THURSDAY, DECEMBER 1, 1892.

CHEMICAL LECTURE EXPERIMENTS.

Chemical Lecture Experiments. By G. S. Newth. (Longmans, 1892.)

"ON revient toujours," &c. and the very description of a good lecture experiment to one who had for thirty years always enjoyed performing an old one, and was overjoyed in bringing out a new one, is something akin to that of the old war-horse when he scents the battle from afar. And both Mr. Newth's experiments and his descriptions are good; so I think that not only the novices of the profession but the old hands will read this book—the first with profit with a view to what they will do, and the second with pleasure in recollecting what they have done. I was dining some years ago with the great Dumas (I don't mean either of the novelists), and after dinner we sat together on the sofa smoking our cigars, when he said to me, "I have been in many positions—professor, minister of state, and investigator—and I have seen the world from many points of view. If I had to live my life again I would not leave my laboratory. The greatest pleasure in my life has been original work; the second greatest that of teaching a class who appreciated what I was telling them." We all know that Dumas was a master in the art of experimental teaching, and those who have practised this art, even at a great distance from the master, will agree with him that the pleasure of giving a well-illustrated experimental lecture on chemistry is not a small one, and even that a man may go on for thirty years and yet not be altogether tired of the job. The reason for this is not far to seek. Our science in its daily progress constantly opens up new paths which yield matter suitable for lecture experiment, and this gives a zest to the discourse unattainable by the teachers of most other subjects. Mr. Newth has collected an ample store, and he has described them clearly. For the collection he has had favourable opportunity; to begin with he was a distinguished student at Owens, and there he may have picked up a few wrinkles; then he has for many years been Lecture Demonstrator to Frankland and Thorpe, and from them the wrinkles he has picked up have certainly been many. But although doubtless some are of his own finding out, I think it would have been well if he had added after the description of each experiment the name of the authority with whom it originated. Thus some have been described by the chemists I have named, others owe their existence to Hofmann, Bunsen, and others. These additions are not only due to the authors, but would add to the interest of the book. Mr. Newth should see to this in the next edition. The old booksellers tell us that Faraday's "Manipulations" is a work which no lecturer should be without, and as everything which that prince of experimenters wrote or did is worthy of attention, they speak truly, and yet no modern chemists can be bound by Faraday's experience of sixty years ago. Things are not as they were; and the methods of work and the illustrations of chemical phenomena which he details belong to a bygone age. And so Mr. Newth comes forward to give the lecturer of to-day a helping hand. The first thing that strikes one on looking through his pages, is how simple are the experiments—so far as illustrating the chemistry of the non-metals goes, and he goes no further—needed to illustrate a course of lectures. We do not require the expensive and delicate instruments of the physicist. With glass and india-rubber, as Liebig said, we chemists perform all our mysteries. Only in a few cases, as, for instance, when we want to hand round wine-glasses filled with liquefied oxygen or air, or when we desire to show our students free fluorine and such like things, does the apparatus become expensive or the experiments troublesome. All the ordinary and many of the extraordinary experiments detailed in the book may be carried out with little cost and without great trouble; indeed most of them may be made by the veriest tyro provided he stick to the letter of the description and does not attempt to vary the proceedings, as one I knew did, who thought that as sulphuric acid is a more powerful desiccating agent than lime, he would dry his ammonia by the former substance instead of by the latter material. No account of any experiment, the author tells us, has been introduced upon the authority solely of any verbal or printed description, but every experiment has been the subject of his personal investigation and the illustrations are taken from his original drawings, so that we may be sure that every experiment will "go" if properly managed and fairly dealt with. Many of the experiments are, of course, old stagers, but none the less useful, whilst others are new to me and probably to most people. To mention many either old or new this is not the place, but one of them, which has struck me as interesting is an easy method of showing the freezing of water by its own evaporation first with a common air-pump, and second with no air-pump at all. I always used a Carre's machine, by which a quart of water could be frozen, but Mr. Newth gives an excellent description of how a beautiful icicle twenty to thirty centimetres long can be obtained both with and without an air-pump. The secret of how to do this can best be learnt by reading pages 57 to 59 of the book. "How to float soap bubbles upon carbon dioxide" has often proved a difficult question to answer experimentally, because if you managed, after a score of trials, to free your bubble from the pipe on which you blew it, the bubble usually bursts the moment it touches your heavy gas. Mr. Newth lets us into the secret. You must remove every trace of hydrochloric acid, which is carried over with the gas, by washing, the presence of this acid being fatal to the life of a soap bubble. Under chlorine (p. 88) a description is given of the mode of sealing up bulbs filled with chlorine and hydrogen. This was first done in the early sixties by my old helper and friend Mr. Joseph Heywood, of Owens, to whom both students and lecturers owe many an ingenious and striking experimental illustration. As Mr. Newth remarks, there are many obvious reasons why the old plan of filling a soda-water bottle with a mixture of equal volumes of the gases and then throwing it out of the lecture-room window into the street, if the sun happened to shine, is "unsuitable for a lecture experiment," and Heywood's bulbs answer the purpose better in all respects. The author does not tell us—as he ought to have done—

