{20}O$, is formed by the interaction of heptylic chloride and aluminium chloride.—The inertness of quicklime. II. The interaction of chlorine and lime, by V. H. Veley. Dry chlorine has no appreciable action on quicklime below 300° ; above this temperature, a partial replacement of oxygen by chlorine occurs. —Note on hyponitrites, by D. H. Jackson. No hyponitrite is formed during the reduction of sodium nitrate with aluminium or barium amalgam. Diver's process for preparing hyponitrites gives the best results when a weak sodium amalgam is employed, and when the action proceeds at a low temperature.—The interaction of hydrogen chloride and potassium chlorate, by W. H. Pendlebury and Mrs. McKillop. The authors have determined the amounts of oxidising gases removed, during successive periods of time, from an aqueous solution of hydrogen chloride and potassium chlorate by a current of air. The action of sunlight on the solution materially increases the quantity of oxidising gas carried away by the air current.—The formation of indoxazen derivatives, by W. A. Bone. The author has studied the action of alkalis on orthochloronitrobenzaldoxime with the object of preparing nitrindoxazen ; in place of this substance, however, the isomeric 1 : 2 : 5 nitrosalicylonitril was isolated, molecular change having occurred during the interaction. A number of new nitro-derivatives were obtained.—The interaction of benzylamine and phenacyl bromide. Synthesis of piazine derivatives, by A. T. Mason and G. Winder. Phenacyl bromide and benzylamine readily interact with formation of the hydrobromides of monophenacylbenzylamine, $Ph . CO . CH_2 . NH . CH_2Ph$ and diphenacylbenzylamine $(Ph . Co . CH_2)_2N . CH_2 . Ph$; on liberating the bases, molecular changes occur. In the case of the monophenacyl-derivative, 1 . 4-dibenzyl-2 : 5-diphenylpiazine dihydride is obtained ; when this substance is heated to the boiling-point, it yields toluene and 2 : 5-diphenylpiazine.

$$CH{\cdot}N{\cdot}CPh$$
$$\ddot{C}Ph{\cdot}\dot{N}{\cdot}\ddot{C}H$$

A number of other piazine derivatives are also described.—The interaction of quinones and metanitraniline and nitroparatoluidine : a preliminary note, by J. Leicester. The author describes a number of condensation products of quinones with *m*-nitraniline and nitro-*p*-toluidine.—Preparation of α-β-diphenylindoles from benzoïn and primary benzenoid amines, by F. R. Japp and T. S. Murray. A mixture of benzoïn, aniline, and zinc chloride yields α-β-diphenylindole, in accordance with the following equation

$$Ph . NH_2 + Ph . CO . CH(OH)Ph = C_6H_4\begin{matrix}C\\ \diagdown\\ NH\end{matrix}\diagup CPh_2 + 2H_2O.$$

New substituted indoles may be prepared by the employment of other aromatic amines in place of aniline.

