THURSDAY, JUNE 23, 1892.

THE NEW LONDON UNIVERSITY.

IN our last issue we laid before our readers a statement of the proposals adopted by the Association for Promoting a Professorial University for London at a meeting held at Burlington House on the 14th inst. It may tend to clear the issue if we now briefly compare these proposals with the provisions of the Gresham Charter.

The Gresham Charter seeks to federate two Colleges and ten medical schools, primarily for examination purposes. Such a University, if created, would have had two competing staffs in the Faculties of Arts and Science and twelve in the Faculty of Medicine. Provision is also made, under certain conditions, for the federation of other institutions, if it can be shown to the satisfaction of the Council—that is, of the Chancellor, the Lord Mayor of London, and the representative members of the Councils of the two constituent Colleges and the ten medical schools —that such institutions are on a basis justifying the expectation of permanent existence; that they are under the independent control of their own governing bodies; and that they are reasonably well equipped in some one Faculty. Such a federation, created not primarily for the true business and proper functions of a University, but solely in the interests of a degree-granting body, could only have one result. The examination schedules must perforce be within reach of the lower grades of instruction, the various constituent elements would be actively competing bodies, and no attempt to create a single competent staff and a single set of fully-equipped University laboratories would be feasible. Is it at all probable that the true work of a University would flourish under such a system as that? Is it in the least degree likely that we could hope to see created in London, a teaching organization worthy of the greatest and richest capital in the world, or even such as many of the smaller European capitals now possess? The fame of a University, if it is to be anything more than a social function, must depend on the character of its teaching. Would the best men be attracted and retained by such a system? There can be only one answer to these questions. The Gresham scheme is not only a wholly inadequate solution of the University question, but in so far as it tends to accentuate and perpetuate the existing state of things its provisions are positively mischievous. No solution of the question can be either just or final which ignores the existence of the present University of London. If London is to have two degree-granting bodies existing, practically, side by side, we shall have confusion worse confounded. Burlington Gardens would inevitably be driven to establish a teaching organization of its own, unless it was supremely indifferent to its fate or supinely content with the teaching of the Correspondence Colleges and the crammers. Why should we neglect, and not only neglect but positively so arrange as to destroy, the prestige of the existing University of London? This University is not effete—it has still within it a great potentiality for good. Surely, in common gratitude, the University which has hitherto consistently upheld a high standard of attainment for its degrees, and which has done so much for the spread of natural science in this country, is worthy of better treatment at the hands of those who profess to minister to the true interests of learning. The Gresham scheme is really an attempt on the part of certain of the medical schools and some of the arts and science teachers to cheapen degrees and so attract students. It is true that the new University medical degrees would carry no license to practise. But is it likely that the University would permanently put up with this unique position, or that its students would continue to submit themselves without a murmur to a double examination system? As the document issued by the Victoria University indicates, the result, in all probability, would be to reduce the two examinations to a single standard by compromise with the licensing body. The scheme, moreover, gives an overwhelming preponderance to the most purely professional of all the faculties, and far too large a share of control to persons of small academic experience who devote occasional spare hours to academic affairs. It makes no attempt to satisfy the demand for the recognition in some form of University work among the people. No wonder, then, that it was strenuously opposed by a powerful section of the governing body, and by a majority of the teachers in the Faculties of Science and Arts, of the most influential College that it proposed to incorporate. The Council of University College, indeed, has never openly ventured to place the scheme before the governing body.

The Gresham University Commissioners are authorized by the terms of their reference "to consider and, if they think fit, to alter and to amend and extend the proposed charter, so as to form . . . a scheme for the establishment, under charter, of an efficient teaching University for London." It is impossible to conceive how the charter submitted to them can be amended so as to form such a scheme if its salient features are preserved. That fact is becoming more and more patent every day. The Association which put forward the proposals we have already referred to now numbers among its members—medicine excepted—a majority of the leading London teachers. If these teachers say that they do not wish the Gresham Charter at any price, it is difficult to see how it can be imposed upon them. Any attempt to resuscitate that charter, even with amendments, will meet, as before, with the opposition of the provincial Colleges, the minor London teaching bodies, and, what is perhaps more important, the organized opposition of a large section of the London teachers, and of some of the most powerful and influential friends of higher education in this country.

The fact is that it is at last clearly recognized that the foundation of a Metropolitan University, which will bear comparison with those of the great Continental cities, is a matter of national importance. The action of the House of Commons with regard to the Gresham Charter offers an opportunity, such as may not soon occur again, for attempting the formation of a University in London on the same ample lines as those to be found in other European capitals. Watchful observers of what has been going on during the past three or four years have deliberately come to the conclusion that it is quite impossible to improve the condition of higher education in London by means of any federation of Colleges. The creation of a homogeneous academic body with power to *absorb*, not to federate, existing institutions of academic rank, is the only real solution of the problem. An academic body of this character might well be organized, so far as teaching is concerned, on the broad lines of a Scottish University. Such a corporation may be conveniently spoken of as a *professorial University*, to distinguish it from a federal University. A federal University may be all that is possible when the constituent Colleges are situated in different towns, as is the case in the Victoria University; but it cannot be efficient in London, where these Colleges would appeal to the same public for support.

The scheme put forward by the Association for Promoting a Professorial University for London is not open to the objections urged against the Gresham scheme. It would found a University on the same broad lines as those of France, Germany, and Switzerland. It would bring to the new University all the power and prestige of the existing University. It will meet with no opposition from the provincial Colleges; on the contrary, it has the active support of many of the leading provincial teachers. It satisfies the demands of the Victoria University that the medical degree shall carry the license to practise, and that the medical representation shall not preponderate. It has, for the first time in the history of the movement, brought the most influential teachers from a variety of London teaching bodies into close and active sympathy, and animated them with a desire for a University of definite type. It is significant that the Council and staff of Bedford College are at one in favour of a University on the general lines laid down in the Association scheme. The Senate of University College has carried a motion urging their Council to adopt a similar resolution in favour of the scheme of absorption. The Association scheme makes full provision for the recognition of work of the University Extension character, and for the appointment of University lecturers at minor and non-absorbed teaching institutions. Whilst proposing central control and central University laboratories of the highest type, it provides for local teaching such as is required for pass degrees or for the lower stages of honours graduation. Lastly, it provides for post-graduation courses and specialized instruction, such as that of the Collège de France and of the greater German Universities.

As regards medicine, it recognizes that it is impossible to "absorb" the medical schools owing to their close relation to great public charities; but at the same time it endeavours to grant much of what the Medical Faculty gained by the Gresham Charter. The Medical Faculty will be elected by the medical teachers themselves. There will be, as in every University of standing, medical professors appointed by the Senate from the Medical Faculty on the recommendation of the faculty. The existence of such a medical professoriate will enhance the dignity of the University and of the medical schools, whilst at the same time it holds out a strong inducement to those schools to select members for the Medical Faculty on the ground of their scientific as well as their administrative reputation. The limitation of the number of medical professors on the Senate will safeguard the character of the medical degree. The scheme, whilst giving very extended powers to the medical schools, meets the objections of the provincial opponents of the Gresham Charter. Lastly, it provides for the due University recognition of the pure science teaching of the medical schools.

We have thus indicated as shortly as possible the main features of the two schemes which are at present before us. The one is essentially parochial in its conception, and vestry-like in its character. The other has in it the elements of a great teaching organization which shall be both metropolitan and imperial in its aims and influence —a University which shall be worthy of London, the capital alike of Great Britain and of the Greater Britain beyond the seas.

THE ANALYSIS OF WINES.

Analyse des Vins. Par le Dr. L. Magnier de la Source. (Paris: Gauthier-Villars et Fils, 1892.)

ALTHOUGH wine is gradually becoming more and more important as an item in the national drink-bill—last year we imported 16,782,038 gallons, valued at £5,995,133—its analysis and the methods for the detection of its sophistication have received comparatively little attention from the chemists of this country. On the other hand, in France and Germany the subject has been very thoroughly investigated in practically all its many details, and carefully worked-out methods have been prescribed for the guidance of the public analysts of those countries. Indeed, there is probably no article of food or drink, with the possible exception of milk, of which the chemistry has been so well thrashed out. Wine is in reality a highly complex fluid, and on account of the character of certain of its proximate constituents it is frequently liable to change. It contains various alcohols, glycerin, acids, salts, "extractive matter," together with those principles which give to it its particular colour, special flavour, smell, or "bouquet." Whilst some of these constituents can be accurately isolated and described, others can only be detected by the sense of smell. The principal alcohol is, of course, ethyl alcohol, but butyl and amyl alcohols, together with ethylene glycol and isobutyl glycol are not unfrequently present in greater or less quantity. The quantity of alcohol in natural wines may be said to vary from 6 to 12 per cent., and the quantity of glycerin from 7 to 10 per cent. of the alcohol present. Tartaric, malic, succinic, glycollic, and oxalic, together with tannic and acetic, are the chief acids in wine. These are said to aid in its preservation, by preventing the formation of fungi. Traces of other fatty acids, such as propionic, butyric, and œnanthic acids are also present, as well as acetaldehyde, and possibly its homologues. Tartaric acid occurs mainly as the dextro variety: lævo-tartaric acid is only of comparatively infrequent occurrence. If tartaric acid is not found, as, for example, in certain samples of sherry, its absence is almost certainly due to its removal by "plastering." The amount of free acid in sound wine, reckoned as tartaric acid, varies between 0·3 and 0·7 per cent.; a greater amount than this imparts sourness to the wine.

Old wines have an acid reaction in consequence of the presence of a certain amount of free acid and potassium bitartrate. A wine not exhibiting this acid reaction tastes flat; the acidity is its most important flavour. For a long time it has been believed that the free acid of wine is tartaric acid alone. Nessler's researches have, however, shown that this is seldom the case; tartaric and malic acids often exist together, and frequently the free acid consists of malic acid entirely. Wines containing tartaric acid taste more tart than those with only malic acid, or a mixture of malic and tartaric acids.

The characteristic smell of wine is said to be due to œnanthic ether; the compound ethers probably confer the bouquets which distinguish one vintage from another: among these are aceto-propylic, butylic, amylic, caprylic, butyro-ethylic, caprylo-ethylic, capro-ethylic, and pelargo-ethylic, and the tartaric ethers. According to Jacquemin, these bouquets are primarily due to the special characters of the yeast used in the several districts. One and the same "must" fermented with the yeast obtained from several different districts gave wines having the bouquet characteristic of the district from which the particular yeast had come. Rommer fermented the juice of an inferior grape and of hot-house grapes respectively with yeast cultures obtained from the Champagne, Côte d'Or, and Buxy districts, and found that in each case the wines had the bouquet of those from which the yeast had been derived. The sugars occurring in wine are dextrose and lævulose. Cane-sugar is never naturally present, even in "must"; it is sometimes added, as in the case of champagne, but it is then rapidly transformed into invert sugar. In some wines, as, *e.g.*, Sauternes and sweet Rhine wines, sugar occurs in the form of inosite. The colouring-matter of normal wine is derived partly from the oxidation of the so-called extractives contained in the juice, and in the case of red wines from matter (œnolin or œnotannin) contained in the husks, stalks, and seeds, which is soluble only by the joint action of acid and the alcohol formed during fermentation. The albuminous substances in the "must" are removed when the fermentation is properly carried out, but in imperfectly fermented wines a certain amount remains, and in the case of white wines may again render them liable to fresh fermentation. In red wines this danger is obviated by the presence of the tannin of the husks.

The inorganic substances contained in wine are potash, soda, lime, and magnesia, in combination mainly with tartaric, phosphoric, and hydrochloric acids. Sherries contain potassium sulphate in excess, owing to the practice of adding gypsum to the "must." This practice, which prevails not only in Spain, but also in Portugal, the south of France, and to some extent in Italy, probably has for its object the precipitation of certain albuminous matters which injuriously affect the wine. It is alleged that the fermentation is in consequence much more rapid and complete, that the wine keeps longer, and that its colour is richer and more lasting. Its real advantage to the wine-maker is that it clarifies the wine rapidly, and allows it to be quickly brought to market. It is chiefly employed with the coarser qualities of red wine, and the gypsum is either added to the grapes and trodden with them, or, in fewer cases, added to the expressed juice; the quantity used is generally 1 to 2 kilos to every 100 kilos of fruit, but it is some times as much as 10 kilos. The action of the calcium sulphate on the bitartrate of potash present in the juice produces an acid sulphate of potash, which gradually forms the normal salt by decomposition of the phosphate present forming free phosphoric acid. Hence a "plastered" wine is relatively rich in potash and sulphuric acid.

Although much has been said as to the baneful effects of plastered wine, very few trustworthy cases of injurious action have been recorded. The Academy of Medicine of Limoges instituted a lengthened inquiry on the subject in 1888, and reported unfavourably on the effects of plastered wine upon health. The French War Department also appointed a Commission, and its conclusions, which, on the whole, were unfavourable to the practice, have been recently confirmed by Nencki, who was requested by the Government of the Canton Berne to report on the advisability of modifying a law, which operates in many parts of the Continent, forbidding the sale of wines containing more than 2 grams of potassium sulphate to the litre. As to the question whether a plastered wine should be called adulterated, it has been contended that a product which, by treatment, is deprived of one of its most characteristic constituents, viz. tartaric acid, whilst another substance, calcium sulphate, not normally present, is introduced, cannot be called anything but adulterated.

As may be supposed, the art of the falsifier is very largely directed to the improvement of the colour of wine; and unfortunately it is upon the product which popular prejudice associates with the name of an eminent statesman, and which has no other attribute of claret than its colour, that his skill is mainly expended. It has been estimated that the whole yield of the "classed growths" of the Médoc does not, even in the best years, now exceed 5,000,000 bottles. Much of this, it is true, comes to England, but enormous quantities of *paysan*, *artisan*, and *bourgeois* wines from the Gironde and Languedoc, mixed with the produce of North Spain and Italy, are worked up and sold as "claret" in this country. This product is not exactly poisonous, nor even, as a rule, positively hurtful, but, it need hardly be said, it has no special merit or individuality. Formerly, the pharmacopœia of the wine-doctor, like that of the physician of old, was restricted to products of the vegetable kingdom; but, in addition to the colouring-matter of *Phytolacca* berries, *Althæa rosea*, bilberries, mallow, elderberries, privet-berries, logwood, alkanna red, lichen reds, all of which are still used to a greater or less extent, he has not been unmindful of the wealth of colouring-matter which is latent in coal-tar; and to-day the banks of the Rhine have their part in the manufacture of other wines than hock. Biebrich scarlet, fuchsine (magenta), the various Ponceaus, Bordeaux reds, crocein scarlet, and similar colouring-matters, find their way to the south of Europe for the purpose of wine sophistication. A substance known as *tintura per los vinos* is largely used in the district of Huesca for colouring Spanish wines. It contains two coal-tar derivatives, one of which is that form of Biebrich red which is turned blue by sulphuric acid, whilst the other, which exists in smaller proportion, closely resembles the colouring matter known as *cerise*. According to an analysis by Jay, the composition of *tintura* is: organic matter, mainly Biebrich red, 66·4; sodium sulphate, 26·10; arsenious oxide, 1·62; iron oxide, lime, &c., 5·88. In view of the peculiar nature of this substance, it is reassuring to know that there is a tendency to return to vegetable colouring-matters, and that large quantities of maqui berries are being imported into Europe from Chili for the purpose of colouring wines. In the three years ending 1887 the exports of this substance were respectively 26,592, 136,026, and 431,392 kilos, by far the largest proportion finding its way to France.

The little book before us has no pretensions to be regarded as a complete treatise on the analysis of wines. Its aim is to furnish the analyst with a number of carefully tested methods for the detection of sophistications and adulterations, and for the rapid determination of those constituents on which the character of wine mainly depends. Dr. Magnier de la Source is well known in France as an authority on the subject, and the *Bulletin* of the French Chemical Society contains papers by him relating to the analysis of wine. His methods are, for the most part, similar to those adopted by the Association of German and Austrian analysts, although they are not described with that minute attention to detail which has been found desirable by the German-speaking chemists. As may be seen on turning over the pages of Fresenius's *Zeitschrift für analytische Chemie*, the "musts" and wines of Germany are periodically examined and reported upon with all the method and regularity adopted in the case of the London water-supply; and it has happened in the past that the modes of determining such constituents as the vegetable acids, glycerin, and "extractive matters" have been discussed and wrangled over in a manner which recalls the famous fights over "organic carbon," "albuminoid ammonia," and "previous sewage contamination" of years ago. The only fault that we have to find with this book is that its author hardly does justice to his German brethren; although, it is but fair to add, some reference to their work is to be found in the excellent bibliography at the end of the volume. T. E. T.

MODERN THERAPEUTICS.

An Introduction to Modern Therapeutics. By T. Lauder Brunton, M.D., &c. (London: Macmillan and Co., 1892.)

THIS work is a reprint of the Croonian Lectures delivered before the Royal College of Physicians, London, in 1889. Whatever Dr. Brunton writes is sure to be interesting, and the present lectures have lost none of their lucidity or freshness though three years have elapsed since they were before the medical profession. It is hardly necessary to say that the subject is one with which Dr. Lauder Brunton is eminently fitted to deal, and the non-medical reader will be convinced when he has read the volume that medicine and therapeutics are far from being the inexact sciences they were not many years ago. The elementary nature of some of the early pages will be understood when it is remembered that the audience before which the lectures were originally given consisted in a large measure of men who had learnt chemistry before the days of Crookes, Lockyer, and Mendeleeff. It was necessary that the author should lead them through a brief survey of the chief facts and theories relating to atoms and molecules until the more difficult subject of the composition, constitution, and methods of union of organic radicles is reached. This is done in an admirably clear summary, assisted by those apt illustrations drawn from every-day life for which Dr. Brunton is so well-known. Our new drngs are now made by the chemist; so great has been the advance of organic chemistry, that the pharmacologist has hard work to keep pace with all the new combinations that issue from the laboratory. But the two classes of investigators, the chemists and the experimental therapeutists, have at least gone hand in hand so far, that it is now possible to judge the action of a drug by its composition. This, however, as Dr. Brunton points out, is not a rule without exception. There are many drugs which behave in unexpected ways; they no doubt, in the future, will be brought into harmony with laws of nature yet to be discovered. At present it is not possible to prophesy the physiological action of a chemical compound with that mathematical accuracy which enables astronomers to foretell eclipses; pharmacology is yet, and perhaps always will be, an experimental science.

The lectures stand practically in the same condition as that in which they were delivered. A volume of equal size to that under consideration would have been necessary to include all the new work that has appeared in the last few years. The tuberculin of Koch; the importance of poisonous proteids, and the diminishing popularity of the ptomaines; the action of the intestinal epithelium (*vice* the liver) as the gatekeeper protecting the body from the entrance of albumose; the application of phagocytosis to the problems of disease, together with the views of the antiphagocytists—these are a few of the big questions that have come to the fore in the last three years, and it is only active pathologists who would be able to realize how much longer these lectures would have been if full reference had been made to all of them. The main facts, and the principal conclusions adduced by Dr. Brunton, will, however, still remain; and all those who read the lectures in the medical journals before will welcome their appearance in a more permanent form now, and to those who missed them in 1889 we can confidently recommend the book as one which will not only be interesting but also useful. W. D. H.

OUR BOOK SHELF.

Elementary Hydrostatics. By W. H. Besant, Sc.D., F.R.S. "Cambridge Mathematical Series." (Cambridge: Deighton, Bell, and Co., 1892.)

THE success this work has achieved will be gathered from the fact that this is the fifteenth edition, so that any further criticism on our part would be quite unnecessary. The brief snatches of historical matter, together with the lucid and simple explanations, all tend to stir up in the student an amount of interest which in the reading of many other works on this subject lies dormant. By a careful study of the illustrations, especially those relating to pumps, presses, &c., the beginner may gather much knowledge about the principles on which they are based. In this edition the text has undergone a careful revision, several alterations and additions having been made. A uniform system of units has been maintained throughout, and the chapters on the motions of fluids and on sound, which in previous editions were inserted among those on the equilibrium of fluids, have here been separated. The examples and problems at the termination of each chapter are as numerous as ever, a new edition of their solutions being near completion. Both at the Universities and elsewhere, the work will still continue to occupy the high position which it has held among treatises of its kind. W.