that Victor Meyer now seals up bulbs of oxygen and hydrogen (electrolytic gas) in a similar way, and that these, like their confrères of Cl and H, can be kept not only in the dark for any time, but, unlike these, also in the light without undergoing any change. The fact that many gases when perfectly dry do not combine is illustrated by the case of chlorine and metals—brass and sodium, pp. 84 and 85—as well as of carbon monoxide and oxygen, for these gases will not explode if dry, p. 189. A more striking way of illustrating this latter case than that with the eudiometer is not mentioned. I will add it. Dry a current of carbonic oxide over glass balls moistened with strong sulphuric acid; light the stream of gas issuing from a horizontal tube; then plunge over the blue flame a cylinder full of air which has been previously dried by shaking it up with a little strong sulphuric acid. The flame instantly goes out. Another case of the kind observed by Arnold lends itself to a lecture experiment. He found that powdered iron will not burn in pure dry oxygen, and in order to be able to estimate hydrogen in iron it was found necessary to insert a small tube containing a drop of water, through which the oxygen passed before coming into contact with the iron, this tube being of course weighed both before and after the experiment. This may well be included in the next edition, which I hope will soon be called for. Another capital experiment to show that iron can be carbonized by contact with a diamond was recently described to me by Mr. Gilbert Fowler, of Owens. A loop of pure thin iron wire is placed in a vertical glass tube surrounded by an atmosphere of hydrogen. Below the loop is a splinter diamond (or some diamond dust) placed on the top of a glass rod working through the lower end of the tube. After heating the wire by a current to the highest possible temperature without fusion, bring the diamond carefully into contact with the heated iron. The metal at once fuses. But of good experiments "there is no end" (Mr. Newth describes 620 for the non-metals alone) whilst of a review of a book in NATURE there must be a speedy end, and I will end by advising all those who like to see and to show good experiments to get Mr. Newth's book.

H. E. ROSCOE.

A MANUAL OF PHOTOGRAPHY.

A Manual of Photography. By A. Brothers, F.R.A.S. (London: Charles Griffin and Co., 1892.)

MR. BROTHERS has in this well-illustrated book brought together a great amount of information relative to the history, processes, apparatus, materials, &c., which will be welcomed by all who are interested, even if only in a general way, in the fascinating art of photography. The work covers about 360 pages, is divided into five parts and is accompanied by a full index.

In the short historical sketch which is introduced as the opening chapter, the author by means of quotations and otherwise gain much information which is not readily accessible, and many facts that are not inserted in our treatises, and which consequently are not generally known. At the present day, when so many possess a camera of some sort or other, it is very curious to carry ourselves back to the time of Daguerre and to picture to ourselves the idea which he put forward when he wrote in his pamphlet, "Those persons are deceived who suppose that during a journey they may avail themselves of brief intervals while the carriage slowly mounts a hill to take views of a country." Whether this is or is not the case now we will not stop to discuss, but we may mention that many other very interesting extracts are made from the same source.

The next three chapters deal with the chemistry, optics, and light as applied to photography. In these there seems to be nothing that calls for special attention, unless it be to state that the author has written them in a charming manner, as for instance the short summary under the heading "Magnesium Light," which one reads with quite renewed interest.