Mathematical Society, November 9.—A. B. Kempe, F.R.S., President, in the chair.—The resolution for the incorporation of the Society, and the list of names as new Council for the session 1893-4 (see NATURE, vol. xlviii. p. 619), were carried unanimously.—The President gave a brief account of the life and work of the late W. S. B. Woolhouse, and then accompanied the presentation of the De Morgan medal, which had been awarded by the Council in June last to Prof. F. Klein, of Göttingen, with an outline sketch of the grounds of the award. Prof. Greenhill, F.R.S., and Dr. Forsyth, F.R.S., who had been deputed by Prof. Klein, in his unavoidable absence, to receive the medal, suitably acknowledged the gift. The following communications were made :—A mechanical solution of the problem of tethering a horse to the circumference of a circular field, so as to graze over an n^{th} part of it, by Prof. L. J. Rogers. (The solution turned on a property of the cycloid).—The stability of certain vortex motions, by A. E. H. Love. The paper contains investigations of the steady motion and small oscillations of Kirchhoff's elliptic vortex, which rotates uniformly in the midst of an infinite mass of liquid, and of Hill's elliptic vortex, which rotates uniformly in the midst of a mass of liquid filling a confocal rigid envelope, the envelope rotating with the same angular velocity. It is proved that Kirchhoff's vortex is stable for all modes of oscillation in which the boundary ceases to be elliptic, provided the major axis is less than three times the minor axis. It is also proved that if the boundary is any ellipse, the vortex rotates steadily with angular velocity suitable to its eccentricity, and that it is impossible for it to change form and remain elliptic. The characteristics of the various modes of oscillation are made out, viz. it is shown that for each mode there is a definite number of wave-lengths of a simple harmonic disturbance in the circumference, provided the amplitude of the disturbance is measured by the ratio of the normal displacement of a point in the boundary to the central perpendicular on the tangent at the point. The general period equations are obtained, and it is shown in particular that Hill's vortex is always stable for elliptic displacements of the boundary of the vortex, the frequency for such displacements tending to zero when the vortex degenerates into a Kirchhoff's vortex by indefinite expansion of the external boundary of the liquid, thus verifying the results found in the more special case. It is also verified that the vortex sheet, which is another degenerate Hill's vortex, is always unstable for the more complex types of disturbance. Messrs. Hill, Basset, Greenhill, and Bryan spoke upon the paper.—Cyclotomic quartics, by Prof. G. B. Mathews.—On the application of elliptic functions to the curve of intersection of two quadrics, by J. E. Campbell.—Note on the theory of groups of finite order, by Prof. W. Burnside, F.R.S. The only quite general theorem at present known concerning the structure of a group (of finite order) is the following, due to Herr Sylow : "If p^α is the highest power of a prime p that divides the order of a group, the group contains a single conjugate set of sub-groups of order p^α, and the number of such sub-groups is congruent to unity, modulus p." In the theory of groups of finite order, and especially in considering the possible structure of a group of given order, this theorem is fundamental. From its enunciation it is clearly independent of the form in which the group may be represented. The only published proofs of it, to the best of the author's knowledge, are the original proof by Herr Sylow (*Math. Ann.* vol. v.), and a proof given by Herr Netto in his "Substitutionentheorie." These both depend essentially on the representation of the group as a group of substitutions, and also on the conception of transitivity in connection with this form of representation. A proof of the theorem is given in the first of these notes, which is as fundamental in conception as

the theorem itself, being entirely independent of the form in which the group may be supposed to be expressed. The latter part of the paper dealt with the orders of simple groups in certain cases.—Prof. Hudson showed and explained some mechanical constructions (by his son, R. W. Hudson) for the parabola, hyperbola, cubical parabola, and semi-cubical parabola.

Royal Meteorological Society, November 15.—Dr. C. Theodore Williams, President, in the chair.—Mr. F. J. Brodie read a paper on the great drought of 1893, and its attendant meteorological phenomena. The author confined his investigation to the weather of the four months, March to June, during which period the absence of rain was phenomenal; barometric pressure was greatly in excess of the average, temperature was high, with a large diurnal range, and the duration of sunshine was in many places the longest on record. The mean temperature over England was about 4° above the average. Along the south and south-west coasts the sunshine was between 50 and 60 per cent. of the possible duration. The rainfall was less than half the average amount over the southern and eastern parts of England, the extreme south of Ireland, and a portion of Durham and Northumberland; while over the southern counties of England generally the fall amounted to less than one-third of the average. The smallest number of days with rain was at the North Foreland, where there were only eighteen.—Mr. W. Marriott gave an account of the thunder and hail-storms which occurred over England and the south of Scotland on July 8, 1893. Thunderstorms were very numerous on that day, and in many instances were accompanied by terrific hail-storms and squalls of wind. It was during one of these squalls that a pleasure-boat was capsized off Skegness, twenty-nine persons being drowned. About noon a thunderstorm, accompanied by heavy hail and a violent squall of wind, passed over Dumfries and along the valley of the Nith; many of the hailstones measured from 1 inch to 1½ inches in length. At the same hour a similar storm occurred at Peterborough. From about two until ten p.m. there was a succession of thunderstorms over the north-east of England and south-east of Scotland, and at many places it was reported that the thunderstorms were continuous for nine hours. Two storms were remarkable for the immense hail-stones which fell during their prevalence over Harrogate and Richmond in Yorkshire. The hailstones were 4 and 5 inches in circumference, and some as much as 3 inches in diameter. Great damage was done by these storms, all windows and glass facing the direction from which the storm came being broken. It is computed that within a radius of five miles of Harrogate not less than 100,000 panes of glass were broken, the extent of the damage being estimated at about £3000. The thunderstorms in the northern part of the country travelled generally in a north-north-westerly direction at the rate of about twenty miles an hour. They appear to have taken the path of least resistance, and consequently passed over low ground and along river valleys and the sea coast. Several storms seem to have followed each other along the same track.