The Threshold of Science. By C. R. Alder Wright, F.R.S. Second Edition, Revised and Enlarged. (London: Charles Griffin and Co., 1892.)

THE primary aim of this book is to interest young readers in various simple and amusing experiments, illustrating some of the chief physical and chemical properties of surrounding objects, and the effects upon them of light and heat. In the present edition the author has made no change which is likely to interfere with this object, but he has added various scientific appendices, and an excellent chapter on the systematic order in which class experiments should be carried out for educational purposes. These additions will be of great service to all who may wish to use the volume not merely as a "play-book," but as an instrument for the training of the mental faculties. Any one who may still have doubts regarding the value of elementary science as an organ of education, will speedily have his doubts dispelled if he takes the trouble to understand the methods recommended by Dr. Alder Wright. The majority of the experiments he has selected must not, of course, be studied merely in his exposition. It is intended that each reader shall make them himself. If that is done, they cannot fail to quicken the intelligence even of "the average boy."

Key to J. B. Lock's Elementary Dynamics. By G. H. Lock, M.A. (London: Macmillan and Co., 1892.)

THIS key will be found most useful both to beginners and teachers alike. The examples are all carefully worked out, many of the more difficult problems being treated at greater length with the view of helping those who are studying without the aid of a teacher. By an intelligent use of this book, a student should acquire a good knowledge of the method of working out problems as well as the important factor of attacking them in the right way. W.

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.*]

Ice in the South Atlantic.

THE following account of ice met with in the South Atlantic at the commencement of last April, which has been supplied to the Meteorological Office by Captain Froud, of the Shipmasters' Society, may be of interest to your readers.

ROBERT H. SCOTT,
June 17. Secretary, Meteorological Office.

Ship *Cromdale*, London.

SIR,—I now send you a short account of my unusual encounter with ice in the above ship on our homeward passage from Sydney.

We left Sydney on March 1, and having run our easting down on the parallel of 49° to 50° S., rounded the Horn on March 30 without having seen ice, the average temperature of the water being 43° during the whole run across.

At midnight on April 1, lat. 56° S., long. 58° 32′ W., the temperature fell to 37°·5, this being the lowest for the voyage, but no ice was seen, although there was a suspicious glare to the southward.

At 4 a.m., April 6, lat. 46° S., long. 36° W., a large berg was reported right ahead, just giving us time to clear it. At 4.30, with the first sign of daybreak, several could be distinctly seen to the windward, the wind being north-west, and the ship steering north east about nine knots. At daylight (5.20) the whole horizon to the windward was a complete mass of bergs of enormous size, with an unbroken wall at the back; there were also many to the leeward. I now called all hands, and after reducing speed to seven knots, sent the hands to their stations and stood on. At 7 a.m. there was a wall extending from a point on the lee bow to about four points on the quarter, and at 7.30 both walls joined ahead. I sent the chief mate aloft with a pair of glasses to find a passage out, but he reported from the topgallant yard that the ice was unbroken ahead. Finding myself embayed, and closely beset with innumerable bergs of all shapes and sizes, I decided to tack and try to get out the way I had come into the bay. The cliffs were now truly grand, rising up 300 feet on either side of us, and as square and true at the edge as if just out of a joiners' shop, with the sea breaking right over the southern cliff and whirling away in a cloud of spray. Tacked ship at 7.30, finding the utmost difficulty in keeping clear of the huge pieces strewn so thickly in the water, and having in several cases to scrape her along one to get clear of the next. We stood on in this way till 11 a.m., when to my horror the wind started to veer with every squall, till I drew quite close to the southern barrier, having the extreme point a little on my lee bow. I felt sure we must go ashore without a chance of saving ourselves. Just about 11.30 the wind shifted to the south-west with a strong squall, so we squared away to the north-west, and came past the same bergs we had seen at daybreak, the largest being about 1000 feet high, anvil-shaped, and at 2 p.m. got on the north-west side of the northern arm of the horse-shoe shaped mass. It then reached from four points on my lee bow to as far as could be seen astern, in one unbroken line. A fact worthy of note was that at least fifty of the bergs in the bay were perfectly black, which was to be accounted for by the temperature of the water being 51°, which had turned many over. I also think that had there been even a small outlet at the eastern side of this mass the water between the barriers would not have been so thickly strewn with bergs, as the prevailing westerly gales would have driven them through and separated them.

I have frequently seen ice down south, but never anything like even the smaller bergs in this group. I also had precisely the same experience with regard to the temperature of the water in our homeward passage in the ship *Derwent* three years ago, as we dipped up a bucket of water within half a mile of a huge berg and found no change in the temperature.

I trust you will warn, as far as possible, those about to sail for the Cape, as these bergs must soon reach that part.

I remain, yours truly,
(Signed) EDGAR H. ANDREW, Master.

June 12.

Land and Freshwater Shells peculiar to the British Isles.

MR. COCKERELL, in his article in NATURE of May 26 (p. 76), draws attention to a list of land and freshwater shells peculiar to the British Islands in Dr. Wallace's new edition of "Island Life." This work is of such very great importance to every one engaged in the study of the geographical distribution of animals, that it is regrettable the author should have repeated an error made in the first edition. *Geomalacus maculosus*, as is mentioned in Mr. Cockerell's article, is not peculiar to the British Islands. A specimen was discovered in Northern Spain as far back as 1868 by Mr. von Heyden, and recorded in the *Nachrichtsblatt d. deutschen Malakozool. Gesellschaft* by Heynemann in 1869. The allied species, supposed to have been found in France, has been proved to be an Arion; but several species of the interesting genus Geomalacus have been recently described by Simroth from Portugal.

Mr. Cockerell also states that several varieties in the list of peculiar British forms may have to be eventually struck out; and this is certainly the case, as the variety *albolateralis* of *Arion ater*, mentioned as "very distinct," was found near Bremen, in Germany, and is described in Simroth's "Naturgeschichte der deutschen Nacktschnecken" (*Zeitschr. f. wiss. Zoologie*, vol. 42, 1885). R. F. SCHARFF.

22 Leeson Park, Dublin, June 13.

THE IMPERIAL INSTITUTE.

THE Imperial Institute is no longer a castle in the air, an abstraction the meaning of which is to be guessed at through a veil of mist, but a solid and handsome structure, affording a pleasant contrast to those in its immediate vicinity.

The objects and purposes which this institution should fulfil have been fully ventilated and discussed in these columns ever since the idea of such a national memorial, commemorative of the fiftieth year of the reign of Her Majesty, was suggested. This being so, it will be interesting to many of our readers if we make one or two comparisons of the scheme as it exists at present with the past suggestions. In an article on "Science and the Jubilee" in 1887 (NATURE, vol. xxxv. p. 217), we wrote:—

". . . . There is room for an Imperial Institute which might without difficulty be made one of the glories of the land, and which would do more for the federation of England and her colonies than almost any other machinery that it is possible to imagine. But it must be almost exclusively a scientific institution. Its watchwords should be 'Knowledge and Welcome.' England, through such an institution, should help her colonies in the arts of peace, as she does at present exclusively in the arts of war. In an Imperial Institute we can imagine the topography, the geology, the botany, and the various applications of science, and the industries of Greater Britain going hand in hand."

Again, referring to the proposed inclusion of an Emigration Office in the scheme, it was remarked:—

"With this we cordially agree. But the return current must be provided for. Those who have lived in England's colonies and dependencies know best the intense home feeling, and in many cases the stern necessity there is of close contact with the mother country. Let the Imperial Institute be England's official home of her returning children—the hall in which she officially welcomes them back. Let them here find all they need, and let information and welcome be afforded with no stinted hand."

An inspection of the parts already ready for occupation in the new building took place on Saturday last, and we confess frankly that the idea of "Welcome" referred to in the preceding paragraph has been fully carried out. The building is admirable architecturally, and in the various halls set apart for the purpose the children of the Greater Britain beyond the seas will find no unworthy home when they visit the mother country. Their intercourse will not be confined to meeting each other; the proposal to create home Fellows of the Institute will, no doubt, be taken advantage of by all interested in all the larger questions on which the progress of the Empire must depend. By this means an Imperial Club of a very real kind has been created.

So far, then, as one of the watchwords, "Welcome," is concerned, there is cause for sincere congratulation. It is too soon to discuss the many proposals regarding the other watchword, "Knowledge," with the future activity of the Institute in the second direction. The lines of activity already actually taken up and provided for in the building as now arranged may be gathered from a glance through the pages of the pamphlet and papers distributed on Saturday.

The contents of the galleries will constitute "a living representation of the resources of the Empire and of the condition of its industries and commerce." The permanent collections will illustrate "the natural and industrial products of the United Kingdom, of the several Colonies, and of India," while, from time to time, occasional exhibitions will be held which will, "it is hoped, stimulate and enlist the sympathies of Colonial, Indian, and British producers, and promote active co-operation with the industrial section of the Empire."

The collections will be arranged and described in such a manner as to afford full "scientific, practical, and commercial information relating to the sources, nature, facilities of supply, and applications of well-known natural products, and of those whose industrial or commercial value still needs development." The libraries, offices of reference, reading-rooms, &c., in conjunction with the above exhibits, should form therefore a mine of wealth. We note also an arrangement by which samples of products will be given to anyone who may be desirous of obtaining specific information respecting any particular product included in the collection.

Ample opportunities are to be offered for conference on matters of common interest, and for the interchange of information relative to both Great and Greater Britain.

Such, then, are some of the points included in the preliminary arrangement of the building. No one, we suppose, considers them as final. Natural selection will come in, and it rests with the representatives of the scientific bodies among the governing body to determine which parts of "Knowledge" of the higher kind shall be fostered. This is a problem for the future. We need not stop to consider it now.

One word about the building itself and the allocation of space.

Passing through the principal entrance, which is constructed altogether of Portland stone, the large reception hall is reached, which, when finished, will constitute one of the finest we have, various marbles and Indian teak panelling being profusely used.

The principal floor contains in its western corridor the British-American and British-Australasian conference rooms, the council chamber, and the secretarial and clerical offices; and in the eastern corridor the British-Indian and British-African conference rooms, the writing, reading, and news rooms, and the temporary library. The principal stairway, leading to the second floor, will, when finished, be a handsome piece of work; the steps will be of Hopton Wood stone, with marble balusters and rails, while the walls will be lined with specimens of British and Colonial marbles, and the ceiling profusely decorated with arabesque plaster.

On the first floor the Fellows' dining and reading rooms are situated. The rooms in the east corridor, occupied at present by a very interesting exhibition of Indian art metal work, will subsequently be used for the commercial department and commercial conferences. In the west corridor various rooms will be put at the disposal of various Societies "whose objects are kindred to those of the Imperial Institute."

On the second floor will be situated the public dining and refreshment room. Here also the rooms in the west corridor and on the south side will be used as sample examination rooms: there will also be a map room and a Fellows' smoking room. The east corridor will, we are somewhat ambiguously informed, be occupied probably by "certain Societies who are seeking the splendid accommodation which the Institute affords for carrying on their work." When these Societies are named, the policy of the governing body in this direction will become more obvious.

TIME STANDARDS OF EUROPE.

THE era of world time is yet far off, and it is certain that the desirable scheme for a uniform horary standard put forward by the Astronomer-Royal (NATURE, vol. xxxiii. p. 521) will not be realized this century. But though this be so, signs of better times in the reckoning of the hours of the day have recently appeared, and the practical outcome of the Prime Meridian Conference at Washington (NATURE, vol. xxxiii. p. 259) is already of importance. Time is a problem to us all—a problem which has baffled the philosopher, driven the astronomer to devices which closely resemble subterfuges, and harassed the watchmaker beyond all other craftsmen. Much light on the difficult but all-important question is focussed in Mr. Lupton's article in NATURE, vol. xxxix. p. 374; but education will do more than it has yet done when the average man succeeds in understanding what he cannot but believe, that forenoon events in Australia are printed in British newspaper offices before daylight on the day they occur, while morning doings in Hawaii cannot fly fast enough by cable to catch the latest edition of the evening papers. In strict justice the time of no two meridians should be the same; and as a matter of fact, in pre-railway days every town, and every garden large enough to boast a sun-dial, set itself by its own local time. Railways have made the uniformity of time within narrow belts of longitude a necessity, and so largely does the railway affect modern civilized life that railway time soon comes to regulate all affairs. The vexation of frequent changes of time standards is familiar to all who have travelled on the Continent, and for many practical purposes the change which has been quietly progressing for the last few years is a benefit of great value. This change was brought home to the dwellers in Belgium and the Netherlands on May 1, 1892, by the retardation of all the railway clocks by from ten to twenty minutes from local to Greenwich time, an alteration of the time-gauge of two countries far more significant than the conversion to standard gauge of the railways of England.

At the Poles, where all meridians converge, there can be no natural standard time, for it is every hour of the day at once; but the regulation of time at these singular points has not yet become a burning question. Were the system of time-reckoning recommended by the Prime Meridian Conference carried out in its entirety, the minutes indicated on all well-regulated clock-dials throughout the world would be the same at a given instant, but the hours would differ at each 15° of longitude by steps of one, twenty-four standards encircling the globe. Thus, for example, at 25 minutes past noon of the prime (or rather the zero) meridian, clocks 90° E. would show 25 minutes past 6 p.m. (18h. 25m.); those 90° W., 25 minutes past 6 a.m. (6h. 25m.); and those at 180°, 25 minutes past midnight. The zero meridian adopted by the Prime Meridian Conference is that of Greenwich; and definite time standards based on hourly intervals from this starting-line have been used since 1883 on the railways of North America. That continent is divided into strips 15° in width, in each of which a separate time standard prevails, from the Gulf of Mexico to Hudson Bay. Atlantic time in the eastern provinces of Canada, and in Newfoundland, shows 8 a.m. at Greenwich noon; Eastern time in the Atlantic States of the Union marks 7 a.m. at the same moment; while Central, Mountain, and Pacific time indicate respectively 6, 5, and 4 a.m. The meridians which set the clocks across America are those of 60°, 75°, 90°, 105°, and 120° W.

The conditions in Europe are more complicated than in America. Each small closely-peopled country, with its national Observatory, naturally tends to adopt throughout its particular national time, although even this is still a desideratum in some. In the difficult subdivisions of Imperial Germany especially, the number of independent and unrelated standards was a grievous obstacle to the interpretation of through railway time-tables.

The British Islands, lying at the extreme west of Europe, should logically keep time of the zero meridian, which intersects Greenwich Observatory; while the Russian Empire (in Europe at least) was by its system of central government and State control of railways equally committed to the time of St. Petersburg. But Pulkova Observatory lies two hours east of Greenwich plus one minute and a quarter, and the alteration required is so small that it may be said already to constitute East European time, two hours in advance of Greenwich, or the standard time of West Europe. The meridian of 15° E., running through Norway, Sweden, Germany, Austria, and Italy, corresponds to Central European time, one hour in advance of that of Greenwich, and if national prejudices and local inertia were overcome, the time of Europe would be placed on a very simple footing by its adoption. The railways of Austria-Hungary have used Central European time on this system since October 1, 1891. More than fifty towns in the monarchy have since then regulated their clocks to correspond, Vienna being the only conspicuous exception, where local time is used for local purposes. Servian time-tables have been assimilated to those of Central Europe, and Bulgarian to Eastern Europe; while Turkey, pulled two ways, yields on both sides, following Central European time on the Salonika railway and Eastern European time on the Constantinople line.

In Sweden railway time has been that of Central Europe (15° E.) since 1879, and in South Germany the change to the same standard took place on April 1, 1892, a fact of much greater importance, because a feat very difficult to accomplish. The four standards of Bavaria, Würtemberg, Baden, and Alsace-Lorraine were previously in use concurrently, and the change involved retarding the nominal hours of all trains from 14 minutes in the case of Bavaria to 34 minutes in that of the Reichsland. Luxemburg came into harmony with the rest of Central Europe at the same date, with the loss of 36 minutes.

By a decision of the Federal Council in May last, mean solar time of the 15th meridian will become standard time for the whole German Empire on April 1, 1893, when it exclusively will be employed for railway, telegraph, and all State purposes. Already several places in North Germany have adopted the new time, and it can only be a matter of a few years for the simpler uniform system to acquire a footing for all the purposes of private life.

The number of European time standards is stated by Dr. Busschere [1] to have been 24 on January 1, 1891, and by the end of 1892 it will only be 13. Of these, three are meridional standards, while ten are the times of capitals, viz: Paris, Madrid, Lisbon, Rome, Berne, Bucharest, Athens, Copenhagen, Berlin, and St. Petersburg, but the last, as already mentioned, practically belongs to the former category. It now remains only for France, Spain, and Portugal to adopt Western European time, for Denmark, Switzerland, and Italy to accept Central time, and for Greece and Rumania to join the other Balkan States in using Central or Eastern time, and the change will be complete.

Strangely enough, although foreign writers tacitly assume that the British Islands are at one in their time standard, there exists in the United Kingdom a diversity as illogical as that which formerly reigned in the States of Southern Germany. While Great Britain and the small island groups associated with it keep the time of the initial meridian, now extended to Belgium and Holland on the east, Ireland is regulated by Dublin time. Thus it happens that when the post-office clock in Stornoway (6° 15′ W.) shows noon, that in Donaghadee (5° 30′ W.) only marks 11h. 35m.

As long ago as 1888, Japan adopted for its standard time that of the ninth hour interval from Greenwich (135° E.), so that the clocks which regulate the movements of the Japanese are set nine hours in advance of ours.

India, Australia, and Cape Colony remain independent in their time relations, although so simple a readjustment as is required might form a graceful concession to the spirit of federation without sacrifice of local dignity or utility.

There is no authentic publication known to us which sets forth the time standards actually employed in the chief towns of the world, but fallacious information on the subject is to be found in many atlases and clock-face diagrams. Even so eminently practical a work as "Bradshaw's Railway Guide" contains month after month a map graduated on the margin to show the difference of time between Greenwich and the rest of

[1] Bulletin of the Royal Belgian Geographical Society, 1892, No. 2, p. 196. From this paper many of the statements given above have been derived.

England, leaving it to be implied that the local time thus shown is that actually employed, and Kelly's famous directories are disfigured with similar tables.

It is much to be regretted that the system of numbering the hours of the day from 0 to 24 has failed to hold the popular fancy. Despite the big clock-face on Greenwich Observatory, people still know their hours by the old ambiguous titles. Usually there is no room for misunderstanding, but mistakes are sometimes possible. A foreign potentate visiting this country recently was much *fêted* during his short stay, breakfasts, luncheons, and dinners being given in his honour, when a certain judge issued a card of invitation to a "Reception at 10 o'clock," which some of the guests interpreted as a.m., and others as p.m. Missing a foreign Prince through such ambiguity is a trifle compared with missing a train or miscalculating the length of a journey, and yet we know of no English time-table (we have heard of American) in which the simple plan of naming the afternoon hours from 12 to 23 is adopted. The method is occasionally used in the record of scientific observations, and always with advantage.

The present time-standards on the railways of Europe may be summarized as follows:—

(1) *Time of the initial meridian* (Western Europe) 0° (12.0):—Great Britain, Belgium, the Netherlands.

(2) *Time of the first hour interval* (Central Europe), 15° E. (13.0): Sweden, Luxemburg, Germany (Prussia excepted temporarily), Austria-Hungary, Servia, Bulgaria, Western Turkey.

(3) *Time of the second hour interval* (Eastern Europe), 30° E. (14.0): Eastern Turkey, Russia (practically).