Coming now to Part II., Processes, we find the most important section of the whole book. As Mr. Brothers rightly observes, the old processes previous to the introduction of the gelatine bromide methods have been put completely in the shade, not because they have been surpassed by better and more trustworthy ones, but simply because they require a little more care in manipulation and consequently the consumption of more time. In order to remedy this to some extent he has given great prominence to them, devoting nearly 140 pages to them, including working details of the more important later processes. For the sake of facility of reference they are arranged in alphabetical order, and in many cases they are accompanied by illustrations which show the actual results that can be obtained by the uses of the methods under consideration. To cite them in anything like detail would carry us too far away, but we may mention one or two briefly. The (wet) collodion process is of course here fully described: the author lays special stress on the advantage of this process, for there is no doubt that where dry plates are now used far better results could be obtained by employing this old wet process. The photo-mechanical process, collotype, receives also a rather lengthy description, but its utility and the excellence of the results obtained necessarily give it some prominence. A specimen illustration of the last mentioned is inserted, as well as one of a recent application of this method for printing in colour. Printing on wood, photo-lithography, platinotype, &c., together with photogravine Woodbury type and a host of others, are all described, some briefly, others of greater importance somewhat more in full.

Parts III. and IV. deal with the apparatus and materials used in the production of a finished picture. In the former the author describes the particular characteristics of many of the various kinds of cameras and accessories, while in the latter are explained the chief uses and actions of the chemicals employed.

Part V., the last, contains short notices of the applications to which photography has given rise. Astronomical Photography is referred to at some length, and we may mention that we have an excellent reproduction of one of Mr. Rutherfurd's beautiful lunar photographs taken at first quarter. The practical

hints in the concluding chapter should be found very serviceable.

Mr. Brothers has produced a very serviceable and useful addition to our photographic literature; as a handbook for students it perhaps is somewhat too bulky, but nevertheless it will be very much used by them. Every photographer who wishes to know something about the art with which he is working, and who does not wish to limit himself to the mere cut-and-dried manipulations, should at any rate make himself acquainted with the volume. W. J. L.

MATRICULATION CHEMISTRY.

Matriculation Chemistry. By Temple Orme. (London: Lawrence and Bullen, 1892.)

THIS is still another elementary manual dealing with the non-metals and their compounds. According to the author it can be studied most advantageously if the rudiments of chemistry have first been acquired. The book is built on pretty much the same plan as many already in existence; here and there, however, the reading is enlivened by ideas which, if not altogether commendable, have some pretensions to novelty.

The author is evidently of opinion that much of the ordinary chemical knowledge can be presented in other ways. Mass and weight first receive attention. In this book there are no atomic weights; atomic masses reign supreme. In using a balance we are told that we do not find weights, but "only masses." Indeed to bring this idea home the following curious question is set:—"When you 'weigh' a thing in an ordinary balance, do you find its weight?"

After a passing allusion to constitutional formulæ, in which they are likened to pyrotechnic frames, the next important alteration with which the author concerns himself refers to the nomenclature of oxides. Such a name as sulphur dioxide or carbon dioxide is discarded, for it is "founded upon a formula which is liable at any time to be altered so as to suit our knowledge of atoms and molecules." Anhydride is described as, "etymologically at least, a still more atrocious term"; hence we find that throughout the book SO_2, CO_2, &c., are spoken of as acids. P_2O_5 is said to be a tribasic acid, N_2O_5 a monobasic acid. CS_2 is called sulphocarbonic acid, P_2S_5 thiophosphoric acid, N_2O hyponitrous acid, and so forth, in spite of the fact that such compounds as that formed from "hydric oxide and phosphoric acid (*sic*) are often called *acids* by modern chemists."

The definition of a salt is thus summarily disposed of:—"You are often asked what a salt is; the only possible answer is that it is a compound."

Such methods of tampering with terms which have a generally-accepted meaning should, it seems to us, meet with no encouragement. They can only end in muddling the reader who wishes to pursue his subject by the aid of any of our standard works. But matter which is liable to do more immediate harm is frequently to be noted. For instance, it is stated that there is no such thing as the Law of Multiple proportions—it is only a corollary of the atomic theory. If, according to its usual interpretation, a law is a generalized statement of fact, it is rather hard to see how its existence is affected by its relations to any theory.

To most chemists the brilliant work of Moissan has sufficed to settle the question of the isolation of fluorine; the author is, however, still sceptical on this point. P_2O_3 is given as the formula of phosphorous acid (*sic*); recent research has shown P_4O_6 to be correct. The valency of potassium is said to have been fixed by a "minute study of its *gaseous* compounds," water is stated to be elastic with regard to *shape*, and from Avrogadro's hypothesis molecules of different gases are stated to be equal in size.