Royal Microscopical Society, November 15,—A. D. Michael, President, in the chair.—Mr. C. L. Curties exhibited and described a microscope by Leitz, of Wetzlar, made on the English model, with tripod foot and inclining body, horse-shoe stage, and sub-stage fittings.—Mr. A. W. Bennett gave a *résumé* of Mr. W. West's paper on new British fresh-water Algæ.—Prof. F. Jeffrey Bell read a paper by Mr. G. Sandeman, on a parasitic disease in flounders. The author stated that there are often found on the coast flounders having small round swellings under the skin, which have been described under the name of multiple tumours. The tumours have the appearance of eggs, deposited irregularly beneath the skin. They cause a slight projection of the skin, which sinks slightly between the individual ova, but, when very many are present in one mass, the large tumour which is formed projects considerably from the body, and is sometimes even a pedunculated or finger-shaped formation. On microscopic examination, the contents of the tumours present all the characteristics of eggs. The cause and habits of the parasite are so obscure that the author finds it impossible to pronounce a definite opinion on the subject.—The President announced that the Society's conversazione would take place in the early spring.—Mr. C. Beck raised a discussion as to the possibility of obtaining a standard tube-length. Dr. W. H. Dallinger congratulated Mr. Beck upon the able way in which he had brought the matter before them. He thought that a committee should be appointed to discuss the whole question.

PARIS.

Academy of Sciences, November 20.—On a new model of a reverberatory electric furnace with movable electrodes, by M. Henri Moissan.—On equations of mixed functions and a problem of geodesics, by M. G. Kœnigs.—On differential equations of the second order with fixed critical points, by M. Paul Painlevé.—On the means of increasing the security of high tension alternate-current distribution, by M. G. Claude. The elimination or diminution of the capacity of the mains with regard to the earth would make it necessary to touch the two poles of the circuit to receive a shock capable of endangering life. This may be obviated most conveniently by neutralising the capacity by self-inductions placed along the circuit.—Action of some metals upon acid solutions of their chlorides, by MM. A. Ditte and R. Metzner. If a plate of tin is plunged into a concentrated hydrochloric acid solution of stannous chloride upon which a layer of water has been poured, crystals of tin are rapidly formed near the surface of separation. The arrangement amounts to a galvanic cell, in which the same electrode is plunged into different liquids. A solution of stannic chloride shows the same phenomenon, which takes place as soon as the water has, by the diffusion of the salt, become sufficiently conducting to permit the passage of the current. The tin above the surface of separation merely acts as a negative electrode, and may be replaced by a platinum wire. That the phenomenon is one of electrolysis may be shown by replacing a small portion of the bar of tin by an insulator placed at the surface of separation. No crystals are deposited until the two separated portions are brought into communication by the diffusing salt. When the stannic chloride solution is placed in a porous pot in a vessel of acidulated water, and the two liquids are joined by platinum plates, no electrolysis takes place; but cadmium treated by the first method shows precisely similar phenomena. Zinc, which is easily dissolved by the most dilute hydrochloric acid, shows nothing similar. Nickel, which is quickly covered with a protecting layer of hydrogen, and also bismuth and antimony, which are insoluble in hydrochloric acid, show no phenomena analogous to those exhibited by tin.—Means of preserving wood from being worm-eaten, by M. Émile Mer. The attacks on the sap-wood by the insects are due to the presence of starch in this tissue. It may therefore be inferred that the fact of the hard wood being free from the invasion is due to its not being amyliferous. The alburnum may be protected by ridding it on starch. This may be done by annulation of the bark at the upper end of the trunk, and by suppressing all buds developed there. Spring is the best season for this operation. The starch has disappeared by autumn, and the trees may be felled during October. Carpenters and joiners will, in this way, be enabled to utilise the whole or part of the sap-wood.—On the development and maturation of the cider apple, by M. L. Lindet. In the maturation of the cooked apple the same transformations take place as during the ripening of the fruit on the tree. The quantity of starch accumulated in the green fruit diminishes, and this diminution coincides with the increase of the saccharose and inverted sugar; these sugars disappear in their turn through respiration.—On the minute structure of the terminal plates of the motor nerves of striated muscle, by M. Charles Rouget.—On the nematodes of the pharyngean glands of ants, by M. Charles Janet. The two glands taken from an ant from an artificial nest (*Formica rufa*) appeared in the form of bunches of yellow tubes resembling actinia with numerous tentacles. Each tube was occupied by one or more *Rhabditis*, which could be dislodged in great numbers by slight pressure on the cover-glass. The whole nest turned out to be thus infested, although the ants appeared to be in good health. The nematodes appear to be a larval form of the sexed individuals living in a free state in the detritus of the nest.—On the polymorphism of *Peridinium acuminatum* Ehr, by M. Georges Pouchet.—On the north-east extremity of the main body of Mont Blanc, by MM. L. Duparc and L. Mrazec.—On the origin of the Alps of Chablais and Stockhorn, in Savoy and Switzerland, by M. Hans Schardt.—Discovery of another pre-historic magdalenoan deposit in the Vézère valley, by MM. Paul Girod and Élie Massénat.—On the variation of composition of lake-water with the depth, by M. A. Delebecque.