Countries conforming to national standards or to no system, with the hour adopted in their capitals at Greenwich noon: Ireland (11.35), France (12.9), Spain (11.46), Portugal (11.23), Switzerland (12.30), Italy (12.50), Rumania (13.44), Greece (13.35).

HUGH ROBERT MILL.

NOTES.

MR. H. T. STAINTON, F.R.S., the well-known entomologist, has been appointed one of the Curators of the Hope Professorship at Oxford, to fill the vacancy caused by the death of Prof. Moseley.

SIGNOR GIUSEPPE FIORELLI is retiring from the general direction of the antiquities of Italy, and his friends and admirers have resolved to mark the occasion by giving expression to their high appreciation of his work as an archæologist. A committee has been appointed by the Accademia dei Lincei to make the necessary preparations. It is proposed that a medal shall be struck in his honour, and that any sum which may remain after this has been done shall be set apart for the encouragement of archæological studies in accordance with Signor Fiorelli's suggestions.

THE second International Congress of Physiology is to be held at Liége on August 28 to 31.

ON Tuesday a conference was held at Lord Brassey's house for the consideration of the best means of establishing a laboratory of marine biology in Jamaica in commemoration of the fourth centenary of the discovery of America. Lord Rosse moved the first resolution, "That an observatory of marine biology in tropical seas is necessary for the development of science." Prof. Ray Lankester seconded the resolution, and in doing so said that nothing could do more to advance our knowledge of biology at the present moment than the work of such a laboratory as that which it was proposed to establish. They wanted a place where the naturalist could work, and above all they wanted an organization, with a permanent official in charge who would gradually accumulate knowledge of the animals and plants which were to be found in the surrounding waters. They wanted in such a laboratory the means of dredging. He hoped they would have a steam vessel, and that the vessel would be large, and the actual building of the laboratory small. He trusted that there would be an adequate private subscription to enable them to build the laboratory, but the carrying on of the work would require an annual income, which he hoped the home Government and the island Government would be prepared to find. The resolution was carried unanimously. Mr. Villiers-Stuart moved, and Mr. Wellesley Bourke (M.L.C., Jamaica) seconded, "That no tropical sea promises so rich a harvest of biological specimens as the great gulf of the West Indies; that Jamaica is the most central and most suitable station for such an observatory, and that its establishment would be a suitable memorial of the fourth centenary of the discovery of the Western Hemisphere." This also was unanimously agreed to.

THE Crystal Palace on Saturday last was specially visited by Lord Kelvin to view the National Electrical Exhibition at present being held in its buildings. This Exhibition, as everyone who has seen it must be aware, is a thoroughly representative one, and besides illustrating the present condition of the application of electricity for practical purposes, carries one back especially in the Post Office exhibit, to the time of its infancy: the historical collection is of considerable importance, and has been well selected. Instruments are there shown, which have five needles on their dials, the presence of which was once necessary to carry on a conversation, the number of words spoken per minute amounting only to single figures. Very interesting old specimens of cables are also shown, together with the part of a telegraph post connected with the pathetic case of a poor woodpecker which, in the endeavour to find the insect that was producing (so he thought) the humming noise in the post, had pecked a large hole in it. In the demonstration room of Messrs. Siemens Brothers, some truly wonderful sights were displayed. The flame produced by exciting an induction-coil by means of an alternating current was produced on a very large scale, and as it issued from the secondary poles, was made to pass through pieces of wood, lumps of salt and slate, the most striking case being its passage through a large piece of plate glass, for which a very strong current was required. Among the many other exhibits, we may mention the demonstrations in cooking by electricity. The bottom of the kettle or saucepan is coated with a specially prepared enamel, into which a fine wire resistance is embedded; by this means, as the wire becomes heated, the temperature of the kettle, and therefore of the water in it, is raised. We may note that the Exhibition closes on Saturday, July 2, so that those who have not already visited it should do so without delay.

A REUTER's telegram from Vizagapatam, Madras, announces the death of Mr. Narasinga Row, the well-known native astronomer. He died on Saturday last.

THE death of Hermann Burmeister, the well-known German zoologist, at Buenos Aires, is announced. He died on May 1 in his eighty-sixth year. In his early days he was a Professor of Zoology at Halle. During the revolutionary period of 1848 and the following years he associated himself prominently with the Liberals, the result being that in 1850 he had to quit Germany. He travelled for some time in Brazil, and then returned to his native country. He went back to South America in 1856, and not only visited most parts of the Argentine Republic, but crossed the Andes by a way which had never before been taken by a European. After another brief visit to Germany, he finally settled in Buenos Aires in 1861, where he formed the well-known National Museum of Natural Science. Only an accident made it necessary for him to resign his position as Director, and the community, by which his services were highly appreciated, took care that he was properly pensioned. He was buried at the cost of the State, and the President was present at the funeral.

DURING the latter part of last week an area of high pressure lay over the Bay of Biscay and the west of France, and an area of low pressure over Scandinavia and the North Sea, causing moderate north-westerly and westerly winds over these islands. The temperature had continued low, the maxima only exceeding 60° at a few places, chiefly in the southern parts of the kingdom, while the nights were very cold for the time of the year, with ground frosts over the inland parts of England. Thunderstorms occurred in many parts, with heavy showers of rain, and hail in the south-east of England. At the beginning of the present week the low barometer extended gradually over the kingdom, and shallow depressions were travelling from west to east. With this distribution of barometric pressure, the winds were from north and east over Scotland, and chiefly from between north-west and south-west over England and the Channel; subsequently the barometer readings became more uniform, and the winds light and variable. The weather continued very unsettled, although there was some increase of temperature. The report issued by the Meteorological Council for the week ended the 18th instant shows that the mean temperature was below the average for the week in all districts, the deficit ranging from 3° in the Channel Islands to 8° in the Midland and Eastern Counties of England. Rainfall was only slightly above the mean in the east of Scotland.

THE Washington Weather Bureau has just distributed two important meteorological papers prepared by General A. W. Greely, Chief Signal Officer. (1) A series of thirty-seven charts showing the absolute maximum and minimum temperatures in the United States for decades, and for all years combined, compiled from observations taken from 1872 to June 1891. The values, together with the date of occurrence, are printed over the names of the stations on ordinary maps, and show very clearly for each locality the limits within which the temperature may be expected to range. (2) Diurnal fluctuations of atmospheric pressure at twenty-nine selected stations in the United States. The tables give the corrections necessary to reduce the mean pressure at any hour of the day to the true daily mean. The values have been obtained by freehand curves from all the available observations from January 1877 to June 1888. It is found that the fluctuations of the secondary maxima and minima diminish from south to north, especially during the summer months. The daily variation in pressure decreases with increasing latitude, especially in the winter months; in summer the same conditions exist, except that the daily range increases inland from the coast. The principal maximum occurs over the whole of the United States in January, about 9h. 45m. a.m. (local time), except along the New England coast, where it is earlier; as the year advances the hour gradually shifts towards the earlier morning until June, after which a reversal gradually occurs. The delay in the hour of the principal minimum is more marked: it gradually becomes later with increasing longitude; the most decided lagging in the summer minimum is in the neighbourhood of the Great Lakes.

PROF. R. KOBERT gives, in the *Chemiker Zeitung* (1892; 16, No. 39), an account of Williams's frog heart apparatus. The apparatus, as modified by Maki, Perles, and Kobert, consists of an arrangement of glass vessels and india-rubber tubes, whereby a heart taken from a newly-killed frog can be made to maintain an artificial circulation of blood, fresh or injected with any poison the effect of which it is sought to determine. The tubes and vessels are mounted on a stand about 1 foot high. The heart is suspended by a cannula leading into a three-way tube communicating with two vertical glass cylinders fitted with glass valves. Through one of these the heart is supplied with blood, either fresh from a rabbit, calf, or dog, and diluted with 0·75 per cent. salt solution, or poisoned. The other vertical cylinder leads back from the heart to the vessel from which the fresh blood is supplied. To start the action, fresh blood is allowed to enter the heart, which is thereby excited to a contraction, and pumps it back into the reservoir. The height through which it is raised, and the quantity that is raised in a given time, gives the work done, and the number of pulsations, and the volume raised in a given time determines the pulse-volume. The force exerted is measured by a small mercurial manometer, which may be rendered self-registering. To study the action of poisons on the power and vitality of the heart it is only necessary to admit the poisoned blood from the second reservoir. When the pulsation has ceased or diminished, fresh blood may be re-admitted, which in many cases restores the pulsation. We have received a letter on this subject from Count F. Berg, of Livonia, who says Prof. Kobert is of opinion that the apparatus, if it were more generally known, would be of great service for the advancement of science, and would render unnecessary many an otherwise indispensable experiment in vivisection.

WE have received a new planisphere, which is being sold by the *Register* Publishing Company, Ann Arbor, Mich. The rotary disk, on which the constellations are clearly marked, is made of good stiff cardboard, and the days of the year round the edge are neatly printed in white figures on a blue background. The planisphere is arranged for latitudes 38° to 48°, and shows on its disk all the principal stars in each constellation, with their lettering, and in some cases their names; thus, α Boötis = Arcturus, α Lyræ = Vega, &c. By simply turning the disk round until the day of the month comes opposite the time of day, the stars above the horizon at that time can at once be seen. On the back is a table for finding the times of visibility and positions of the planets, while there is also a key to enable one to determine the name of a planet which cannot be recognized. When once used, the handiness of such a planisphere as this will soon make itself apparent; and not only will it be adopted by possessors of telescopes, but it should be in the hands of all those who wish to be able to find and correctly name the various constellations.

INQUIRIES have recently been made by the British Consuls in Japan as to the various native industries that have sprung up for the production of articles which have hitherto been imported into that country from abroad. A summary of the information thus obtained has been prepared by Mr. Gubbins, Secretary of Legation at Tokio, and has been printed in the Foreign Office Miscellaneous Series. Mr. Gubbins says that in the case of some of the industries introduced into Japan, the country is now self-supporting, foreign competition being no longer possible; in others so much has been accomplished as to render it certain that the time is not far off when importation will altogether cease. The future of other industries again—such as that of cotton-spinning—though not so assured, is still hopeful; while even in those branches in which the least results have been obtained she possesses a constant advantage in the great cheapness of labour. Mr. Gubbins thinks that this progress has not been made at the sacrifice of any of the various artistic industries which are more peculiarly her own. While admitting that there is truth in the criticism that would disparage her progress for the reason that it is imitative and not constructive, he holds that the fact that Japan, an Oriental country, has been able to dissociate herself from her sister countries of the East and to profit by Western inventions to the extent that is in evidence augurs well for the years to come.

IN the new number of the *Records of the Australian Museum* (vol. ii., No. 1), Prof. Alfred Newton, F.R.S., has a note which may be of interest to ornithologists in Australia. Having lately occasion to investigate the range of the sanderling (*Calidris arenaria*), he came across a memorandum made in the yea

1860 of his having then seen, in the Derby Museum at Liverpool, two specimens of the larger race of this species, one in winter dress and the other in incipient spring plumage, both being marked as females, and as having been obtained at Sandy Cove in New South Wales, April 20, 1844, by the late John Macgillivray. This wandering species does not seem to have been hitherto recorded from Australia. Prof. Newton finds little verification of Temminck's assertion in 1840 ("Man. d'Ornithologie," iv. p. 349), often repeated in one form or another, that the sanderling occurs in the Sunda Islands and New Guinea; or even of a statement made by a recent writer in general terms, that it is a winter visitor to the islands of the Malay Archipelago ("Geographical Distribution of the Charadriidæ, &c.," p. 432). Java seems to be the only one of these islands in which its presence has been determined, and though it was included with a mark of doubt in the lists of the birds of Borneo by Prof. W. Blasius (1882) and Dr. Vorderman 1886) respectively, it has been omitted, and apparently with reason, from that of Mr. Everitt (1889). It is well known to pass along the whole of the west coast of America, and it has been obtained in the Galapagos and the Sandwich Islands, but Prof. Newton knows of no instance of its having been observed in any Polynesian group or within the tropics to the eastward of Java.

IN the same number of the *Records of the Australian Museum* is a valuable paper (with plate), by Mr. Charles Chilton, on a Tubicolous Amphipod from Port Jackson. Among some Australian Crustacea sent to Mr. Chilton as exchanges by the trustees of the Australian Museum was a tube-dwelling Amphipod collected in Port Jackson. There was a plentiful supply both of specimens and of the tubes formed by them, and after a full examination and comparison of them with Mr. Stebbing's description and figures, Mr. Chilton has no doubt that they belong to *Cerapus flindersi*, Stebbing, a species described from a single female specimen taken in Flinder's Passage during the voyage of the *Challenger*. Mr. Stebbing says nothing of the tube in his description, and Mr. Chilton presumes, therefore, that he has not seen it. Mr. Chilton is able to supplement Mr. Stebbing's description in this respect, and to describe the male of the species, and to give the points in which it differs from the female, and also some interesting facts on the changes in form that occur during the growth of the male.

SOME time ago the *Ceylon Observer* gave an account of the killing of a wild boar by a cheetah near Galle. In its issue of May 25 it prints a letter from Mr. Clive Meares, who says that the fortune of war has now gone the other way, a cheetah having been killed by a wild boar. The coolies of Ginniedominie estate, Udagama, on going to work on the morning of May 23, discovered in a tea-field near the jungle signs of a severe struggle having taken place between a cheetah and a wild boar—judging by the marks. On further search the dead body of a cheetah was discovered in the tea, death having evidently been caused by the severe handling it had received from the boar. The brain being very much congested with blood and several teeth marks deeply buried in the neck, there could be no doubt as to the cause of death. On the animal being skinned the wounds were found to be very deep. She weighed 42 pounds, and she was 71 inches long from nose to tip of tail, and 24 inches in height at the shoulders.

MR. A. REA, the Superintendent of the Archæological Survey, Madras, has reported an important discovery he has made of another casket, some relics, and inscriptions in the Buddhist stupa at Bhatuprolu in the Kistna District. In Sewell's *List of Antiquities*, vol. i. p. 7, mention is made of a casket found in the dome of the stupa some years ago. It struck Mr. Rea that as the chief deposit was usually placed near the centre of the foundations, it was probable that another casket might be found. Copies of his report, with inscriptions, have been ordered to be sent to Dr. Hultzsch, the Government Epigraphist; to archæological experts in India, and to various learned Societies.

MINING seems likely to be splendidly represented at the Chicago Exhibition. It is announced that "all of the precious minerals, all of the economic minerals, all of the precious stones, all of the coals, all of the building stones and marbles, all of the clays and sands, all of the salts and pigments, as well as the machinery, implements, and appliances employed in their conversion to the uses of man, will be fully represented." Especial attention will be devoted to the iron industry. The Exhibition will provide ample data as to the location and extent of the greater iron deposits, the analyses of the ores, with all the machinery and devices employed in mining, hoisting, conveying, storing, &c.

PROF. DANIEL G. BRINTON contributes to the new number of the Proceedings of the American Philosophical Society, vol. xxx., No. 137, valuable papers on the Chintantec language of Mexico, the Mazatec language of Mexico and its affinities, and South American native languages. Of the latter languages he says that they are the least known of any in the world.

A VOCABULARY of the Eskimo language has been compiled by M. Ryberg, a Danish official in Greenland. It represents work carried on during fifteen years.

THE publication of the quarterly journal for cryptogamic science, *Grevillea*, will still be continued under the proprietorship of Mr. E. A. L. Batters, and the editorship of Mr. George Massee.

MR. E. D. MARQUAND has published a list of the flowering plants and vascular cryptogams of Guernsey. It includes the remarkable number of 636 flowering plants, 18 ferns, and 9 fern allies. Of these about 130 are not recorded for Guernsey in Prof. Babington's "Primitiæ Floræ Sarniceæ."

THE latest researches of the Finnish expedition to the Kola Peninsula will modify the position of the line which now represents on our maps the northern limits of tree-vegetation in that part of Northern Europe. The northern limit of coniferous forests follows a sinuous line which crosses the peninsula from the north-west to the south-east. But it now appears that birch penetrates much farther north than the coniferous trees, and that birch forests or groves may be considered as constituting a separate outer zone which fringes the former. The northern limits of birch groves are represented by a very broken line, as they penetrate most of the valleys, almost down to the sea-shore; so that the tundras not only occupy but a narrow space along the sea-coast, but they are also broken by the extensions of birch forests down the valleys. As to the tundras which have been shown of late in the interior of the peninsula, and have been marked on Drude's map in Berghaus's atlas, the Finnish explorers remark that the treeless spaces on the Ponoi are not tundras but extensive marshes, the vegetation of which belongs to the forest region. The Arctic or tundra vegetation is thus limited to a narrow and irregular zone along the coast, and to a few elevated points in the interior of the peninsula, like the Khibin tundras, or the Luyavrurt (1120 metres high). The conifer forests, whose northern limit offers much fewer sinuosities than the northern limit of birch-growths, consist of fir and Scotch fir; sometimes the former and sometimes the latter extending up to the northern border of the coniferous zone.

THE British Consul in Hainan, in his last report, says that during the past year he has made two journeys in that island, one to certain prominent hills near Hoihow, known as the "Hummocks," which lie fifteen miles to the west, on the road to Ch'eng-mai, the other a gunboat cruise to Hansui Bay. The people at both these places, and presumably all along the north-west coast, though believing themselves Chinese, speak a language which is not only not Chinese, but has a large percentage of the words exactly similar to Siamese, Shan, Laos, or Muong. The type of the people, too, is decidedly Shan, without the typical Chinese almond eye. At one time (1000 years ago) the Ai-lau or Nan-chau Empire of the Thai race extended from Yun-nan to the sea, and the modern Muongs of Tonquin, like the Shans of the Kwangsi province, the ancestors of both of which tribes belonged to that empire, probably sent colonies over to Hainan; or the Chinese generals may have sent prisoners of war over. It is certain that some at least of the unlettered, but by no means uncivilized, tribes in the central parts of Hainan speak a type of language which is totally different from that spoken by the Shan-speaking tribes of the north-west coast. Yet the Chinese indiscriminately call all the non-Chinese Hainan dialects the Li language. The subject, Mr. Parker says, is one of great interest, well worth the attention of travellers. It was his intention to pursue the inquiry when making a commercial tour of inspection round the island, but his transfer to another post compels him to abandon his scheme.

THE additions to the Zoological Society's Gardens during the past week include a Brown Capuchin (*Cebus fatuellus*) from Guiana, presented by Mr. Edward Solomon; two Black Swans (*Cygnus atratus*) from Australia, presented by Lady William Osborne Elphinstone; a Greater Spotted Woodpecker (*Dendrocopus major*), two Common Cormorants (*Phalacrocorax carbo*), British, presented by Sir H. B. Lumsden, K.C.S.I.; a Greater Sulphur-crested Cockatoo (*Cacatua galerita*) from Australia, presented by Mr. F. R. Brown; two Common Rheas (*Rhea americana*) from the Argentine Republic, deposited; an Erxleben's Monkey (*Cercopithecus erxlebeni* ♂) from West Africa, a Victoria Crowned Pigeon (*Goura victoriæ* ♀) from the Island of Jobie, two Wonga-Wonga Pigeons (*Leucosarcia picata*) from New South Wales, a Rosy-billed Duck (*Metopiana peposaca* ♀) from South America, twenty Common Teal (*Querquedula crecca*), European, purchased; a Thar (*Capra jemlaica*), two Burrhel Wild Sheep (*Ovis burrhel* ♂ ♀), an Axis Deer (*Cervus axis* ♂), four Temminck's Tragopans (*Ceriornis temmincki*), a Himalayan Monaul (*Lophophorus impeyanus*), bred in the Gardens.

OUR ASTRONOMICAL COLUMN.