Even when the author is apparently trying to be precise he is apt to mislead. The following definition is an example:—"A chloride means a compound of chlorine with some other substance which, though it is not itself metallic in its general characteristics, possesses that important property of a metal, the capability of uniting *energetically* with chlorine." Is it to be understood from all this that a chlorine compound which is not produced by energetic union—say an endothermic compound like C_2Cl_4—is not a chloride?

These extracts may serve to show that the book requires to be carefully overhauled before it can be placed with confidence in the hands of a beginner.

OUR BOOK SHELF.

Vegetable Wasps and Plant Worms; a Popular History of Entomogenous Fungi, or Fungi parasitic upon Insects. By M. C. Cooke, M.A., LL.D., A.L.S. [364 pp. 4 pl. and figs. in text.] (London: S.P.C.K., 1892.)

IT is somewhat surprising that a book on a subject of such importance alike to the entomologist and fungologist has not been forthcoming long ago. It is true that a Memoir on the subject was undertaken thirty-five years ago by Mr. G. R. Gray, but, being privately printed, was limited in circulation. To this work Dr. Cooke admits his indebtedness for a large amount of information bearing on the entomological aspect of the subject, and it is to be regretted that he was not aware of the existence of a much extended manuscript revision of the same work, at present in the Botanical Department, Natural History Museum.

Dr. Cooke's book is professedly a popular work on the subject, and consequently does not deal with the economic side, relating to such matters as the "muscardine" or silkworm disease, further than to indicate the nature and affinities of the fungus causing the disease.

The fungi parasitic upon insects are arranged under four primary groups: the *Cordyceps* group, the *Laboulbeniaceæ*; the *Entomophthoræ*, and lastly a heterogeneous collection of moulds, which, with few exceptions, are not truly parasitic and destructive. The structure and general characteristics of these groups, with glimpses of their life-history, are dealt with in an introductory chapter. Entomologists, whose main interest will be to ascertain the name of any fungus parasitic on an insect, will find this a comparatively easy matter, as the general arrangement is an entomological one, commencing with the Hymenoptera; and under each is given an account of all the fungi that are known to be parasitic upon species included in the order. Numerous woodcuts in the text and four plates assist very materially in the determination of species. From the mycological standpoint the arrangement indicated above is purely artificial, and introduced

for a purpose; while for the benefit of those who desire to know more of the inter-relationship of the fungi enumerated, a classified list is given of all the species, arranged under their respective families, including the distribution and name of the host.

For the general reader, who is not specially interested in either insects or fungi, there is a considerable amount of interesting information bearing on such subjects as vegetable caterpillars, vegetable wasps, foul-brood of bees, &c., and the interest is not lessened by following the transition from the romantic and highly imaginative accounts given by early travellers of these productions, to the statements in accordance with modern knowledge. There is a slip on p. 35; *Cordyceps Sheeringii* should be *C. Sherringii*. The indices are very complete and the figures, excepting one on p. 10, good.

Notes on Qualitative Chemical Analysis. By P. Lakshmi Narasu Nayudu, B.A. (Madras: K. Murugesa Chetty, 1892.)

IT is interesting to meet with books such as this, which serve to indicate how the study of chemistry is progressing in the colonies and dependencies of the empire.

The author sets out with the endeavour to keep the *rationale* of the various processes of qualitative analysis well to the front, as in this way he considers the value of the study as a means of scientific training can alone be brought out. Group-reagents and the reasons for their use are first discussed as a preliminary to a somewhat exhaustive study of the reactions of the different basic and acid radicles. At the end of each group tables are given showing at a glance the behaviour of the radicles towards the various reagents.

It is somewhat astonishing that after such a minute study of the reactions of all the more common radicles, the author should give no schemes for the separation of the constituents of the different group-precipitates. In spite of the fact that under each radicle he gives as many, if not more, reactions than are given in the larger works on qualitative analysis, he contents himself with merely going through the examination of a simple salt. The expenditure of but little space would remedy this omission, which limits the sphere of usefulness of the book. It is to be noted also that film-tests find no place in the system adopted.