NEW SOUTH WALES.

Linnean Society, September 27.—The President, Prof. David, in the chair.—The following papers were read:—Descriptions of new species of *Bostrychidæ*, by Arthur M. Lea.

—Botanical notes from the Technological Museum, Sydney. No. 1, by J. H. Maiden and R. T. Baker. The paper embodied a number of fresh localities for New South Wales plants, and also New South Wales localities for plants hitherto known only from Queensland, viz. *Decaspermum paniculatum*, *Psychotria nematopoda*, *Tetranthera ferruginea*, (*Litsæa hexanthus*). There are also recorded observations on *Amperea spartioides* with pedicellate female flowers, several at each node, *Hovea acutifolia*, with glabrous pods; notes on *Melodorum Leichhardti*, *Sideroxylon myrsinoides*, *Blechnum serrulatum*, *B. cartilagineum*, *Eucalyptus saligna*, and others.—Preliminary note on a species of *Balanoglossus* from the coast of New South Wales, by J. P. Hill. *Balanoglossus*, hitherto unrecorded from Australia, has recently been met with, both at Broken Bay and at Jervis Bay, in loose sand under large stones between tide-marks. A detailed account of this interesting form, in all probability a new species, was promised.—Note on the presence of vestigial Mullerian ducts in a full-grown male lizard (*Amphiblurus muricatus*), by J. P. Hill.

DIARY OF SOCIETIES.

LONDON.

THURSDAY, NOVEMBER 30.

SANITARY INSTITUTE, at 8.—Textile Manufactures, Silk, Cotton, Woollen, and Linen Industries: Dr. J. T. Arlidge.

FRIDAY, DECEMBER 1.

GEOLOGISTS' ASSOCIATION, at 8.—Notes on a Discovery of Fossils at Little Stairs Point, Sandown Bay, Isle of Wight: Thos. Leighton.—Notes on the Sharks' Teeth from British Cretaceous Formations: A. Smith Woodward.—The Breaking-up of the Ice on the St. Mary River, Nova Scotia, and its Geological Lessons: Geoffrey F. Monckton.

INSTITUTION OF CIVIL ENGINEERS, at 7.30.—Forms of Tensile Test-Pieces: Leonard H. Appleby.

SUNDAY, DECEMBER 3.

SUNDAY LECTURE SOCIETY, at 4.—The Body's Servants—A Talk about Cells and their Work: Dr. Andrew Wilson.

MONDAY, DECEMBER 4.

VICTORIA INSTITUTE, at 8.—Habit in Man: Dr. Schofield.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Application of Air in Motion to Chemical Industry: H. G. Watel. (Adjourned Discussion.)—Note on the Copper Mines of Singhbhoom: H. Harris.—The Product of the Action of Mercuric Chloride upon Metallic Silver: Chapman Jones.

ARISTOTELIAN SOCIETY, at 8.—On the Import of Categorical Propositions Miss E. E. Constance Jones.

ROYAL INSTITUTION, at 5.—General Monthly Meeting.

TUESDAY, DECEMBER 5.

ZOOLOGICAL SOCIETY, at 8.30.—On the Geographical Distribution of Earth worms: F. E. Beddard, F.R.S.—On a Collection of Coleoptera sent by Mr. H. H. Johnston, C.B., from British Central Africa: C. J. Gahan.—On a Collection of Petrels from the Kermadec Islands: Captain F. W. Hutton, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Impounding-Reservoirs in India, and the Design of Masonry Dams: Mr. Clerke, Mr. Sadasewjee, Colonel Jacob, and Prof. Kreuter. (Discussion.)

WEDNESDAY, DECEMBER 6.

GEOLOGICAL SOCIETY, at 8.—The Purbeck Beds of the Vale of Wardour: Rev. W. R. Andrews and A. J. Jukes-Browne.—On the Variety of Ammonites (Stephanoceras) subarmatus, Young, from the Upper Lias of Whitby: H. W. Monckton.—On a Picrite and other Associated Rocks at Barnton, Edinburgh: H. W. Monckton.