COLOURS ON THE SURFACE OF MARS.—During the last opposition of Mars a series of observations was made by Prof. Pickering with the object of determining the general colour of this planet's disk, and that of the various markings distributed over its surface. In a preliminary account of this work which he has contributed to the June number of *Astronomy and Astro-Physics*, we are made acquainted with some of the observed facts, which will be read with keen interest, as we are nearing a time when like observations can be repeated. The instruments used were the 12-inch and 15-inch at Cambridge, and the 13-inch at Arequipa, Peru. With the two former sixty paintings were made, together with sixty-six uncoloured drawings, and with the latter some of the more recent observations were undertaken. The general light from the planet, although usually termed ruddy, was found to lie about midway between that of a candle and electric light of equal brilliancy, being somewhat bluer than the former and redder than the latter.

Great difficulty seems to have been found in matching Mars's colour in the day and night time, the presence or absence of the bluish white light reflected from the atmosphere bringing about a great difference in the colour of the pigments used. The colour finally settled upon may be represented by equal parts of dragon's blood and sienna. The ruddiness, as the limb was approached, gave way to a distinct yellow tint, due perhaps to atmospheric absorption, an effect, as Prof. Pickering remarks, which is quite at variance with the action of our own atmosphere. In addition to these colours grays and greens have been noticed, indeed at times the greens have been more intense than the red. The grey objects were found, when the seeing was very good, to have a slightly yellowish tinge about them, but when viewed by daylight a browner tint more accurately represented their colour.

Numerous observations were made also with the intention of determining the colour of those parts more darkly tinted, and the colour of the canals; but Prof. Pickering only mentions that there were indications of slight colour alterations, reserving his opinion on these points in order not to bias those of other observers, who will be able in the coming opposition to examine this planet's surface from this point of view.

During the months of July and August the planet, excepting for its low altitude, will be most favourably situated for observation, the opposition occurring on August 4, when its distance from the earth will be about 35,000,000 miles.

OBSERVATIONS OF THE MOON.—The *Monthly Notices* (vol. lii., No. 7) contains, besides the observations of the right ascensions and north polar distances of the moon made during the year 1891 at the Radcliffe Observatory, Oxford, a comparison of these results, with the tabular places taken from Hansen's lunar tables. The two suppositions on which these results are compared are, as Mr. Stone says: (1) that the mean times found in the usual way from the sidereal times at mean noon given in the *Nautical Almanac*, were not altered in scale, or affected with any different systematic errors of determination, by the adoption in 1864 of a different ratio of the Julian year of 365¼ "mean solar days" to the mean tropical year; (2) that the "mean times" which accurately correspond to a given "sidereal time of a meridian" were necessarily changed in 1864 by the use of a different ratio of the "Julian year," and therefore of the "mean solar day" to the mean tropical year, to fix the tabular right ascensions of the clock stars at the meridian transits. It is from these tabular right ascensions of the clock stars that the observed right ascensions are deduced by the aid of clocks; and the right ascensions thus found are finally rendered definite by the direct reference to the positions of the sun deduced from the north polar distances and obliquities of the ecliptic.

During the period included in the years 1847 to 1863 the mean annual error in longitude of Hansen's tables amounted to $-1''\cdot85$, no regular law of increase being indicated. Taking the case of those observations made up to the end of last year, the mean annual error, as shown in the third table, has steadily increased from the year 1863 at an average rate of $0''\cdot75$ per annum, the error now amounting to as much as $19''\cdot30$. If the corrected argument be used for taking out the mean annual error of Hansen's tables during the same period, this value becomes $-1''\cdot49$, which differs from $-1''\cdot85$ (the value for the preceding period) by a quantity which in such a case is very small.

A PLANET BEYOND NEPTUNE?—For some time it has been thought that in all probability our sun is accompanied by one or two other planets which lie outside the orbit of Neptune. The idea gained a considerable footing in many minds after Prof. Forbes's paper, which he read in 1880 before the Royal Society of Edinburgh, his prediction being based on cometary aphelia positions. In order to investigate this question more fully, Mr. Isaac Roberts, having obtained the necessary approximate positions of these hypothetical bodies, undertook to make a search for them, employing the method of long exposure photography. The result of this search he communicates to the May number of the *Monthly Notices*.

The probable position indicated by Prof. Forbes lay between R.A.'s 11h. 24m. and 12h. 12m., with declinations 0° 0' to 6° 0' north; and over this region Mr. Roberts took two sets of eighteen plates, each plate covering more than four square degrees, the exposure being of 90 minutes' duration. A close examination of the plates showed that, in Mr. Roberts's words, "no planet of greater brightness than a star of the fifteenth magnitude exists on the sky area herein indicated."

GEOGRAPHICAL NOTES.

THE Royal Geographical Society's *soirée* took place on the 17th inst. at the South Kensington Museum, when the guests were received by the President and Council. The attendance was very great. The attractions of the evening included selections by the Coldstream Guards band, solo and part singing in the lecture theatre, and an exhibition by the dioptric lantern of maps and views, with explanation by Mr. H. J. Mackinder.

SOME interesting particulars as to the present state of the Marshall Islands are published in the *Deutsches Kolonialblatt*. The population is estimated at 15,000 aborigines, and about 100 whites. Cocoa-nuts and copra are the staple exports; pandanus, breadfruit, and arrowroot being cultivated on a small scale. The natural grass is not suitable for pasture, but with the introduction of foreign grass seed, cattle and sheep breeding may become profitable. Taking into consideration the character of the soil and the density of population, the future of the German protectorate in the Marshall Islands is acknowledged not to be very bright, although the authorities hope that it may become of enhanced importance for trade with Germany.

THE *National Geographic Magazine* has just published an account by Dr. Charles Willard Hayes of the expedition through the Yukon district in 1891, conducted by Mr. Schwatka on behalf of a syndicate of American newspapers. Entering by the Yaku inlet, the expedition made its way by canoe, as soon as the ice disappeared, up the Yaku River; thence it crossed the watershed, and continued on Lake Ahklen and the Teslin River to Lewes River, a tributary of the Yukon. A traverse survey was made all the way, and the route laid down in a serviceable manner, though of course without the precision of an actual survey. This district has been several times visited by prospectors, and parts of it mapped by previous explorers; but the expedition opened up, probably for the first time, the unknown region extending from the Yukon to the St. Elias Mountains. Across this blank, usually filled in hypothetically on maps, the expedition surveyed a line of 330 miles, from Selkirk, on the Yukon, to the junction of the Chittenah and Nizzenah rivers. The report gives a clear summary of the topography, drainage, orographic system, and geology of the region traversed.

PRINCE HENRY OF ORLEANS has returned to France after a difficult journey from the Upper Mekong, through the Shan States and Siam, where he reached the coast at Bangkok.

CAPTAIN W. G. STAIRS, whose quiet heroism in Stanley's Emin Relief Expedition was brought prominently before the world two years ago, has fallen a victim to African travel. He was born at Halifax, Nova Scotia, in 1863, and educated at Merchiston Castle School, in Edinburgh, subsequently studying at the Royal Military College, Kingston, Ontario. After his training in Canada he spent some time in New Zealand as a civil engineer; but obtaining a commission in the Royal Engineers, he came to Chatham, and completed his military training. When the Emin Relief Expedition was fitting out in 1887, he volunteered to accompany it; and from the first he impressed Mr. Stanley as a man of exceptional qualities—an opinion strengthened by the strict obedience and absolute loyalty which distinguished him throughout the trying years that followed. As the only member of the advance party (Dr. Parke excepted) who had much interest in scientific matters, Captain Stairs would undoubtedly have made large additions to knowledge had it not been for the imperative exclusiveness of his work as an officer. He was selected for the best piece of geographical exploration attempted during the expedition—the ascent of Mount Ruwenzori. Last year Lieutenant Stairs was promoted to a captaincy, but the fatal attraction of Africa led to his resignation in order to accept command of the Katanga Company's expedition. This Company was formed in Belgium to administer and exploit the south-eastern corner of the Congo Free State, in what is known as Msidi's country. Stairs left Zanzibar last summer, crossed to Lake Tanganyika by the familiar trade route *viâ* Tabora, and reached Mpala on October 31, after a remarkably rapid and easy journey. Thence he traversed Msidi's country in the rainy season, where he suffered much from fever, but succeeded in reaching the Ruo on May 13, and arrived at Vicenti, near the mouth of the Zambesi, on June 3. But at Chinde, just as the expedition had overcome all the difficulties of the way, and only waited for a passage to Zanzibar, Captain Stairs died. This sad event has removed from the list of African travellers one of the bravest, most prudent and modest of young explorers.

THE MICROSCOPE'S CONTRIBUTIONS TO THE EARTH'S PHYSICAL HISTORY.[1]

MEN will have forgotten much when the second half of this nineteenth century is no longer remembered. Whatever may have been its faults, it has no rival in the past history of the world as an epoch of scientific progress. This progress has been largely due to the felicitous co-operation of the mind of the student with the skill of the craftsman in the more perfect construction of instruments of research. By them darkness has been made visible; the opaque, translucent; the unseen, conspicuous; the inert, sensitive; silence, vocal. A thousand methods of experiment, tests of the most delicate nature, have been devised, so that vague conjecture has been replaced by exact knowledge, and hypothesis by demonstration. In such an epoch it may seem a little fanciful to select any one term of years as exceptionally fruitful; but it is remarkable that in the first decade of this half-century, science was enriched by three contributions, each of which has led to consequences of far-reaching import. In 1858 Charles Darwin and Alfred Russel Wallace announced simultaneously the conclusions as to the origin of species at which they had independently arrived, and the well-known book by the former author appeared in the following year. They thus formulated the results of protracted investigations and patient experiments with the simpler appliances of earlier days. They subjected, more strictly than ever before, the facts of nature to an inductive treatment, and thus lent a new impulse to biological science. Their hypothesis gave a definite aim to the researches of students, and kindled an unquenchable flame of intellectual activity. In 1860, Bunsen and Kirchoff announced the results of applying the spectroscope to problems in chemical analysis. By means of this instrument not only have investigations attained a precision hitherto impossible, but also the student, no longer cribbed, cabined, and confined, to the limits of the earth, can question the stars in their courses, and bid nebulæ and comets reveal the secrets of their history. Lastly—though the problem be in a humbler sphere, dealing with neither the immensities of stellar physics nor the mystery of life—Henry Clifton Sorby, in 1856, described the results of microscopic investigations into the structures of minerals and rocks. Strictly speaking, indeed, the method was not wholly novel. So long since as 1827, William Nicol, of Edinburgh, had contrived to make sections of fossil wood sufficiently thin for examination under the microscope; but the device, so far as I know, had not been generally applied, or its wide possibilities apprehended.

You have heard in this place on former occasions of the triumphs of the spectroscope in extra-terrestrial space; of the revelations of the microscope in regard to the least and lowest forms of life; I have ventured to ask your attention to-day to the work of that instrument in a humbler and more limited field—the constitution and history of the earth's crust. My task is beset with difficulties. Did I address myself to experts, these would be but a small portion of my audience; if I speak to the majority, it will be hard to make intelligible a subject bristling with technicalities. Moreover, as this building is so ill-suited for the usual methods of illustration, I have decided to dispense with diagrams or lantern slides, and will try to tell, in the plainest language at my command, the conclusions as to the genesis of rocks and the earlier history of the earth to which the researches of the last few years seem to be tending.

I have excluded from my story investigations which bear upon the biology of the past, though the work of the microscope in this field has not been less fruitful or interesting, because these are more widely known. Moreover, they have not specially engaged my attention, and there is, I believe, an expectation amounting to an unwritten law, that whoever has the honour to occupy my present position should be so far egotistical as to talk of the particular plot, however small it may be, on which he has laboured in the garden of science. So I will crave the indulgence of the few experts present, and the patience of the majority of my audience, while I try to tell the story of microscopical research into the history of the earth's crust.

Twenty years ago, I believe, not half that number of geologists in the British Isles made any real use of the microscope. Now they may be counted by scores, not only in the United Kingdom, but also in every civilized land. Obviously in a science so new, in a research which is extending so rapidly,

[1] The Rede Lecture for 1892, delivered before the University of Cambridge, by T. G. Bonney, Sc.D., F.R.S.

much diversity of opinion must exist on some theoretical questions. Into the details of controversies it is not my purpose to enter; but I shall content myself with indicating the conclusions to which I have been led in the time which the many inevitable duties of life permitted me to devote to this branch of geology.

Before doing this it may be well to indicate very briefly the mode in which the microscope is applied to the examination of rocks. Commonly it is as follows: slices, cut by the lapidary's wheel from minerals or rocks, are ground down smoothly till they are about one one-thousandth part of an inch thick, and are then mounted on glass. By this means most minerals, including the great majority of the ordinary constituents of rocks, become translucent, if not transparent. They are then examined under a specially-constructed microscope, fitted with Nicol's prisms and other contrivances for optical tests. Occasionally also certain chemical tests can be applied. To what extent an object is magnified depends on the nature of the investigation. A very minute crystal can sometimes be studied, under favourable circumstances, when enlarged to at least 800 diameters; but in ordinary cases, where the chief constituents of a rock and their mutual relations are the object of research, a magnification of from 50 to 100 diameters is commonly the most advantageous. Sands, clays, and incoherent materials can be readily studied by mounting them temporarily or permanently on glass; sometimes, also, good work can be done, and time saved, by crushing up fragments of minerals and of rocks, and by treating the powder thus obtained in the same way. Investigations, which promise to throw light on the problem of the development of minerals, have been recently made by examining the insoluble residues of those rocks which are chiefly composed of carbonates. Solutions of different specific gravities have proved very useful in the determination of the mineral constituents of a rock, which are sorted out by them, as by a strainer, from a sand, mud, or a powdered mass, so that each kind can be studied separately either by microscopical or by chemical analysis.

The subject evidently, in process of time, tends to divide itself into two branches: the one concerned mainly with the characters of the individual constituents of a rock, the other with the wide problem of their mutual relations, or, in other words, with the history of the rock-mass: branches properly denoted by the words *petrography* and *petrology*, though these terms are often confused. The former is more strictly a department of mineralogy; the latter a department of geology. This it is of which I chiefly speak to-day; this it is in which the most marked advances have been recently made.

How great these have been may be more readily appreciated if I mention a few matters, concerning which, even a quarter of a century since, great uncertainty prevailed. Though it was then generally admitted that one great group of rocks, such as clays, sandstones, limestones, &c., were sediments, and that another great group, the rocks called igneous, had solidified in cooling from a fused condition; the origin of a third, and by no means unimportant group, the crystalline schists and gneisses—the metamorphic rocks, as they were commonly called—was considered very doubtful. Many geologists also believed that not a few igneous rocks had been once sediments, like those in the first group, which had been subsequently fused or "digested" by the combined action of heat, water, and pressure. Thus it was supposed that clays and felspathic sandstones could be traced through various stages till they became granite, and rocks of the most diverse chemical composition could be transmuted one into the other. The province of metamorphism was the fairy-land of science; it needed but a touch of the magic wand, and, like Bottom the weaver, a rock was at once "translated." It would be easy, were it worth while, to enumerate instance after instance of these alleged transmutations, every one of which has been proved to be groundless. No doubt, even at the time named, these assertions were questioned by some geologists, but that they could be made so confidently, that they could be inculcated by the official representatives of geology in this country, shows the hopeless confusion into which petrology had fallen.

By means of the microscope also much light has been thrown upon the history even of the better known rocks. The classification of the igneous group has been simplified, and the relations of its several members have been determined. The microscope has dispelled many an illusion, and reduced a chaos to order. In regard to the sedimentary group, it often has determined the true nature of their constituents, and has suggested the sources from which they have been derived or the agents by which they have been transported. Thus, through its tube, we have been enabled, not only to gaze at the most intimate structure and composition of rock-masses, but also to catch glimpses of the earth's physiography in ages long before the coming of mankind.

But in speaking of the services rendered by the microscope, I must not forget a needful caution. If the instrument be employed for petrological rather than petrographical purposes, it must never be divorced from work in the field. No training in the laboratory, however complete, no research in a library, however laborious, can of themselves make a petrologist. No question can be completely mastered, unless it be also studied in the field; nay, even the specimens for examination under the microscope, as a rule, should be collected by the student himself, and the characters and relationships of the rock-masses from which they are detached should be carefully noted. It was said, on no mean authority, some fifty years since, that, in the education of a geologist, travel was the first, the second, and the third requisite. Perhaps the statement, like most epigrams, was somewhat one-sided, but the truth in it has not been diminished by the increased perfection of our instrumental methods. In petrology, the chimæras of the home-keeping student of the laboratory have been, and still are, as hurtful to progress, as the dreams of the peripatetic geologist, whose chief appliances are a stout pair of legs and a hammer.

This, then, was the problem which, some thirty years since, presented itself to geologists who were interested in petrology. Here are two groups of rocks, the sedimentary and the igneous. The origin of these we may be said to know, but as to that third group, which, though not as large, is far from unimportant—what is its history? what are its relations to the other two? The records of its rocks at present are illegible. Is there any hope that success will reward the attempt to decipher them? Time and perseverance have given an answer, and though much is still uncertain, though much remains to be done, some real progress, in my opinion, has been made. As the stones sculptured of old by the hand of man are yielding up their secrets, as the hieroglyphs of Egypt and the cuneiform characters of Assyria are telling the tale of the conquerors whose bones are dust, as the tongues of the children of Heth, and of the black-headed race of Accad, are being learnt anew, so the records of the rocks, wherein no trace of life is found, are being slowly, painfully, but ever more surely deciphered, and knowledge grows from year to year.

To obtain success the problem must be attacked in the following way. As the first step, the two great groups already mentioned, the origin of which is known, must be thoroughly studied. The examples selected must be nearly or quite unaffected by any agent of change, such as heat, water, and pressure. Among the specimens representative of the sediments, the materials must range from fine to coarse—for the grains in the latter serve also as samples of the rocks from which they have been broken, and suggest their own inferences. Among the igneous rocks, types ranging from the most glassy to the most crystalline forms must be examined, in order to ascertain not only the constituent minerals, but also their associations and mutual relations. Suppose this done—suppose a fairly good idea obtained of the characteristic structures and possible variations in either class—we have then to ascertain how far and in what way each representative can be modified by natural agencies. At the outset, probably, it will be found convenient to trace the processes of mineral and even of structural change without any immediate reference to the efficient cause. It soon appears that in the case of minerals, which differ in physical properties, but not in chemical composition, the one species replaces the other; the less stable gradually altering into the more stable form. Thus calcite takes the place of aragonite, hornblende of augite; one mineral may be broken up into a group, as a colloid into crystalloids, or felspar into quartz and white mica; new species may be produced by addition or subtraction of constituents from without, or by exchange from within; the replacement of silicates by carbonates, the conversion of granite into tourmaline-rock, the formation of epidote, chlorites, and serpentine, are a few among the many instances of this kind of change. By tracing the process from one part of a rock to another, numerous facts are collected and relationships ascertained. But during these investigations questions are raised in a student's mind which begin to clamour for an answer. Why does such and such a rock change, now in this way, now in that? So it becomes necessary to correlate our observations, to frame hypotheses, and open out new lines of inquiry.

So far as we know, water, pressure, heat, are the main agents in producing change in rocks, after the latter have been once deposited or solidified. In most cases it is not easy to insulate perfectly the effect of each agent, for probably every rock, which has undergone important changes, has been to some extent affected by all of them. Still many examples can be found, in which the influence of one has predominated greatly over that of the other two. For instance, it is now agreed that the structure of a slate is the result of pressure, though this probably produced a slight rise of temperature, and the rock is not likely to have been perfectly dry. Again, when a clay has been converted into an assemblage of crystalline silicates in the vicinity of an intrusive mass of granite, this is mainly the effect of heat, though the pressure cannot have been inconsiderable, and the presence of water is almost certainly essential.