It may be said that the author adheres well to his purpose of showing why any particular operation is performed. The book contains a large amount of useful information. Occasionally, however, the mode in which it is stated is peculiar. "In the cold" is an expression commonly used in speaking of a reaction. The use of "in the heat," a term often employed by the author, is, on the other hand, uncommon. To speak, too, of "neutral solutions of zinc salts containing strong acids" is confusing. In some cases, as when using bodies like potassium metantimoniate or sodium hydrogen tartrate, it would be advisable to give the name as well as the formula: it isn't every student who is acquainted with such substances. It is erroneous to say that fluorine does not combine with carbon even at a high temperature. According to Moissan, all the allotropes of carbon, except the diamond, unite with fluorine, indeed some of the forms are, in the cold, spontaneously inflammable in the gas.

The following typographical errors are omitted in the list of errata. On p. 47 "meterially" should be "materially," "gSo_4," &c. should be "$MgSo_4$," &c. on p. 58, and "Ba_2P_2O" is given for "$Ba_2P_2O_7$" on p. 69.

Science Instruments. Catalogue of Scientific Apparatus and Reagents manufactured and sold by Brady and Martin. (Newcastle-on-Tyne, 1892.)

AT the present time, when almost all branches of experimental science are growing so rapidly, and new and improved pieces of apparatus are continually coming into existence, it is satisfactory to find that instrument makers are trying to keep pace with the times, and to afford purchasers the means of ascertaining with the minimum trouble what apparatus can be obtained to serve a particular end. This catalogue is an instance that such is the case. It is a well-bound book, profusely and clearly illustrated. The different kinds of apparatus, useful both for teaching and for technical purposes, are well classified. To prevent mistakes in ordering, each piece of apparatus is separately numbered, and where a new form is figured, a few lines are added explanatory of the principle involved.

The instruments quoted belong to various branches of experimental science—chemistry, bacteriology, physics, mechanics, and meteorology. A selection of instruments made by the Cambride company, and miscellaneous apparatus, diagrams, chemical reagents, &c., are also included.

The sections on bacteriology and gas analysis are especially full, and indicate the interest at present taken in these departments.

A table of contents and an index are supplied. On p. 145 "Irish" is misprinted for "Iris"; and what is termed an "optical bank," on p. 164, is usually called an "optical bench."

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.*]

Universities and Research.

AT the discussion in Edinburgh on the proposed National Laboratory, Lord Kelvin and Sir Geo. Stokes took marked exception to my contention that the primary business of Universities was research, contending that it was teaching. In a sense their contention is true, but not in contradistinction to my contention. The distinction would hardly be worth fighting over were it not that they took up the further ground that only those researches should be engaged in in Universities which were likely to interest the students. Of course the leaders of science can if they choose sell the great birthright of Universities for a mess of fees, but I hope they will not be permitted to do so without protest. What view the democracy take of Universities is of the very last importance with our democratic institutions, and I trust all those who have the welfare of the nation at heart will protest against the Universities being turned into coach-houses. In this connection it is most important to bear in mind the distinction between the functions of Universities and those of schools and colleges. The function of these latter is primarily to teach those who resort to them. The function of the University is primarily to teach mankind. In former days, when the means for distributing information were very imperfect, students used to flock from all sides to learn directly from a great mind. Nowadays the great mind distributes his teaching broadcast. In old days the only way to learn what was being done to advance knowledge was to go to the place where knowledge was being advanced. Nowadays we read the Transactions of our learned societies at home. But at all times the greatest men have always held that their primary duty was the discovery of new knowledge, the creation of new ideas for all mankind, and not the instruction of the few who found it convenient to reside in their immediate neighbourhood. Not that I desire to minimize the immense importance of personal influence, it is overwhelming; but it is a question quite beside the one at issue, which is whether the advance of knowledge by research and the teaching of the whole nation by the discoveries made is not rather the primary object of Universities than the instruction of the few students who gather in their halls: that is the real question at issue between Lord Kelvin, Sir Geo. Stokes, and myself. Are the Universities to devote the energies of the most advanced intellects of the age to the instruction of the whole nation, or to the instruction of the few

whose parents can afford them an, in some places fancy, education that can in the nature of things be only attainable by the rich?