ENTOMOLOGICAL SOCIETY, at 7.—On a Collection of Lepidoptera from Egypt: George T. Bethune-Baker.—The Rhynchophorous Coleoptera of Japan: Part III. Scolytidæ: Walter F. H. Blandford.

THURSDAY, DECEMBER 7.

ROYAL SOCIETY, at 4.30.—The Organogeny of Asterma gibbosæ: E. W. MacBride.—Reptiles from the Elgin Sandstone: Description of Two New Genera: E. T. Newton, F.R.S.—A Dynamical Theory of the Electric and Luminiferous Mediam: J. Larmor, F.R.S.—Note on the Action of Copper Sulphate and Sulphuric Acid on Metallic Copper: Prof. Schuster, F.R.S.—On Copper Electrolysis *in vacuo*: W. Gannon.—On a Chart of the Symmetrical Curves of the Three-Bar Motion: W. Brennand.

LINNEAN SOCIETY, at 8.—Catalogue of the Described Neuroptera Odonata (Dragonflies) of Ceylon, with Description of New Species: W. F. Kirby.—On the Cause of the Fall of the Corolla in Verbascum: Signor U. Martelli.

CHEMICAL SOCIETY, at 8.—An Apparatus for the Estimation of the Gases dissolved in Water: Dr. Truman.—Metallic Oxides and the Periodic Law: R. M. Deeley.

FRIDAY, DECEMBER 8.

ROYAL ASTRONOMICAL SOCIETY, at 8.

SANITARY INSTITUTE, at 8.—Metallic Poisons, Lead and Arsenic: Prof. T. Oliver.

SATURDAY, DECEMBER 9.

PHYSICAL SOCIETY, at 5.—A Potentiometer for Alternating Currents: J. Swinburne.—The Specific Resistance of Sea-Water: W. H. Preece, F.R.S.—The Calculation of the Coefficient of Self-Induction of a Circular Current of a Given Cross-Section and aperture; and The Magnetic Field of a Cylindrical Coil: Prof. G. M. Minchin.

ROYAL BOTANIC SOCIETY, at 3.45.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—By Moorland and Sea: F. A. Knight (E. Stock).—Laboratory Teaching: C. L. Bloxam, 6th edition (Churchill).—An Elementary Treatise on Theoretical Mechanics, Part 2—Introduction to Dynamics, Statics: A. Ziwet (Macmillan).—Micro-Organisms and Fermentation: A. Jorgenson, translated by A. K. Miller and E. A. Lennholm, new edition (Lyon).—Concrete, its Nature and Uses: J. L. Sutcliffe (Lockwood).—The Sacred City of the Ethiopians: J. T. Bent (Longmans).—University College of N. Wales, Calendar 1893-4 (Manchester, Cornish).—The Pamirs, 2 vols: Earl of Dunmore (Murray).—Against Dogma and Free Will, and for Weismannism: H. C. Hiller, 2nd edition (Williams and Norgate).—The Wilder Quarter-Century Book (Ithaca, N. Y. Comstock Publishing Company).—The Story of Our Planet: Prof. Bonney (Cassell).—The Elements of Applied Mathematics: C. M. Jessop (Bell).—A Year amongst the Persians: E. G. Browne (Black).—The Principles of Waterworks Engineering: J. H. T. Turner and A. W. Brightmore (Spon).—Science and Education: T. H. Huxley (Macmillan).—Letters of Asa Gray, 2 Vols.: edited by J. L. Gray (Macmillan).—Oxford Bible for Teachers, with Helps (two styles) (Frowde).

PAMPHLETS.—A Check List of the Slugs: Prof. T. D. A. Cockerell (Dulau).—Temperature and Vertebræ? Dr. D. S. Jordan (Ithaca, New York).—Sulle Osservazioni Mareografiche in Italia, &c.: G. Grablovitz (Genova).

SERIALS.—Notes from the Leyden Museum, Vol. xiv. No. 3, and Vol. xv. No. 4 (Williams and Norgate).—Sitzungsberichte und Abhandlungen der Naturwissenschaftlichen Gesellschaft Isis in Dresden, 1893, Jan. bis Juni (Williams and Norgate).—Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie, Siebzehnter Band v. Heft (Williams and Norgate).—Zeitschrift der Gesellschaft für Erdkunde zu Berlin, Band xxviii. 1893, No. 3 (Berlin).—Mittheilungen von Forschungsreisenden und Gelehrten aus der Deutschen Schutzgebieten, vi. Band, 4 Heft (Berlin).—Bollettino della Societa Geografica Italiana, Serie 3, Vol. 6, Fasc. 8-9 (Roma).

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