Thus, in one series of examples, properly selected to illustrate the slaty rocks, we can watch the development of new minerals. We can observe which of these are readily produced and quickly attain to a considerable size, which are more slowly formed, or seem incapable, even if common, of much enlargement. We are thus led by inductive processes to conclusions as to the effects of pressure in the development of minerals in a mass of materials of a particular composition. In another series of rocks which has been affected by the heat of intrusive masses, we can watch the gradual growth of new constituents, as we proceed inward towards the originally heated mass, till we have passed from clay or slate to a crystalline aggregate of minerals, such as quartz, micas, andalusite, staurolite, and garnet. Similar effects may be noted in other kinds of sedimentary rock. Changes also are produced mainly by the action of water, but on this I need not enlarge.

Again, as another line of inquiry, the effects produced on igneous rocks by the same agents must be studied. Here the results which are more or less directly due to the action of water are often highly interesting, but as these are only indirectly connected with the main subject of this lecture, I content myself with a passing reference. With igneous rocks the effects of heat seem generally less important than with sedimentary; probably because the mineral constituents of the former are usually in a more stable condition than those of the latter, so that these also need only be mentioned; but the effects of pressure in some cases, especially with the more coarsely crystalline igneous rocks, are highly interesting and significant.

In a region such as the Scotch Highlands or the European Alps the rocks, in the process of mountain-making, have been obviously subjected, perhaps at more than one epoch, to tremendous pressures. The effect of these appears to have been sometimes a direct, sometimes a shearing fracture; that is to say, a mineral or rock, in the one case, has been crushed, as in a press, in the other, during the process of powdering it has been dragged or trailed out, with a movement somewhat similar to that of a viscous substance. As an example, let us take the effects produced in a granite by crushing. The grains of quartz are broken up; the crystals of felspar are first cracked and then reduced to powder; the mica flakes are bent, riven, and tattered. By pressure also the solvent power of water, already present in the rock, is increased; by the crushing its access to every fragment and its subsequent percolation are facilitated. Thus the black mica is often altered in various ways; the felspar dust is changed into white mica and chalcedonic quartz; the constituents are reduced in size and tend to assume a roughly parallel order; the mineral character and structure have been alike changed; a massive rock has been replaced by a foliated one; a coarse granite by a fine-grained quartzose or micaceous schist. This change can be demonstrated at every stage; it suggests that many foliated rocks—many gneisses and crystalline schists—may be igneous rocks of which both the mineral character and the structure have been modified by pressure.

We may presently see how far this inference can be justifiably extended, but, as a first step, the effect of pressure on one of the more basic igneous rocks must be considered. Let us take as an example a coarse-grained variety of the rock, which is familiar to us as basalt. It consists of a felspar, different from that of granite, of augite, of some iron-oxide, and perhaps of olivine. In studying this rock we are confronted by greater difficulties, for, of the two dominant minerals, the felspar is rather less stable than that which occurs in granite, and the augite passes readily into hornblende. Thus, when the latter change occurs we are at first unable to determine whether it is due to pressure or to some other agent. Some petrologists, I believe, would not hesitate to appeal to the presence of hornblende in a rock such as we are considering as a proof that it had been modified by pressure. With this opinion I cannot agree. On examination of the numerous instances in which we are convinced that the hornblende is not an original constituent but has replaced augite, we notice that the former mineral is not constant in its characters. It may be granular in form; it may assume its usual crystalline shape; it may be more or less bladed or needle-like. Have these differences, we ask, any significance? In order to answer the question, specimens of hornblendic rocks must be sought in regions which obviously have been subjected to tremendous pressure, as is testified by the fact that every other rock has been more or less crushed or rolled out; others must be obtained from regions where the associated masses exhibit no signs of extraordinary disturbance, even though they may be more brittle than the subject of our study. In the former case the change may be reasonably attributed to pressure, in the latter it must be due to some other cause. Are hornblendic rocks from the one region similar in structure to those from the other? By no means. Where no evidence can be offered in favour of pressure, there the hornblende either retains wholly or almost wholly the outline of the mineral which it has replaced, or else assumes its normal prismatic form; but where an appeal to pressure seems justifiable, we find that the hornblende appears as unusually elongated prisms, blades, or even needles, and the structures of the rock as a whole can be readily recognized by a practised eye. The evidence for the latter statement is yet unpublished, but it will, I hope, appear before long.

So our investigations have led us thus far: that, in sedimentary rocks, in the presence of water, certain changes are mainly produced by heat, and certain by pressure. In the latter case, however, the new minerals, though very numerous individually, are generally minute; the longest diameter being seldom so much as one-hundredth of an inch. Even where this rule is broken, it is only by minerals which are proved by other experiments to be so readily developed that their presence on a large scale has no real significance. The rule holds also to some extent in the case of crystalline schists produced by the crushing of crystalline rocks, markedly in the case of those derived from granites and rocks of similar composition, but less conspicuously in those which were originally augitic or hornblendic. Though even here, where the decreased size of the minerals is less uniformly marked, new and distinctive structures are assumed.

I have spoken only of two or three common types of rocks, but it would be easy, did time permit, to support the principles enumerated, by quoting from a great variety of examples. There are, I believe, few, if any, important kinds of rock which have not been examined, and it appears to me demonstrated that, while pressure is a most important agent of change,[1] while many schists may be regarded as resulting from it, a considerable group remains, which are separated from the others by a very wide chasm, and this can only be jumped by deserting reason and trusting hypothesis.

In this last group of rocks (supposing no disturbances produced by subsequent pressure, for which, however, we can generally make allowance) the constituent minerals are commonly fairly large—say from about one-fiftieth of an inch upwards in diameter. Very many of these rocks, when studied in the field, exhibit every indication of a sedimentary origin. Though as a rule no original constituent grain can be certainly determined, though they are now crystalline, yet their general structure and association are inexplicable on any other supposition. They bear some resemblance to the sediments which have been altered by contact metamorphism, though they present different characters. These, moreover, remain invariable through considerable thicknesses of rock and over wide areas. The alteration is regional, not local, so that such rocks cannot be regarded as cases of simple contact metamorphism, even though heat may be suspected of having been an important agent in producing the change. But to another large series, including many of the rocks commonly called gneisses, the sedimentary origin is less easily attributed. Not a few of these in mineral com-

[1] It is probable that some changes of importance are produced in rocks by long-continued and repeated pressures, which are insufficient to give rise to crushing; but these I have passed by, because, as it seems to me, further evidence is needed before we can diagnose, with any certainty, the results of this particular disturbing cause.

position correspond with granites, and sedimentary rock thus constituted, though not unknown, is rare. The minerals commonly exhibit a parallel or foliated and not seldom even a banded arrangement; in the latter case the layers of different mineral composition in their mutual relations and associations imitate with remarkable success the structure of a banded sedimentary rock. Even a dozen years since little doubt was entertained that this group also had a detrital origin. Occasionally, however, its members, when studied in the field, exhibited characteristics which were difficult to explain on any such hypothesis, and presented resemblances in habit to certain crystalline igneous rocks, from which, however, they were proved to differ in their microscopic structures.

In rocks which have crystallized from a state of fusion some of the mineral constituents usually exhibit their proper crystalline outlines; but in these others the same minerals had no definite shape, and were simply granular. Of this structure two types were observable: in the one the grains were elongated, in the other they were roundish in outline but slightly wavy or lobed. The former type was commonly found in the more distinctly banded varieties; the latter in the more massive and faintly foliated kinds which in hand-specimens were not readily distinguished from true granite.

As in rocks, no less than in living beings, diversities of structures are nature's record of a difference in history, it became a question whether these peculiarities were significant of origin or of environment. By prolonged observations the following results were established:—(1) That crystalline rocks, which could be proved, by their relation to others, to be truly igneous, sometimes exhibited banded structures. (2) That these structures, in certain cases, could not be attributed to any subsequent pressures or crushings, for no sign of them could be found in neighbouring rocks, which, from their composition and nature, ought to have yielded more readily. (3) That a faint foliation or banding, especially in the case of granitic rocks, could be sometimes detected in irruptive veins, in which cases the aforesaid granular structure was detected on microscopic examination. (4) That cases were occasionally found where a light-coloured granite had broken into a dark hornblendic rock, and the fragments of the latter had been gradually softened, elongated, and even drawn out into bands, together with the intruder, till they perfectly simulated, as already mentioned, a stratified mass. (5) That in certain of these cases, where a rock, exceptionally rich in hornblende, had been partially fused by a pale-coloured granite, a banded black-mica gneiss had been produced, indistinguishable, macroscopically and microscopically, from those which have been already mentioned.

It follows from these observations that the great group of crystalline rocks, which are connoted comprehensively as schists and gneisses, includes rocks which may have originated in one of three different ways:—(1) Some have once been molten, but have become solid under rather exceptional circumstances, probably having lost heat slowly, and having continued to move very gradually during the process of consolidation. (2) Others have been produced by the thorough alteration of sedimentary materials, in which a high temperature has been maintained for a long time, in the presence of water and under considerable pressure. (3) Others, again, have been the result of great pressure, which has acted on rocks already crystalline, and has produced mineral changes, sometimes to the complete obliteration of the original structure. The second and third of these groups are truly metamorphic rocks, to the first the term, strictly speaking, is not applicable.

As a rule, it is not difficult to distinguish between these three groups, and in all probability the ambiguities which still remain will be solved by patient and persevering work. Cases, no doubt, will occur on which no inference can be founded; cases where, from one cause or another, nature's record has become illegible. But to this disappointment the scholar and the archæologist has to submit equally with the geologist. Negative evidence of this kind has no disturbing power; any amount of it is outweighed by a single scrap of clear and positive testimony. It is generally a waste of time to puzzle over bad specimens; they are much more likely to produce a perplexed agnosticism than a rational faith; for a creed has its place in science no less than in theology.

I have mentioned one mode in which materials rather markedly different in mineral character may be, in a certain sense, interstratified and to some extent blended, but should add that recent researches render it highly probable that there are other modes in which mineral or chemical constituents may be differentiated in a magma which was once homogeneous. To discuss these would carry us into questions of crystallogenesis, which have no direct bearing on my present subject, though in these also the microscope has rendered the most valuable services by suggesting inferences and by testing theoretical conclusions; questions upon which so much light has been thrown by the researches of Guthrie, Lagorio, Sorby, and others; but I may refer in passing to the law established by Soret, that by a change of temperature a homogeneous solution may be rendered heterogeneous; since any compounds by which it is nearly saturated tend to accumulate in the colder parts. Gravitation also, when certain minerals are crystallizine from a magma, may cause them to rise or to sink, and in this way also heterogeneity may be produced. So when the mass of mingled fluids and solids is constrained to move, a streaked or banded structure may be the result produced; as in a process familiar to the glass-blower.

But when the geologist has learnt from the microscope to recognize differences of structure in crystalline rocks, and to appreciate their significance, he finds that a wider problem is presented to his mind, provided he has not been led by the fascinations of laboratory studies to despise or neglect work in the field. Granted that one group of rocks, covered by the term metamorphic, has undergone great changes since its members were first deposited or solidified, can these be connected with any phase in the earth's history? Have they any chronological significance? Even twenty years since few geologists would have hesitated to reply:—"None whatever: a rock may have undergone metamorphism at any epoch in the past. Muds and sands of Eocene, Jurassic, Carboniferous, Silurian, of any geological age, have been converted into crystalline schists. Proofs of some part of this assertion can be found even within the limits of the British Isles; it can be completely established within those of Europe." But during the last few years this hypothesis has been on its trial; witness after witness in its favour has been, so to say, brought into court, and has broken down under cross-examination. I can assert this without hesitation, for I have some personal knowledge of every notable instance in Europe which has been quoted in the debate. Microscopic study, combined with field work, has invariably discovered that some very important link in the supposed chain of proof is wanting, and has demonstrated without exception that these crystalline schists are very old; much more ancient always than any neighbouring rock to which a date can be assigned, if not older than the first rocks in which any trace of life has been found. It has been also demonstrated that sedimentary masses, after they have been buried deep beneath superimposed strata and exposed to great pressure, have emerged comparatively unchanged. Such rocks are most valuable as illustrations of the effects of dynamical and other agencies; but they are sufficiently distinct from the crystalline schists to indicate that the environment in the one case must have differed greatly from that in the other. The results of contact metamorphism prove that heat is an important agent of change; but as these also present their own marked differences, they fail to afford a complete solution of the problem.

Moreover, among ordinary sedimentary rocks, we cannot fail to notice that, as a rule, the older the rock the greater the amount of mineral change in its constituents. A good illustration of this is afforded by the Huronian system of North America, the rocks of which are rather older than the Cambrian of this country. Some of them, while still retaining distinct indications of a sedimentary origin, have become partially crystalline, and supply examples of a transition from a normal sediment to a true crystalline schist. Even the older Palæozoic rocks almost invariably exhibit considerable mineral changes, though with them it is only on a microscopic scale. Hence, taking account of all these results, we seem to be forced to the conclusion that the environment necessary for changing an ordinary sediment into a crystalline schist existed generally only in the earliest ages, and but very rarely and locally, if ever, since Palæozoic time began.

Further, in regard to those peculiar structures which, as already stated once led geologists to consider certain rocks, really of igneous origin, as metamorphosed sediments; they also appear to have been much more frequently produced in the earliest ages. They are common in association with the ordinary crystalline schists; they are found, so far as I know, rarely, if ever, with little altered sediments. The microscopic study of the coarser stratified rocks—grits, sandstones, &c.—lends some support to this view, by showing that, as we go back in time, a larger proportion of their materials, *cæteris paribus*, has been derived from crystalline rocks, and that even the fragments, obviously of sedimentary origin, exhibit signs of some mineral change; that is to say, the mudstones and sandstones in the later grits are apt to be represented in the earlier by phyllites and quartzites.

So the results of microscopic study, in alliance with, not divorced from, work in the field, lead us to the conclusion that in the early ages of this globe's history conditions generally prevailed which became gradually, perhaps even rapidly, rare and local; or, in other words, that in geology the uniformitarian doctrine must not be stated in terms wholly unlimited, though, since this was first enunciated by Lyell, nothing has been discovered to shake our faith in its general truth, or to resuscitate the catastrophic hypothesis which it replaced. But geologists are forbidden by students of physics to regard the universe as a "self-winding clock." The latter affirm, and the former frankly admit, that this globe through long ages has been losing heat by radiation; that there was a time when the temperature of its surface far exceeded that of molten iron: a temperature which now would be reached only at a depth of many miles. If this be so, the conditions under which rocks were formed on the surface of the globe in early days must have been very different from those which subsequently prevailed. Suppose, for example, this surface to have been just white-hot—namely, at a temperature much below that at which most, if not all lavas, consolidate. In that case the ocean would be vapour, and the weight of the atmosphere would be augmented by that of a shell of water of the area of the globe, and two miles in thickness; or, in other words, the atmospheric pressure would be about 350 times its present amount. If so, even a lava-flow would consolidate under a pressure equivalent to that of some 4000 feet of average rock. But after the surface temperature had become low enough to permit the seas to be gathered together, and the atmospheric pressure had become normal; after rain and rivers, winds and waves, had commenced their work; after sediments, other than the "dust and ashes" of volcanoes, had begun to accumulate; still these at a short distance below the surface would find a very different environment from that which now exists. It has been proved by Lord Kelvin that at the end of about one twenty-fifth portion of the whole time which has elapsed since the first solidification of the earth's crust, the underground temperature must have risen at nearly six times its present rate. To reach a zone, the general temperature of which is 212° F., it would now be necessary to descend, as a general rule, at least 8200 feet, and probably rather more. But in those early days the crust would have been at this temperature at a depth of about 1600 feet, and at 10,000 feet it would have risen to 1050° F., instead of 250° F., which now would be exceptionally high. To this depth many rocks, both in Palæozoic and later ages, have been buried, and they have emerged practically unchanged. Hence it follows that the latter temperature is comparatively ineffective; the former, however, could not fail to facilitate mineral changes and the development of coarsely crystalline structures.

These changes, these structures, have been produced in sedimentary rocks in the immediate neighbourhood of a large mass of intrusive igneous rock, such as a coarse granite. To what temperature the former have been raised cannot be ascertained. Suppose, however, it were 1500° F., which probably is not a very erroneous estimate, this temperature, at the epoch mentioned, would be found at a depth of 15,000 feet. It is now, probably, at least 15 miles beneath the surface. In other words, the zone at which marked mineral changes could be readily produced, quickly sank, and has long since reached a depth practically unattainable. The subterranean laboratory still exists, but the way to it was virtually closed at a comparatively early period in the earth's history.

Another effect of this rapid downward increase of temperature must not be forgotten. When it amounted to 1° F. for every 10 feet of descent, a temperature of 2000° F. would have been reached at a depth of not quite four miles. This would be rather above the melting-point of many rocks, if they were at the surface; so that, even under the pressure, they would be either very near it or imperfectly solid. If the thickness of the crust were only about four miles, flexures would be readily produced, and the effects of tidal stresses would be considerable; but even if the earth had become solid as a whole, there would have been large masses of rock, comparatively near to the surface, in an unstable condition, and thus liable locally to slow deformations, displacements, fluxional movements, and intrusion into other masses already at a high temperature, with the result of partial melting down and mutual reactions. Disturbances such as these, slow, but constantly recurring, would produce structures imitative of stratification. It is a remarkable coincidence, to say the least, that these structures are characteristic of Archæan rocks, and are extremely rare, if ever present, in those of later date.

But some geologists are so rigidly uniformitarian as to shrink from admitting that any portion of the earth's original crust can possibly be preserved. "Take time enough," they say, "and the changes can be made." But will time alone suffice for every kind of change? How long will it be before gunpowder explodes at blood-heat? But passing over this obvious difficulty, we may ask: Is there time enough? So geologists once thought, as fancy travelled back over endless æons. But they are checked by the physicist: "earth and sun alike," he affirms, "are masses subject to the laws of radiation; these countless millions of years of which you dream will bring you to a period when not only the earth, but also the whole solar system, was nebulous. All the history of your planet, physical as well as vital, so far as it can be covered by your records, must be compressed into a very moderate number of millions of years, for we have to consider the possibilities not only of a cooling earth, but also of a cooling sun." If this be so, and it seems difficult to dispute the decision; if we are forbidden to look back along "the corridors of time" till they vanish in the perspective of infinite distances, it becomes more and more probable that the whole volume of the earth's history is within our reach, and that its opening chapters will some day be deciphered.

The progress which has been made since the microscope was pressed into the service of geology augurs well for the future, if we work in a spirit of scepticism and a spirit of hope. Of scepticism, lest we trust too much either in ourselves or in even the princes of science; for experience proves that the seductive charms of phantom hypothesis may lead all alike astray from the narrow path of truth into the morasses of error. Of hope, for experience also proves that by patient labour and cautious induction many an illusion has been dispelled and many a discovery been made. Our eyes must soon grow dim, our hands become nerveless, but other workers will be found to take warning from our mistakes and to profit by our toil. The veil which shrouds the face of Nature may be never wholly withdrawn, but its fringe has been already raised; even in our own generation so much has been accomplished that the hope may be indulged of at last learning something of the history of these earliest ages, when the earth had but lately ceased to glow, and when the mystery of life began.

THE LADIES' CONVERSAZIONE OF THE ROYAL SOCIETY.

THE Ladies' *Conversazione* of the Royal Society took place on the evening of June 15 last, and in every way was a distinct success, the attendance being the greatest on record, and all the available space both for the guests and exhibits being fully occupied. The exhibits, although they included a few that were shown at the last *soirée*, were for the most part new, and the following is a brief summary of the most noticeable of them:—

Dr. H. Hicks, F.R.S., showed the remains of a mammoth found in Endsleigh Street, in March last, at a depth of only 22 feet. The bones were of enormous proportions, and in their proximity was discovered a tusk which was estimated to have been 12 feet in length.

A series of enlarged transparent sections of the fossil plants of the Coal-measures were exhibited by Prof. W. C. Williamson, F.R.S.

Most interesting were the water-colour drawings of Greek temples, &c., by Mr. F. C. Penrose, which illustrated his current investigations on the astronomical orientation of ancient Greek emples. The drawings included those of the Propylæa, the Temple of the Wingless Victory, Parthenon, west and east fronts of the Parthenon, north portico of the Erechtheum, east portico of the Theseum, and the Temple of Jupiter Olympius.