In view of the discussion upon the proposed Teaching University for London it is to be hoped that these things will not be overlooked amid the local questions and rival institutions. It is to be hoped on the one hand that those who will have the privilege of learning in the greatest city in the world will not be deprived of the personal influence of its greatest men by relegating these to some haven of laboratories where no bracing breath of students shall interfere with the inmates. On the other hand it is to be hoped that London will so far honour itself as not to be content until it sees its University a centre of thought and investigation from which shall radiate new ideas and discoveries to enlighten and benefit the whole nation. Before I close there is a matter of great importance to which I fear sufficient importance is not attached by those who are directing this matter and that is the great objections there are to mixing up Universities and Colleges with examining boards. We here in Trinity College, Dublin, suffer very much from the fact that a considerable number of our students never reside here, but only come over for periodical examinations. We only suffer in one way, while if London adopted this abominable arrangement it would suffer in two ways. We suffer because our degree is much less valued than it would be if all our students were compelled to reside. All our students have not that education got by friction with their fellows and by contact with trained intellects which no examination can test, and which is such a valuable training, and in consequence our degrees are the less valuable. London would suffer in this way, and it is a very serious way too. In addition to this London would suffer from the inordinate importance that would be attached to extern examiners if the University examined London and extern students. So far we have escaped this danger, but it is inevitable in London because the extern element there would be large, influential and organized, while with us it is of little strength. The result would be to perpetuate and intensify that horrible teaching for examinations which is so necessary an evil in the case of the majority of students, but from which the leaders of thought should be exempt. It matters not that the syllabus nor even that the very questions are approved by the professor, if the examination is conducted to any serious extent by an independent mind. The student will seek a coach, who will probably teach him very well indeed, but whose whole view of learning will be of the passing-an-examination type, and who will infect his pupil with this miserable disease. Gradually the professor himself will be involved in the vortex, and the whole University will gradually look upon the passing of examinations as the end of life for students, and this is the acme of coaching and the bathos of education.

GEO. FRAS. FITZGERALD.

Trinity College, Dublin, November 25.

The Stars and the Nile.

AFTER reading Mr. J. Norman Lockyer's papers on the connection of the orientation of Egyptian temples with the heliacal rising of certain stars, I was interested to find that a custom still exists in the neighbourhood of the Second Cataract having a strong resemblance to the old Egyptian custom.

The Nuba people of this part foretell the first rise of the Nile by the heliacal rising of the Pleiades, or as they call it, "Turáya." For Sirius they have no special name, calling it merely "the driver" or "follower" of the three stars (Orion).

It must be remembered that the first sign of the rise at Wady Halfa occurs at the beginning of June, reaching Assouan about a week later, but for some days the increase is very slow, and scarcely perceptible except in the readings of the Nile gauges.

These Nuba people still preserve in their language many ancient Egyptian words, and possibly we may have here a trace of the old custom, the Pleiades being taken instead of Sirius on account of the earlier date of the rise in the district of the Second Cataract than in Egypt itself.

H. G. LYONS, Capt. R.E.

Cairo, November 14.

A Palæozoic Ice-Age.

THE account by Dr. Wallace in NATURE (p. 55) of glacial deposits recently discovered in Australia is a most important and welcome addition to our knowledge. But to us the surprising circumstance is that Dr. Wallace appears quite unaware of the fact that this is only an addition to a great series of discoveries, by no means confined to Australia, affording evidence of a Palæozoic ice-age. That the deposits near Sandhurst are Palæozoic may, in the absence of any indication to the contrary, be assumed, since they are clearly similar in position and character to the well-known boulder beds of Bacchus Marsh, and these have been correlated with the strata containing ice-borne fragments, amongst the marine beds west of Sydney and also at Wollongong to the southward, and in Queensland to the northward. All these beds have been shown to be upper carboniferous. A good account of the facts known up to 1886 may be found in Mr. R. D. Oldham's paper on the Indian and Australian coal-bearing beds (Rec. Geo. Surv. Ind. xix. p. 39).