Mr. W. M. Flinders Petrie showed some excellent water-colour drawings of the pavement which he has recently discovered in the Palace of Chuenaten at Tell el-Amarna (1400 B.C.) during his recent excavations. This pavement is quite unique in Egypt, and is especially valuable owing to the marvellous treatment of the plants depicted.

The water-colour sketches exhibited by Prof. F. W. Oliver (for the Scientific Committee of the Royal Horticultural Society) illustrated some typical examples of the damage done to plants by London fog. The injuries shown, he said, were exceedingly prevalent amongst cultivated hot-house plants in the London district during this kind of weather, and extended to a considerable distance from the metropolis, cases occurring as far as Cooper's Hill and Dorking. The sulphurous acid of the fog seemed, in many cases, to have acted directly on the living substance of the foliage and leaves, producing these lesions, while in others there seemed to have been evidence of an accumulative action of the deposits of sulphuric acid.

Mr. W. Crookes, F.R.S., who at the last *soirée* repeated some of Tesla's wonderful experiments, exhibited a novelty in the form of burning nitrogen. He employed an electric current of 65 volts and 15 amperes, alternating 130 times a second, passing it through the primary of a large induction coil. From each of the secondary poles, flames became visible, and met at the centre, being composed mainly of burning nitrogen; when the terminals were separated, so that the flames could not strike across but were in consequence extinguished, it was found that by putting them nearer together a lighted taper was sufficient to re-ignite them. The temperature of the flame exceeds slightly that of a good blowpipe, and a spectroscopic examination of the flame itself shows simply a faint and continuous spectrum. Mr. Crookes pointed out that such a method of exciting an induction coil was first employed by Mr. Spottiswoode in 1880, but "it is not known, however, that any chemical explanation of the flame has before now been published."

Mr. A. A. C. Swinton showed some very interesting photographs of electrical discharges that had been obtained by simply causing the discharges to take place across the surfaces of prepared sensitive dry plates, and consequently without the intervention of any lens. The distinctive character of the figures by the two kinds of discharges were very noticeable, so also was the evidence of their oscillatory nature.

Other electrical exhibits were:—

An ingenious device for disconnecting the supplier of electricity if a dangerous voltage happened to be established in a house, and a leakage indicator for high tension currents, both exhibited by Messrs. Drake and Gorham.

Electrical discharges over prepared surfaces, by Mr. J. Wimshurst, showing that over imperfectly conducting surfaces of large area branch-like forms of flashes are produced, and with a great difference of potential sparks of seven feet in length can be attained.

High-tension electrical apparatus, by Mr. L. Pyke, for working a considerable number of vacuum tubes from one generating source, the tubes in this case being each connected with terminally connected inductors, themselves counterpoised against two external conductors connected to the terminals of the transformer.

The Director of the Royal Gardens, Kew, exhibited a specimen of a double cocoa-nut (*Lodoicea seychellarum*), with illustrations showing its germination. This palm is tall and fan-leaved, and peculiar to two of the Seychelles Islands; its fruit weighing from 25 to 30 pounds. At the germination of the seed, "the embryo is gradually pushed out of the seed by the growth of the seed-leaf (cotyledon). One end of this remains attached to the seed, and conveys to the embryo the nutriment derived from the gradual absorption of the endosperm." Three of the drawings and a model had an additional interest in that they were made by the late Major-General Gordon.

Mr. Romanes's exhibits of living rats and rabbits attracted much attention, and would perhaps have attracted slightly more if any of the former animals had by chance got astray. They were illustrative of some of the results of experimental breeding with reference to theories of heredity. The examples clearly showed that the male and female elements did not *always* so blend together that the offspring presented characters more or less intermediate between those of the parents, but that the progeny sometimes took wholly after the father or wholly after the mother.

Another animal exhibit consisted in a living specimen of a remarkable non-venomous South African snake (*Dasypeltis scabra*), from the Zoological Society of London. This animal lives solely on birds' eggs. Each egg is swallowed whole, and by a muscular contraction of the gullet, its contents flow into the stomach, while the shell is rejected by the mouth in the form of a pellet.

Among the other exhibits we may mention the systematic and simple construction of the dark absorption bands A, B, and *a* in the solar spectrum, after Mr. Higgs's photographs, by Prof. A. S. Herschel, F.R.S.; the photographs of stellar spectra, including Nova Aurigæ, Arcturus, &c., by Mr. Norman Lockyer, F.R.S.; the photographs of leguminous plants for the determination of the fixation of free nitrogen, by Sir J. B. Lawes, Bart, F.R.S., and Dr. J. H. Gilbert, F.R.S.; and an ingenious instrument for measuring the thermal expansion of very minute solid bodies up to high temperatures, and tracing the volume charge of the silicates up to and over the interval of plasticity, by Mr. J. Joly, F.R.S.

The exhibit in the Archives Room, by the Postmaster-General, was during the whole evening thoroughly appreciated, the Telephone Company's installation being the means by which the guests were able to listen to the music of Salammbo from the grand opera at Paris. Previous to the switching on of the opera, conversation was carried on with some of the officials at the Paris end, and the accuracy with which the peculiarities of the various voices were transmitted was little short of marvellous.

The lantern demonstrations also attracted considerable attention. Mr. Saville Kent and Mr. C. V. Boys, F.R.S., as at the previous *soirée*, both showed their photographic slides, those of the former dealing with coral reefs, &c., and those of the latter with flying bullets. Mr. Norman Lockyer exhibited some photographs taken both at home and foreign Observatories, illustrative of the application of photography in astro-physical researches. The slides included some beautiful photographs of stellar spectra and solar prominences, from the Paris Observatory; of the moon and Jupiter, taken with the large Lick instrument; of the nebulosity surrounding η Argûs, photographed by Dr. Gill, F.R.S.; of the great February sun-spot, taken in India and forwarded to the Solar Physics Committee; and of the spectra of Nova Aurigæ and Arcturus, taken at Kensington. The most striking slide of all was that of the great nebula of Orion, taken by Dr. Common, F.R.S., with his five-foot reflector at Ealing. The apparent brilliancy of the stars, and the wonderful tracery in the nebulous parts, appealed to the eye not so much as an image of a slide on a screen, but as a direct view of this beautiful object through the great telescope itself. The slides shown by Mr. E. B. Poulton, F.R.S., were illustrative of the methods by which the originally opaque wings of certain butterflies and moths had become transparent and usually scaleless; numerous stages in the generation of scales were also shown.

THE FOURTH CENTENARY OF COLUMBUS.

DURING the present year great celebrations will take place in Spain, Italy, and America, in memory of Columbus and his first adventurous voyage of 1492. Although no public commemoration is arranged for in this country, the Royal Geographical Society, fully conscious of the momentous nature of that first voyage, and of the enormous expansion of geographical science which has resulted from it, set apart last Monday evening for a special Columbus meeting. The usual exhibition of maps and pictures included a number of early charts of great beauty, and a fine photograph of a contemporary portrait of Columbus, recently made known by Mr. Markham. The paper of the evening, read by Mr. Clements Markham, C.B., F.R.S., was occupied with an account of recent discoveries with regard to Columbus, and the correction of many erroneous ideas widely entertained until now. As a critical summary of perhaps one of the most difficult branches of research—that into the actual life of a popular hero enhaloed with centuries of tradition—this paper is of great value. An abstract of it, and of the appendices on other fifteenth century explorers, is given below.

Much new light has been thrown upon the birth and early life of Columbus of late years by the careful examination of monastic and notarial records at Genoa and Savona.

There is no doubt as to the birthplace of Columbus. His father was a wool-weaver of Genoa, whose house was in the Vico Dritto di Ponticelli, which leads from the gate of San

Andrea to the church of S. Stefano. It was battered down during the bombardment of Genoa in the time of Louis XIV., was rebuilt with two additional stories, and is now the property of the city of Genoa.

Here Columbus was born, the date of his birth being fixed by three statements of his own, and by a justifiable inference from the notarial records. He said that he went to sea at the age of fourteen, and that when he came to Spain in 1485 he had led a sailor's life for twenty-three years. He was, therefore, born in 1447. The authorities who assign 1436 as the year of his birth rely exclusively on the guess of a Spanish priest, Dr. Bernaldez, Cura of Palacios, who made the great discoverer's acquaintance towards the end of his career.

The notarial records, combined with incidental statements of Columbus himself, also tell us that he was brought up, with his brothers and sister, in the Vico Dritto at Genoa; that he worked at his father's trade and became a "lanerio," or wool-weaver; that he moved with his father and mother to Savona in 1472; and that the last document connecting Cristofero Colombo with Italy is dated on August 7, 1473. But in spite of his regular business as a weaver, he first went to sea in 1461, at the age of fourteen, and he continued to make frequent voyages in the Mediterranean and the Archipelago—certainly as far as Chios.

When Columbus submitted his proposition for an Atlantic voyage to the Spanish sovereigns, they referred it to a committee, presided over by Father Talavera, which sat at Cordova, and condemned it as impracticable. It is generally supposed that the proposals of the Genoese were subsequently submitted to an assembly of learned persons at the University of Salamanca, and again condemned. The truth was quite different. Columbus was gifted with a charming manner, simple eloquence, and great powers of clear exposition. It was an intellectual treat to hear him recount his experiences, and the arguments for his scheme. Among those who first took an interest in his conversation, and then became a sincere and zealous friend, was the Prior of the great Dominican Convent of San Estevan, and Professor of Theology at Salamanca, who shrewdly foresaw that the most effectual way of befriending Columbus would be by affording ample opportunities of discussing the questions he raised. For this object there could be no better place than the University of Salamanca, where numerous learned persons were assembled, and where the Court was to pass the winter. The good Prior lodged his guest in a country farm belonging to the Dominicans, called Valcuebo, a few miles outside Salamanca. Hither the Dominican monks came to converse on the great deductions he had drawn from the study of scientific books, and from his vast experience, discussing the reconciliation of his views with orthodox theology. Later, in the winter, Columbus came into the city and held conferences with men of learning, at which numerous courtiers were present. These assembages for discussion—sometimes in the quiet shades of Valcuebo, sometimes in the great hall of the convent—excited much interest among the students and at Court. The result was, that the illustrious Genoese secured many powerful friends at Court, who turned the scale in his favour when the crucial time arrived. Such is the slight basis on which the story of the official decision of the Salamanca University against Columbus rests.

Captain Duro, of the Spanish Navy, has investigated all questions relating to the ships of the Columbian period and their equipment with great care; and the learning he has brought to bear on the subject has produced very interesting results. The two small caravels provided for the voyage of Columbus by the town of Palos were only partially decked. The *Pinta* was strongly built, and was originally lateen-rigged on all three masts, and she was the fastest sailer in the expedition; but she was only 50 tons burden, with a complement of eighteen men. The *Niña*, so-called after the Niño family of Palos, who owned her, was still smaller, being only 40 tons. The third vessel was much larger, and did not belong to Palos. She was called a "nao," or ship, and was of about 100 tons burden, completely decked, with a high poop and forecastle. Her length has been variously estimated. Two of her masts had square sails, the mizen being lateen-rigged. The crew of the ship *Santa Maria* numbered fifty-two men all told, including the admiral.

Friday, August 3, 1492, when the three little vessels sailed over the bar of Saltes, was a memorable day in the world's history. It had been prepared for by many years of study and labour, by long years of disappointment and anxiety, rewarded at length by success. The proof was to be made at last. To the incidents of that famous voyage nothing can be added. But we may at least settle the long-disputed question of the landfall of Columbus. It is certainly an important one, but it is by no means a case for the learning and erudition of Navarretes, Humboldts, and Varnhagens. It is a sailor's question. If the materials from the journal were placed in the hands of any midshipman in Her Majesty's Navy, he would put his finger on the true landfall within half an hour. When sailors such as Admiral Becher, of the Hydrographic Office, and Lieutenant Murdoch, of the United States Navy, took the matter in hand, they did so. Our lamented associate, Mr. R. H. Major, read a paper on this interesting subject on May 8, 1871, in which he proved conclusively by two lines of argument that Watling Island was the Guanahani or San Salvador of Columbus.

The spot where Columbus first landed in the New World is the eastern end of the south side of Watling Island. This has been established by the arguments of Major, and by the calculations of Murdoch, beyond all controversy. The evidence is overwhelming. Watling Island answers to every requirement and every test, whether based on the admiral's description of the island itself, on the courses and distances thence to Cuba, or on the evidence of early maps. We have thus reached a final and satisfactory conclusion, and we can look back on that momentous event in the world's history with the certainty that we know the exact spot on which it occurred—on which Columbus touched the land when he sprang from his boat with the standard waving over his head.

The discoveries of Columbus, during his first voyage, as recorded in his journal, included part of the north coast of Cuba, and the whole of the north coast of Española. The journal shows the care with which the navigation was conducted, how observations for latitude were taken, how the coasts were laid down—every promontory and bay receiving a name—and with what diligence each new feature of the land and its inhabitants was examined and recorded. The genius of Columbus would not have been of the same service to mankind if it had not been combined with great capacity for taking trouble, and with habits of order and accuracy.

Columbus regularly observed for latitude with Martin Behaim's astrolabe or the earlier quadrant, when the weather rendered it possible, and he occasionally attempted to find the longitude by observing eclipses of the moon with the aid of tables calculated by old Regiomontanus, whose declination tables also enabled the admiral to work out his meridian altitudes. But the explorer's main reliance was on the skill and care with which he calculated his dead reckoning, watching every sign offered by sea and sky by day and night, allowing for currents, for leeway, for every cause that could affect the movement of his ship, noting with infinite pains the bearings and the variation of his compass, and constantly recording all phenomena on his card and in his journal. Columbus was the true father of what we call proper pilotage.

On his return his spirit of investigation led him to try the possibility of making a passage in the teeth of the trade wind. It was a long voyage, and his people were reduced to the last extremity, even threatening to eat the Indians who were on board. One night, to the surprise of all the company, the admiral gave the order to shorten sail. Next morning, at dawn, Cape St. Vincent was in sight. This is a most remarkable proof of the care with which his reckoning must have been kept, and of his consummate skill as a navigator.

In criticizing the Cantino map showing Cortoreal's coastlines, Mr. Markham showed that absurd mistakes had been made, not by the voyager or his pilots, but by the cartographer, and subsequent commentators. Vespucci's description of his "first voyage" in 1797, was subjected to very thorough criticism, and shown, in spite of the arguments of authors who have tried to support the veracity of that ingenious romancer, to have been a pure fabrication. Little or no credit could be given to Vespucci in any case, as he was forty-eight years old on first going to sea, and in those days apprenticeship from boyhood was indispensable for a knowledge of seamanship.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The Science Examiners have issued the following Class Lists:—

Chemistry.—First Class: C. L. Fort (New), R. E. Hughes

(Jesus), G. Ingham (Merton), A. L. Ormerod (New). Second Class: D. Berridge (Wadham), P. Henderson (Queen's), A. E. Richardson (Wadham), F. R. L. Wilson (Keble). Third Class: C. J. M. Parkinson (Jesus), H. Wynne-Finch (New). Fourth Class: S. Wellby (Trinity).

Physiology.—First Class: P. S. Hichens (Magdalen), H. H. G. Knapp (non-Coll.), A. C. Latham (Balliol), E. Mallam (Magdalen), W. Ramsden (Keble). Second Class: G. J. Conford (Christ Church), E. Stainer (Magdalen). Third Class: S. B. Billups (non-Coll.). Fourth Class: J. S. Clouston (Magdalen).

Physics.—First Class: S. A. F. White (Wadham). Second Class: G. M. Grace (Jesus). Third Class: none. Fourth Class: F. W. Bown (University), J. C. W. Herschel (Christ Church).

Morphology.—First Class: R. W. T. Günther (Magdalen).

Botany.—Second Class: O. V. Darbishire (Balliol).

Women:—Louisa Woodcock is placed in the Second Class, Morphology.

University Extension.—In a Convocation held on Tuesday the following persons were declared on a scrutiny to be duly elected as delegates, under the provisions of the statute Of the delegates for the extension of teaching beyond the limits of the University:—H. J. Mackinder, M.A., Student of Christ Church; W. W. Fisher, M.A., Corpus Christi College, Aldrichian Demonstrator of Chemistry; J. F. Bright, D.D., Master of University College; A. Sidgwick, M.A., Fellow of Corpus Christi College; J. Wells, M.A., Fellow of Wadham College; and the Rev. W. Lock, M.A., Fellow of Magdalen College.

The Encænia.—In a Convocation holden in the Sheldonian Theatre on Wednesday, June 22, the degree of D.C.L. (*honoris causâ*) was conferred upon the following persons:—

His Excellency, William Henry Waddington, Ambassador Extraordinary and Minister Plenipotentiary from the French Republic at the Court of St. James, Honorary Fellow of Trinity College, Cambridge, Hon. LL.D.

His Highness the Thakore of Gondal.

The Very Rev. Henry George Liddell, D.D., late Dean of Christ Church.

Edward Caird, M.A., Professor of Moral Philosophy in the University of Glasgow, formerly Fellow of Merton.

W. M. Flinders Petrie.

The Rev. John Gwynn, D.D., Regius Professor of Divinity in the University of Dublin.

Daniel John Cunningham, M.D., Professor of Anatomy and Chirurgery in the University of Dublin.

Edward Dowden, LL.D., Erasmus Smith's Professor of Oratory in the University of Dublin.

The Rev. John P. Mahaffy, D.D., Professor of Ancient History in the University of Dublin.

Benjamin Williamson, M.A., Sc.D., Fellow of Trinity College, Dublin.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 2.—"On Current Curves." By Major R. L. Hippisley, R.E. Communicated by Major MacMahon, F.R.S.

(1) Starting with the equations

$$i = \frac{E}{R}(1 - e^{-\frac{Rt}{L}})$$

and

$$i = \frac{E}{\sqrt{(R^2+p^2L^2)}}\sin(pt - \theta),$$

which represent the curves of currents in circuits *without* iron cores, according as the impressed E.M.F. is constant or varying as $\sin pt$, we can determine the curves according to which the current rises and falls in circuits *with* iron cores, both for a constant impressed E.M.F. and for a sinusoidal E.M.F.

(2) In the first case, with constant applied E.M.F., we can determine by Lagrange's formula of interpolation the equation to the (B, H) curve of the particular core under consideration. This will be of the form

$$B = a_0 + a_1H + a_2H^2 + \ldots + a_nH^n,$$

where n is one less than the number of observed simultaneous values of B and H from which the equation is calculated. Substituting in the equation

$$E - \frac{dB}{dt} = Ri,$$

we get, after integration,

$$t = b_0 \log\frac{E}{E - Ri} - b_1i - b_2i^2 - \&c., \text{ to } n + 1 \text{ terms},$$

b_0, b_1, b_2, &c., being numerical. The paper gives b_0, b_1, b_2, &c., in terms of the constants of the circuit, &c.

The corresponding equation when the E.M.F. is removed and the current is dying away is

$$t = c_0 \log\frac{E}{Ri} - c_1i - c_2i^2 - \&c. + \text{a constant}.$$

From these two equations the curves can be plotted.

(3) This method is not applicable to the case in which the impressed E.M.F. is sinusoidal, on account of difficulties of integration. But both cases can be treated in another way:—Take a series of points on the (B, H) curve of the iron core, such that the chords joining them practically coincide with the curve itself. Let B_κ, H_κ, and $B_{\kappa+1}$, $H_{\kappa+1}$, be the co-ordinates of two consecutive points. The equation to the curve between these points is approximately

$$B = m_{\kappa+1}H + \text{constant},$$

where

$$m_{\kappa+1} = \frac{B_{\kappa+1} - B_\kappa}{H_{\kappa+1} - H_\kappa}.$$

Substituting in the equation

$$E - \frac{dB}{dt} = Ri,$$

we get, after integration,

$$t_{\kappa+1} = t_\kappa + \frac{m_{\kappa+1}L}{R}\log\frac{E - Ri_\kappa}{E - Ri_{\kappa+1}},$$

which is true to a very close approximation for any simultaneous values of t and i between the above limits. From this equation, by determining the various values of m, and remembering that t_0 and i_0 are both zero, we can determine in succession the times at which the current has the known values o, $\frac{H_1}{L}$, $\frac{H_2}{L}$, . . . &c., and the current curve can be plotted.

On making $E = 0$ in the original differential equation, and observing the proper limits, we get

$$t_{n+1} = t_n + \frac{m_{n+1}L}{R}\log\frac{H_n}{H_{n+1}}$$

as the equation to the curve representing the dying away of the current when the E.M.F. is withdrawn; m_n, m_{n+1} being determined from the descending (B, H) curve.

(4) When the impressed E.M.F. is sinusoidal, we substitute for dB/dt in the equation

$$E\sin pt - \frac{dB}{dt} = Ri,$$

having determined the various values of dB/dt, as in the foregoing.

As by the present method the value of m changes *abruptly* from m_κ to $m_{\kappa+1}$, we must employ the *general* solution of the above, which for the interval t_κ, $t_{\kappa+1}$, is

$$i = \frac{E}{\sqrt{(R^2 + m_{\kappa+1}^2p^2L^2}}\sin(pt - \theta_{\kappa+1}) + A_{\kappa+1}e^{-Rt/m_{\kappa+1}L},$$

in order that the current at the commencement of the interval t_κ, $t_{\kappa+1}$, may have the same value which it had at the end of the interval $t_{\kappa-1}t_\kappa$. The complementary function

$$A_{\kappa+1}e^{-Rt/m_{\kappa+1}L},$$

enables us to insure this condition; for, by taking the constant $A_{\kappa+1}$ of such a value that the above equation is satisfied when $i = i_\kappa$ and $t = t_\kappa$, there is no abrupt change in the current. The complementary function, in fact, represents the gradual dying away of whatever excess or defect of current there would be in the circuit when m changes.

This equation is true for all values of i between i_κ and $i_{\kappa+1}$; and, therefore, enables us to find the time, $t_{\kappa+1}$, at which the current attains the known value $H_{\kappa+1}/L$.

By changing κ into $\kappa + 1$, we obtain similarly the time $t_{\kappa+2}$ at which the current has the value $H_{\kappa+2}/L$, and so on.

Thus the determination of $t_{\kappa+1}$ is made to depend upon t_κ, and in order to make a start we must assume that the value of i is known for some definite value of t. It is not of much consequence what assumption, within reason, is made, as, though the calculated curves will vary with the assumption made, they will all eventually merge into the true periodic current curve at some point which will be exhibited when the *first* evanescence of $Ae^{-Rt/mL}$ takes place.

As this complementary function is a continually decreasing quantity, it becomes negligible when it is allowed time enough. This opportunity is afforded when the straighter portions of the (B, H) curve are reached.

In the paper are given diagrams showing the plotted curves of current calculated from the above equations, together with tables of calculated values.

"The Conditions of the Formation and Decomposition of Nitrous Acid." By V. H. Veley.

The main points of this inquiry may briefly be summarized as follows:—

(1) The formation of the impurity of nitrogen peroxide in nitric acid, imparting to it the well-known yellow tint, takes place in the case of the more concentrated acid, even at a temperature of 30°, and of the less concentrated acids at from 100°–150°, even when the acid is not unduly exposed to sunlight.

(2) The reaction between nitric oxide and nitric acid may be regarded as reversible, thus:—

$$2NO + HNO_3 + H_2O \rightleftarrows 3HNO_2,$$

provided that the acid be sufficiently dilute, and the temperature sufficiently low. Under these conditions equilibrium is established between the masses of nitric acids when the ratio of the former to the latter is, roughly speaking, as 9 : 1. The actual ratio varies slightly on the one side or the other, according to the conditions of the experiments. With more concentrated acids and at higher temperatures the chemical changes taking place are more complicated, and the decomposition of the acid more profound.

(3) The decomposition of solutions containing both nitric and nitrous acids is also investigated; the rate of the change is shown to be proportional to the mass of the nitrous acid undergoing change. The curve representing the amount of chemical decomposition in terms of the mass present is shown to be hyperbolic, and illustrative of the law

$$\text{(I.)}\ \frac{dC}{dT} = -\frac{C^2}{M}.$$

This holds good, whatever be the method employed for the production of the nitrous-nitric acid solution.

The observed values for C or the concentration of the nitrous acid are concordant with those calculated according to the above differential equation within the limits of experimental error.

The rate is dependent upon the ratio of the masses of the nitrous and nitric acid, being the more rapid, the greater the proportion of the former to that of the latter.

In the particular case of the liquid prepared from nitric oxide and nitric acid, wherein the reproduction of solutions of similar concentration presents less difficulty, it is shown that as the temperature increases in arithmetical the rate of change increases in geometrical proportion, in accordance with the equation

$$\text{(II.)}\ v_t = v_{t_1} k^{(t-t_1)},$$

the value for k being 0·0158.

Finally, though the nitrous-nitric acid solutions behave in a similar manner as regards the diminution of the mass of the nitrous acid, yet, in other respects, such as evolution of gases and the action upon metals, they are dissimilar.

"On the Method of Examination of Photographic Objectives at the Kew Observatory." By Major L. Darwin. Communicated by Captain Abney, R.E., F.R.S.

The paper describes the method of examination of photographic objectives which has been adopted at the Kew Observatory, chiefly on the recommendation of the author. In selecting and devising the different tests, Major Darwin acted in co-operation with Mr. Whipple, the Superintendent of the Observatory, and was aided by consultations with Captain Abney.

The object of the examination is to enable any one, on the payment of a small fee, to obtain an authoritative statement or certificate as to the quality of an objective for ordinary purposes.

An example is first given of a "Certificate of Examination," such as would be obtained from Kew, and then the different tests are discussed in detail. The following are the different items in the Certificate of Examination, or the various tests to which the objective is subjected:—

(1) to (4) None of this information forms part of the result of the testing.

(5) *Number of External Reflecting Surfaces.*

(6) *Centering in Mount.*

(7) *Visible Defects, such as Veins, Feathers, &c.*

(8) *Flare Spot.*

(9) *Effective Aperture of Stops*, which is given for each one supplied with the objective. In recording the results, it is proposed that the system of numbering recommended by the International Photographic Congress of Paris of 1889 should be adopted.

(10) *Angle of Cone of Illumination, &c.*

(11) *Principal Focal Length.*—This is found by revolving the camera through a known angle, and measuring the movement of the image of a distant object on the ground glass; with the Testing Camera it is so arranged that an angular movement can be given with great ease and accuracy, and that the angle is such that half the focal length is directly read off on a scale on the ground glass. The observation is made when the image is at a point some 14 degrees from the axis of the objective, and the effect of distortion and curvature of the field is discussed; it is proved that the focal length thus obtained, even though it may not be identical with the principal focal length as measured on the axis, is nevertheless what the photographer in reality wants to ascertain.

(12) *Curvature of the Field.*

(13) *Distortion.*—This test depends in principle on ascertaining the sagitta or deflection in the image of a straight line along one side of the plate. In the discussion it is shown that to give the total distortion near the edge of the plate would not answer practical requirements, and that the proposed method of examination does give the most useful information that can be supplied.

(14) *Definition.*—This is found by ascertaining what is the thinnest black line the image of which is just visible when seen against a bright background. It is shown that this is the best method that could be devised of measuring the defining power of an objective, and that it is not open to serious objections on theoretical grounds.

(15) *Achromatism.*—In the Certificate is recorded under this heading the difference of focus between an object when seen in white light and the same when seen in blue or red light.

(16) *Astigmatism.*—This test is performed by measuring the distance between the focal lines at a position equivalent to the corner of the plate, and by calculating from the result thus obtained the approximate diameter of the disk of diffusion due to astigmatism.

(17) *Illumination of the Field.*—The method of examination, which is due to Captain Abney, is described.

"On Certain Ternary Alloys. Part VI. Alloys containing Aluminium, together with Lead (or Bismuth) and Tin (or Silver)." By C. R. Alder Wright, D.Sc., F.R.S., Lecturer on Chemistry and Physics in St. Mary's Hospital Medical School.

The experiments described in this paper are a continuation of the previous researches on the miscibility of molten metals under such conditions that whereas two of the metals, A and B, will not mix together in all proportions, the third, C, is miscible in all proportions with either A or B severally. The alloys now investigated are those where A is lead (or bismuth); B, aluminium; and C, tin (or silver). They show considerable analogy with, and resemblance to, those previously described containing the same metals as A and C respectively, but zinc instead of aluminium as B; but certain differences are noticeable: thus the substitution of aluminium for zinc invariably *raises the critical curve*, causing it to lie *outside* its former position, this being observed whether the heavy immiscible metal, A, be lead or bismuth, and whether the solvent metal, C, be tin or silver. On the other hand, the substitution of bismuth for lead always *depresses the critical curve*, causing it to lie *inside* its former position; this being equally observed whether the lighter immiscible metal, B, be zinc or aluminium, and whether the solvent metal, C, be tin or silver. In the case of the metals bismuth-zinc-silver and lead-zinc-silver, peculiar bulges (inwards and outwards) were noticed in certain parts of the critical curve, due to the formation of definite atomic compounds, $AgZn_5$ and Ag_4Zn_5; no corresponding indications are observed when aluminium replaces zinc in these mixtures, whence apparently similar atomic combinations of silver and aluminium are not formed. On the other hand, lead-zinc-tin and lead-aluminium-tin alloys correspond sharply with each other in that they are the only alloys yet examined where the direction of slope of the tie lines is not the same throughout; in each case the lower ties slope to the left (lead side), and the upper ones to the right (zinc side); the point where the angle of slope of the lower ties is a maximum corresponds in each case with a ratio between lead and tin in the heavier alloys formed approximating pretty closely to that indicated by the formula Pb_3Sn, suggesting that the sloping of the lower ties is due to the formation of this definite atomic compound. The upper ties in each case exhibit a tendency to converge towards a point on the right-hand side of the curve, approximately where the ratios of zinc to tin and aluminium to tin respectively are those indicated by the formulæ Zn_4Sn, and Al_4Sn; suggesting the existence of these definite compounds.

In the course of the experiments, it is shown incidentally that bismuth and aluminium are practically immiscible when molten: at about 900° C. bismuth dissolves less than 0·1 per cent. of aluminium, whilst aluminium dissolves about 2·0 per cent. of bismuth. The binary alloys of bismuth and aluminium stated by previous observers to exist are simply more or less intimate intermixtures of the two metallic solutions.

"On the Theory of Electrodynamics as affected by the nature of the Mechanical Stresses in Excited Dielectrics." By J. Larmor.

The various theories of electrodynamics are examined from the standpoint of their ability to explain the experimental facts as to pressures in liquid dielectrics which have been made out by Quincke and other experimenters.

The principal conclusions are as follow:—

(1) It follows from the experimental results that the stress in an excited fluid dielectric between two condenser plates consists, at any rate to a first approximation, of a tension along the lines of force and an equal pressure in all directions at right angles to them, superposed upon such stress as would exist in a vacuum with the same value of the electric force.

(2) It follows from experiments that the numerical value of these additional equal tensions and pressures is, at any rate to a first approximation, $(K - 1)F^2/8\pi$, where F is the electric force, and K the inductive capacity.

(3) Such a distribution of equal tension and pressure is necessarily the result of a uniform volume distribution of energy in the dielectric, irrespective of what theory is adopted as to its mode of excitation.

(4) If we consider the mode of excitation to be a *quasi*-magnetic polarization of its molecules, the numerical magnitude of these stresses should be

$$\frac{K - 1}{8\pi}F^2\left(1 + \lambda\frac{K - 1}{4\pi}\right),$$

where λ is a coefficient which depends on the molecular discreteness of the medium, and is probably not very different from the value $\frac{4}{3}\pi$. A discrete polarization of the molecules does not account for the stress, so far as this coefficient is concerned.

(5) The stress which would exist in a vacuum dielectric is certainly due in part to a volume distribution of energy, as is shown by the propagation of electric waves across a vacuum. There is thus no reason left for assuming any part of it to be due to a distribution of energy at its two surfaces, acting directly on each other at a distance. There is therefore ground for assuming a purely volume distribution of energy in a vacuous space, leading to a tension $(1/8\pi)F^2$ along the lines of force, and a pressure $(1/8\pi)F^2$ at right angles to them.

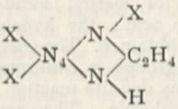
(6) The *quasi*-magnetic polarization theory rests on the notion of a dielectric excited by a surface charge on the plates, and therefore involves a surface-distribution of energy, unless in the extreme case when the absolute value of K is very great; in that case a slight surface-charge produces a great polarization effect, and in the limit the polarization may be taken as self-excited. Thus the absence of a surface-distribution of energy leads to Maxwell's displacement-theory, in which all electric currents are circuital, and the equations of electrodynamics are therefore ascertained.

(7) It appears that even this limiting polarization theory must be replaced, on account of the stress-formula in (4), by some dynamical theory of displacement of a more continuous character.

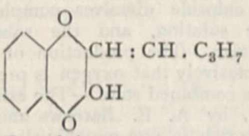
"The Hippocampus." By Dr. Alex. Hill.

Observations upon the brains of various aquatic mammals which show that, when the sense of smell is completely absent, as judged by the total suppression of the olfactory bulb and nerves, the essential constituent of the "hippocampus," the fascia dentata, is absent also. Amongst other mammals the fascia dentata varies in development as the olfactory bulb.

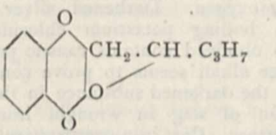
Chemical Society, June 2.—Dr. W. H. Perkin, F.R.S. Vice-President, in the chair.—The following papers were read:—Ethylene derivatives of diazoamido-compounds, by R. Meldola and F. W. Streatfeild. The authors find that ethylene diazoamides result from the action of ethylene dibromide and caustic alkali on diazoamides dissolved in alcohol. The products thus obtained have the general formula—



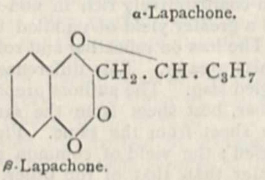
mixed ethylene-diazoamides can also be obtained. These compounds are very stable, and are decomposed by prolonged contact with concentrated hydrochloric acid at ordinary temperatures.—The action of light on silver chloride, by H. B. Baker. The small loss in weight which silver chloride undergoes on exposure to light has led the author to investigate whether oxygen is absorbed at the same time that chlorine is evolved, Robert Hunt having long ago stated that such an absorption does occur. Silver chloride was placed in a bulb connected with a long tube standing over caustic potash solution; the atmosphere consisted of air or oxygen. On exposing this apparatus to light, the liquid rose in the tube, showing that oxygen had been absorbed. The proportion in which the elements silver, chlorine, and oxygen were contained in the darkened substance was then determined. The results agree approximately with the formula Ag_2ClO. The experimental difficulties in the way of an exact determination of the composition of the darkened product are very great, owing to the fact that the dark substance is mixed with an enormous quantity of unchanged silver chloride. The product of exposure to light never contains more than 0·1 gram of the dark-coloured substance per 50 grams of unaltered silver chloride. Another cause of inaccuracy complicates the result if the analyses be not made immediately after exposure; the darkened substance turns white again if left in the dark, probably owing to the formation of another oxychloride. The thoroughly dried darkened substance yields water on reduction in pure hydrogen, and also evolves oxygen on treatment with pure chlorine. The results of determinations of the constituents of the darkened product made by various analytical methods agree as well as could be expected. Silver chloride does not darken when exposed to light in absence of oxygen. No darkening was observed in a vacuum, in carbon dioxide, or in carefully purified carbon tetrachloride. It is, however, difficult to eliminate traces of alcohol, carbon disulphide, &c., from carbon tetrachloride, and the darkening caused by these impurities has hitherto been confounded with that caused by oxygen. Darkened silver chloride dissolves completely in boiling potassium chloride solution, and the solution so obtained contains caustic potash. The production of this free alkali seems to prove conclusively that oxygen is present in the darkened substance in the combined state.—The estimation of slag in wrought iron, by A. E. Barrows and T. Turner. Cast iron comparatively rich in non-metallic elements is known to afford a greater yield of puddled bar than do purer samples of iron. The loss on reheating and rolling into finished iron is, however, also greater. This difference has been attributed to intermingled slag. The authors prepared four samples of iron, viz. best bar, best sheet from the same bar, common bar, and common sheet from the same. Pig iron of known composition was used; the yield of common puddled bar was 6·5 per cent. greater than that of the other, but the loss on reheating was also 1·5 per cent. greater, leaving a balance of 5 per cent. in favour of the common iron. The results of analyses show that the silicon is equally, and very slightly, reduced in each case, whilst the phosphorus was much reduced in common iron, and but scarcely affected in best. This does not favour the view that much more slag is removed in one case than in the other. The authors conclude that for practical purposes the weight of slag in best and common iron may be taken as identical, and that on reheating and rolling each loses about the same weight of slag. The additional loss noticed on reheating impure iron is due chiefly to the elimination of phosphorus, probably in the form of ferrous phosphate. On attempting to estimate the slag by combustion in chlorine, a method already employed for cast iron, it was found that the slag was readily attacked by the gas at a very low red heat. An examination of the behaviour of a number of iron ores and slags showed that action occurs according to the equation $3FeO = Fe_2O_3 + Fe$; the free iron subliming as ferric chloride.—Corydaline, ii., by J. J. Dobbie and A. Lauder. Analyses of salts of corydaline are given in support of the formula $C_{22}H_{29}NO_4$, originally proposed by the authors for this alkaloid. The alkaloid employed by them is identical with that extracted by Adermann from the roots of *Corydalis cava*. Corydaline yields four molecular proportions of methyl iodide on treatment with concentrated hydriodic acid; the hydriodide of a new base $C_{18}H_{21}NO_4,HI$ is also obtained. The conclusion that corydaline contains four methoxy-groups is confirmed by the inability of the authors to obtain any definite reaction with phenylhydrazine or phosphorus pentachloride.—The action of bromine on allylthiocarbimide, by A. E. Dixon. Allylthiocarbimide readily combines with bromine, yielding dibromopropylthiocarbimide as an oily liquid which decomposes on distillation under ordinary pressures. This compound does not afford dibromopropylphenylthiourea when treated with aniline, but the two substances react with elimination of hydrogen bromide and formation of a compound of the formula $C_{10}H_{11}BrN_2S$, probably *n*-phenylbromotrimethylene-ψ-thiourea.—The hydrolytic functions of yeast, Part i., by J. O'Sullivan. It is generally stated, on the authority of Berthelot, that the water in which yeast has been washed possesses, like yeast itself, the power of hydrolyzing cane sugar, and that the active substance can be precipitated from the solution by means of alcohol. The author shows, however, that healthy yeast yields none of its invertase to water in which it is washed. When such yeast is placed in contact with sugar, hydrolysis is effected solely under the immediate influence of the plasma of the cell, no invertase leaving the cell while hydrolysis is taking place. A detailed account is given of experiments carried out under various conditions, which show that water which had been in contact with highly active yeast for various times had no hydrolytic power, although on the addition of a mere trace of invertase, it at once became active. The author therefore concludes that the resolution of cane sugar under the influence of yeast is entirely due to zymic hydrolysis.—The constitution of lapachic acid (lapachol) and its derivatives, by S. C. Hooker. Lapachic "acid" is found in a crystalline state in the grain of a number of South American woods, and derives its name from the lapach tree, which is plentiful in the Argentine Republic. On treatment with sulphuric acid, lapachol is converted into an isomeride generally known as lapachone. The author proposes to term this latter substance β-lapachone, it being a derivative of β-naphthaquinone. When lapachol is treated with concentrated hydrochloric acid, α-lapachone, a derivative of α-naphthaquinone is obtained. The author assigns the following constitutional formulæ to these three isomerides—



Lapachol.



α-Lapachone.



β-Lapachone.

It is shown that Paterno's isolapachone in reality contains less hydrogen than the lapachones, and is doubtless a β-naphthaquinone-propyl-furfuran.

Linnean Society, June 2.—Prof. Stewart, President, in the chair.—The Vice-Presidents for the year having been nominated by the President, a vote of thanks to the officers of the Society was proposed by Mr. Thomas Christy, seconded by Mr. C. J. Breese, and carried.—Mr. H. Bernard exhibited specimens and made remarks on the probably poisonous nature of the hairs and claws of an Arachnid (*Galeodes*).—On behalf of Capt. Douglas Phillott there was exhibited a curious case of malformation in the beak of an Indian parrakeet, *Palæornis torquatus*. The upper mandible was so abnormally decurved as almost to penetrate between the rami of the lower mandible, and although the bird was in good condition at the time it was shot by Capt. Phillott at Dera Ismail Khan, Punjab, in March last, it was evident that had it not been killed then, death must have soon ensued from a severance of the trachea by the sharp extremity of the prolonged mandible.—Mr. D. Morris exhibited, and made some very instructive remarks on, plants yielding Sisal hemp in the Bahamas and Yucatan, and pointed out their distribution and mode of growth. He also exhibited and described the preparation of a gut silk from Formosa and Kiungchow.—Mr. Scott Elliott gave a brief account of a journey he had recently made to the west coast of Africa, and described the character of the vegetation of the particular region explored, and the plants collected by him.—Mr. Jenner Weir exhibited and made remarks on a species of Psyche.—On behalf of Mr. Ernest Floyer, a paper was read by the Secretary on the disappearance of certain desert plants in Egypt through the agency of the camel.—Mr. F. Perry Coste gave an abstract of a paper on the chemistry of the colours in insects, chiefly Lepidoptera. The paper was criticized by Prof. Meldola, who was unable to accept the views expressed, the results of the experiments made being, in his opinion, inconclusive.—The meeting was brought to a close by the exhibition of an excellent oxyhydrogen lantern, recently presented to the Society by Dr. R. C. A. Prior, when Dr. R. B. Sharpe exhibited a number of coloured slides of birds designed to illustrate the interesting subject of mimicry and protective coloration.

Geological Society, June 8.—W. H. Hudleston, F.R.S., President, in the chair.—The following communications were read:—The Tertiary microzoic formations of Trinidad, West Indies, by R. J. Lechmere Guppy. (Communicated by Dr. H. Woodward, F.R.S.) After giving an account of the general geology of the island, and noticing previous memoirs devoted to that geology, the author describes in detail the characters of the Naparima Beds, to which he assigns an Eocene and Miocene age. He considers that the Nariva Marls are not inferior to but above the Naparima Eocene Marls, and are actually of Miocene date. Details are given of the composition and characters of the "argiline," the foraminiferal marls occasionally containing gypsum, and the diatomaceous and radiolarian deposits of Naparima. The Pointapier section is then described, and its Cretaceous beds considered, reasons being given for inferring that there was no break between the Cretaceous and Eocene rocks of the Parian area. Detailed lists of the foraminiferal faunas of the marls are given, with notes. The author observes that the Eocene molluscan fauna of Trinidad shows no near alliances with other known faunas, thus differing from the well-known Miocene fauna of Haiti, Jamaica, Cuba, Trinidad, and other localities. Only one mollusk is common to the Eocene and Miocene of the West Indies. The shallow-water Foraminifera are found in both Eocene and Miocene, whilst the deep-water Foraminifera are nearly all of existing species. It would appear that during the Cretaceous and Eocene periods a sea of variable depth (up to 1000 fathoms) occupied the region now containing the microzoic rocks of Trinidad, whilst a mountain-range (which may be termed the Parian range) extended continuously from the north of Trinidad to the littoral Cordillera of Venezuela, forming the southern boundary of the Caribbean continent, and possessing no large streams to transport mechanical sediment into the Cretaceo-Eocene sea which opened eastward into the Atlantic. An appendix by Mr. J. W. Gregory deals with the microscopic structure of the rocks. The reading of this paper was followed by a discussion, in which the President, Dr. H. Woodward, Mr. J. W. Gregory, Mr. Vaughan Jennings, and Dr. Hinde took part.—The Bagshot Beds of Bagshot Heath (a rejoinder), by the Rev. A. Irving. — Notes on the geology of the Nile Valley, by E. A. Johnson Pasha and H. Droop Richmond. (Communicated by Norman Tate.) The rocks on either side of the Nile are chiefly Eocene (and Cretaceous?) from Cairo to Esneh; south of this is sandstone, which the authors believe to be Carboniferous, and to yield possible indications of coal, reaching to near Assouan, where it meets the granite and basalt of that region; a few miles south the sandstone begins again and continues to Wady Halfa, broken only by granite dykes. The granite is intrusive into and alters the sandstone, whilst the latter reposes upon the basalt and in some cases was deposited against upstanding basaltic masses. Unmistakable lavas occur near the Nile east of Minieh and west of Assiout. A description of some remarkable faults is given, and various minerals are noticed as occurring in the sedimentary rocks and the bed of an ancient river.

Mathematical Society, June 9.—Prof. Greenhill, F.R.S., President, in the chair.—Prof. Henrici exhibited a model of movable hyperboloids of one sheet. In 1873 he gave a student at University College the problem to construct a model of a hyperboloid of one sheet by fixing three sticks anyhow, placing others so as to cut these, and tying them together wherever they met. He told the student that the system would soon become rigid, but was surprised to find that this was not the case. It was easy to see the reason of this fact, and thus he established the theorem: If the two sets of generators of a hyperboloid be connected by articulated joints wherever they meet, then the system remains movable, the hyperboloid changing its shape. It was also soon found that each point moves during this deformation along the normal to the momentary position of the surface, and that therefore the different positions of the surface constitute a system of confocal hyperboloids. He then made a model such that the generators represented by sticks meet at points which lie on lines of curvature of the hyperboloids. These describe, therefore, confocal ellipsoids and hyperboloids of two sheets. In January 1874, Prof. Henrici exhibited this model at a meeting of the Society. Shortly afterwards a student made two copies of this model, and these were fastened together in such a manner that both could move together, remaining always confocal. It was this last model that was now shown. The properties of the movable hyperboloid became more widely known through a question which Prof. Greenhill set in 1878 at the Mathematical Tripos Examination, and this led Prof. Cayley to give a solution of it in the *Messenger of Mathematics*. Since that time several French mathematicians have made further investigation of the property in question. MM. Darboux and Mannheim, in particular, have made beautiful application of the deformable hyperboloid to the motion of a gyrating rigid body.—The following further communications were made:—The second discriminant of the ternary quantic, $x'u + y'v + z'w$, by Mr. J. E. Campbell. If the ordinary discriminant of this quantic in x, y, z, be formed, the result will be a quantic in x', y', z'. The discriminant of this latter the writer believes vanishes identically with certain exceptions. Prof. Henrici referred the author to a paper by himself in vol. ii. of the Society's Proceedings.—On the reflection and refraction of light from a magnetized transparent medium, by A. B. Basset, F.R.S. The object of this paper is to apply the theory of gyrostatically loaded media, to investigate the reflection and refraction of light at the surface of a magnetized transparent medium. This subject has been partially discussed by Mr. Larmor in a paper communicated to the Society last December, in which he has obtained the equations of motion of the medium; but the paper in question contains (Mr. Basset thinks) a certain amount of vague and obscure argument, founded upon general reasoning, which is calculated to envelop the subject in a cloud of mystery, rather than to enlighten the understanding. He, therefore, finds it necessary to write out the theory *de novo*, and to enter into a careful discussion respecting the boundary conditions. The principal results are as follows: When the magnetic force is parallel to the reflector, and also to the plane of incidence, the expressions for the amplitudes of the reflected light are the same as those which he obtained by means of an extension of the electromagnetic theory (see *Phil. Trans.*, 1891, p. 371); but when the magnetic force is perpendicular to the reflector, the above-mentioned expressions are of the same form as those furnished by the electromagnetic theory, with the exception that the signs of the magnetic terms are reversed. An experimental test of the relative merits of the two theories might probably be obtained by means of certain experiments performed by Prof. Kundt (*Berlin. Sitzungsberichte*, July 10, 1884; translated *Phil. Mag.*, October 1884), but the mathematical work, although presenting no difficulty, would be somewhat laborious. Having worked out these results, he endeavours to obtain a theoretical explanation of Kerr's experiments, on reflection from a magnet, by combining the theory of gyrostatically loaded media with the theory of metallic reflection, explained in his book on "Physical Optics," chapter xviii. sections 386-87; but the results are not entirely satisfactory. This, however, is not surprising, inasmuch as the theory of gyrostatically loaded media takes no account of the statical effects of magnetization.—Note on approximate evolution, by Prof. Lloyd Tanner. This note supplies a deficiency in a paper (Math. Soc. Proc., vol. xviii.) in which Prof. Hill pointed out the incorrectness of the rule for contracting the processes of finding the square and cube roots of a number—namely, it gives a practical test for determining the cases when the rule can, and when it cannot, be safely applied.—A proof of the exactness of Cayley's number of seminvariants of a given type, by Mr. E. B. Elliott, F.R.S.—Further note on automorphic functions, by Prof. W. Burnside.

Royal Meteorological Society, June 15.—Dr. C. Theodore Williams, President, in the chair.—The following papers were read:—English climatology, 1881-1890, by Mr. F. C. Bayard. This is a discussion of the results of the climatological observations made at the Society's stations, and printed in the *Meteorological Record* for the ten years 1881-1890. The instruments at these stations have all been verified, and are exposed under similar conditions, the thermometers being mounted in a Stevenson screen, with their bulbs 4 feet above the ground. The stations are regularly inspected, and the instruments tested by the Assistant Secretary. The stations now number about eighty, but there were only fifty-two which had complete results for the ten years in question. The author has discussed the results from these stations, and given the monthly and yearly means of temperature, humidity, cloud, and rainfall. His general conclusions are:—(1) With respect to mean temperature, the sea coast stations are warm in winter and cool in summer, whilst the inland stations are cold in winter and hot in summer. (2) At all stations the maximum temperature occurs in July or August, and the minimum in December or January. (3) Relative humidity is lowest at the sea coast stations, and highest at the inland ones. (4) The south-western district seems the most cloudy in winter, spring, and autumn, and the southern district the least cloudy in the summer months, and the sea coast stations are, as a rule, less cloudy than the inland ones. (5) Rainfall is smallest in April, and, as a rule, greatest in November, and it increases from east to west.—The mean temperature of the air on each day of the year at the Royal Observatory, Greenwich, on the average of the fifty years 1841 to 1890, by Mr. W. Ellis. The values given in this paper are derived from eye observations from 1841 to 1848, and from the photographic records from 1849 to 1890. The mean annual temperature is 49°·5. The lowest winter temperature, 37°·2, occurs on January 12, and the highest summer temperature, 63°·8, on July 15. The average temperature of the year is reached in spring, on May 2, and in autumn on October 18. The interval during which the temperature is above the average is 169 days, the interval during which it is below the average being 196 days.

SYDNEY.

Royal Society of New South Wales, May 4.—Annual Meeting.—H. C. Russell, F.R.S., President, in the chair.—The report stated that 61 new members had been elected during the year, and the total number on the roll on April 30 was 478. During the year the Society held eight meetings, at which the following papers were read:—Presidential address, by Dr. A. Leibius.—Notes on the large death-rate among Australian sheep in country infected with Cumberland disease or splenic fever, and Notes on a spontaneous disease among Australian rabbits, by Adrien Loir.—Compressed-air flying machines, Nos. 13 and 14, and on a wave-propelled vessel, by L. Hargrave.—A cyclonic storm or tornado in the Gwydir district; Preparations now being made in Sydney Observatory for the photographic chart of the heavens; Notes on some celestial photographs recently taken at Sydney Observatory; and Notes on the rate of growth of some Australian trees, by H. C. Russell, F.R.S.—Some folk-songs and myths from Samoa, translated by the Rev. G. Pratt, with introductions and notes, by Dr. John Fraser.—Notes on the use, construction, and cost of service reservoirs, by C. W. Darley.—On the constitution of the sugar series, by W. M. Hamlet.—On kaolinite from the Hawkesbury Sandstone, by H. G. Smith.—A contribution to the microscopic structure of some Australian rocks, by the Rev. J. Milne Curran.—On some New South Wales and other minerals (note No. 6), by Prof. Liversidge, F.R.S.—Artesian water in New South Wales (preliminary notes), by Prof. T. W. E. David.——The Medical Section held four meetings. The following papers were read :—A brief account of the histology and development of tubercle, by Prof. Anderson Stuart.—Remarks upon the nature and treatment of diphtheria, by Dr. W. Camac Wilkinson.—Glimpses of the past : a series of sketches with pen and pencil of the medical history of Sydney, by Dr. Honison. ——The Microscopical Section held five meetings. The following paper was read :—Notes on slicing rocks for microscopical study, by the Rev. J. Milne Curran.——The Civil and Mechanical Engineering Section held eight meetings. The following papers were read :—Recent researches on the strength, elasticity, and endurance of materials of construction with especial reference to iron and steel, by Prof. Warren.—The bridge over Lane Cove River at the head of navigation, by H. H. Dare.—On the calculation of stresses by means of graphic analysis, by J. I. Haycroft. —On the tacheometer and its application to engineering surveys, by W. Poole, Jun.—On the sewerage of country towns : the separate system, by Dr. Ashburton Thompson.——The Clarke Medal for 1892 had been awarded to Prof. W. T. Thiselton Dyer, F.R.S. The Council had issued the following list of subjects with the offer of the Society's bronze medal, and a prize of £25 for each of the best researches if of sufficient merit :— (To be sent in not later than May 1, 1893) Upon the weapons, utensils, and manufactures of the aborigines of Australia and Tasmania ; on the effect of the Australian climate upon the physical development of the Australian-born population ; on the injuries occasioned by insect pests upon introduced trees. (To be sent in not later than May 1, 1894) On the timbers of New South Wales, with special reference to their fitness for use in construction, manufactures, and other similar purposes ; on the raised sea-beaches and kitchen middens on the coast of New South Wales ; on the aboriginal rock-carvings and paintings in New South Wales.—The Chairman read the Presidential address, and the Officers and Council were elected for the ensuing year, Prof. Warren being President.

PARIS.

Academy of Sciences, June 13.—M. d'Abbadie in the chair.—A new contribution to the history of the truffle, *Tirmania Cambonii*, "Terfâs" of Southern Algeria, by M. A. Chatin.—On subcutaneous or intra-venous injections of liquid extracts from several organs as a therapeutic method, by MM. Brown-Séquard and d'Arsonval.—In the place of the late Dom Pedro d'Alcantara, M. von Helmholtz was elected Foreign Associate. —Researches on the solar atmosphere, by Mr George E. Hale, of the Kenwood Astrophysical Observatory, Chicago. A photograph of a metallic protuberance, obtained with an aperture of 12 inches and a large grating spectroscope, shows all the lines previously announced in the ultra-violet, and the following additional ones: 3961·7 (manganese?), 3900·7 (calcium), 3886·4 (hydrogen), and 3860·4 (iron?). The writer has succeeded in photographing faculæ in the centre of the disk. —On the general problem of the deformation of surfaces, by M. L. Raffy.—On the theory of the fuchsian functions, by M. Ludwig Schlesinger.—On transformations in mechanics, by M. P. Painlevé.—On considerations of homogeneity in physics, by M. A. Vaschy.—On the non-realization of the spheroidal state in steam boilers : reclamation of priority, by M. de Swarte.—On the co-existence of dielectric power and electrolytic conductivity, by M. E. Bouty. A rigid condenser is formed of iron disks separated by small wedges of mica, and joined by iron screws isolated by mica and placed opposite the wedges. This condenser is plunged into a fused mixture of equal parts of the nitrates of sodium and potassium. Air bubbles are carefully removed with plates of mica, and the condenser is withdrawn at the moment when the salt commences to solidify. The liquid, retained by capillarity, forms between the disks an adherent regular solid layer. The apparatus while yet hot is plunged into melted paraffin, which surrounds it with an isolating layer devoid of hygroscopic power. The experiments give a value for k approaching 4, and nearly constant within the limits of temperature in which the specific resistance in ohms may vary from $3·6 \times 10^{11}$ to $2·6 \times 10^{9}$, *i.e.* in the ratio of about 138 to 1. Here the conductivity and the dielectric capacity belong to molecules of the same kind. It is probable that if the experiments could be extended to ordinary electrolytes, they would give results of the same kind—that is, finite values of the dielectric constant k. The distinction between dielectrics and electrolytes would thus solely reside in the amount of their conductivity. Dielectric polarization, established in a very short time in comparison with the ten-thousandth of a second, would correspond, in Grotthuss's scheme, to the initial orientation of the compound molecules, their conductivity to their progressive rupture.—On the retardation in the perception of the different rays of the spectrum, by M. Aug. Charpentier. On suddenly illuminating the slit of a spectroscope by white light, the red portion of the spectrum is seen first, and the light seems to shoot across from the red to the violet. This was confirmed by rotating an inverted sector of a circle, 1 cm. broad at the base, and 8 to 10 cm. long once in two or three seconds. The extreme point seemed drawn out into a kind of spectrum extending from the red to the green. The maximum duration of excitation compatible with the isolation of the colours does not exceed about four or five thousandths of a second.—On the anhydrous crystallized fluorides of nickel and cobalt, by M. C. Poulenc.—Action of nitric oxide upon the metals, and upon the metallic oxides, by MM. Paul Sabatier and J. B. Senderens.—Thermochemical study of guanidine, of its salts and of nitroguanidine, by M. C. Matignon.—Researches on the disodic derivatives of the three isomeric diphenols, by M. de Forcrand.—On normal pyrotartaric or glutaric acid, by M. G. Massol.—Study of the decomposition of the diazo compounds, by MM. J. Hausser and P. Th. Muller.—The folds in the Secondary formations in the neighbourhood of Poitiers, by M. Jules Welsch.—On the genesis of the ophiolitic rocks, by M. L. Mazzuoli.—Three cases of increase in the velocity of transmission of sense-impressions, under the influence of injections of the testiculary liquid, by M. Grigorescu.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Country Thoughts for Town Readers: K. B. B. de la Bere (Simpkin).—The Etiology and Pathology of Grouse Disease: Dr. E. Klein (Macmillan).—Marine Shells of South Africa: G. B. Sowerby (Sowerby).—Atlas of Clinical Medicine. vol. i.: Dr. B. Bramwell (Edinburgh, Constable). —The Standard Course of Elementary Chemistry, Parts 1–5: E. J. Cox (Arnold).—English Botany, Supplement to the Third Edition, Part 2: N. E. Brown (Bell).—Volcanoes, Past and Present: Dr. E. Hull (Scott).—Den Norske Nordhavs-Expedition, 1876–78, xxi. Zoologi, Crinoida: D. C. Danielssen (Christiania, Grondahl).—Coal Gas as a Fuel, fourth edition: T. Fletcher (Liverpool, Tinling).

PAMPHLETS.—Twenty-second Annual Report of the Wellington College Natural Science Society, 1891 (Wellington College).—Johns Hopkins University of Baltimore Register for 1891–92 (Baltimore).—British Universities (Manchester, Cornish).

SERIALS.—Astronomy and Astro-Physics, June (Northfield, Minnesota). —L'Anthropologie, tome iii. No. 2 (Paris, Masson).—Journal of the Royal Microscopical Society, June (Williams and Norgate).—Contributions from the U.S. National Herbarium, vol. ii., No. 2 (Washington).—Bulletin of the New York Mathematical Society, vol. i. No. 9 (New York).

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