It is scarcely necessary to refer to the fact that extensive Palæozoic glacial deposits, of the same age as those of Australia, have been found in several parts of India, some as far within the tropic as lat. 18° N., others in the Salt Range of the Punjab, that the famous Dwyka conglomerates of South Africa are similar and in all probability contemporaneous, and that boulder beds of very possibly the same geological date have been observed in Brazil. We should not have mentioned these but for the fact that the idea of a Palæozoic ice-age is apparently novel to Dr. Wallace. We do not think, however, that the reason why so well-informed a naturalist is unacquainted with geological data long known to many is any mystery. It has become an accepted article of faith amongst most European geologists (there are, of course, exceptions) that no ice-age occurred before the last glacial epoch, just as it is part of the geological creed that the carboniferous flora was of world-wide extension, and as it has become the prevailing belief that the deep oceans have been the same since the consolidation of the earth's crust. Now the discoverers of glacial evidence in the carboniferous beds of India and Australia also assert that the carboniferous flora of those countries differed *in toto* from that of Europe and resembled the jurassic flora of European regions, and some of them add that the great southern flora of South Africa, India, and Australia must have inhabited a vast continent, part of the area of which is now beneath the depths of the Indian Ocean. Partly from Indian and Australian geologists being regarded as heretics geologically, partly from other causes, the evidence of ice-action in India and Australia has been generally ignored. No better proof could be afforded of the fact that European geologists in general have omitted to notice the series of discoveries in the southern hemisphere and in India than the publication of Dr. Wallace's paper.

The glacial evidence as it now stands is extremely interesting and perhaps transcends in importance that of the Pleistocene glacial epoch. For as the effects of the carboniferous ice-age were felt within the present tropics, either the earth's axis of rotation must have shifted considerably, or else the refrigeration of the surface must have been due to a cause distinct from that supplied by the late Mr. Croll's theory, even when supplemented by Sir R. Ball's amendment.

Our own interest in the whole subject is chiefly due to the circumstance that we happened in 1856 to be the first who met with the ancient boulder-bed in India, and suggested that it might be explained by the action of ice. The discoveries in Australia and South Africa were of course quite independent of those in India, but were, we believe, slightly later in date.

November 20. W. T. BLANFORD.
HENRY F. BLANFORD.

Geology of Scotland.

MAY I supplement Prof. Green's history of geological mapping in Scotland (NATURE, vol. xlvii. p. 49) by pointing out that Mr. Cruchley published, on March 23, 1840, "A Geological Map of Scotland by Dr. MacCulloch, F.R.S., &c., published by order of the Lords of the Treasury by S. Arrowsmith, Hydrographer to the King." This fine map is on the scale of four miles to an inch. From the omission of "the late" before MacCulloch's name, it seems possible that the plates were in course of engraving before his death in 1835.

GRENVILLE A. J. COLE.

Royal College of Science for Ireland, Dublin.

British Earthworms.

I ENTIRELY concur with Dr. Hurst's view that the supposed new species, described by the Rev. Hilderic Friend as *L. rubescens* is in reality Savigny's *L. festivus*. I may add a further reason for discarding the term *L. terrestris*, Lin., and substituting *L. herculeus*, Sav., for our common large worm. Savigny himself used "Enterion terrestre" to indicate a worm differing considerably from *L. terrestris*, Lin., in the position and extent of the clitellum; moreover it belongs to the genus *Allolobophora* and not to *Lumbricus* at all.

With regard to the second "new" species, *A. cambrica*, recently described by Mr. Friend, I believe that it is merely a variety of *A. chlorotica*, Sav.

According to the description it *appears* to differ from the latter species in three points:—(1) colour; (2) extent of clitellum; (3) number of spermathecæ.

(1) Now, amongst my collection of British worms I find one, of which a water-colour sketch taken from the living specimen closely resembles Mr. Friend's description of the colour of *A. cambrica*. My notes as to size, habits, &c., agree with his description. I have carefully re-examined my specimen, and find that it agrees perfectly with *A. chlorotica*; or, in other words, I find that *A. chlorotica* may vary—as Hoffmeister knew that it did vary—so much as to resemble *A. mucosa*, and I may suggest that it is a mimetic resemblance.

(2) Further, with regard to the clitellum of *A. chlorotica*; in the table given by the Rev. Hilderic Friend, it is stated to cover somites 29–36. As a matter of fact the next somite, 37, is nearly always included. This brings *A. cambrica*, Friend, into harmony with *A. chlorotica*, Sav.

(3) Thus the only differential character left is the number of spermathecæ; and I cannot agree to the validity of a new species on this single character; several specimens should be examined to settle the point, as variation in this feature is known to occur.

I take a certain amount of credit to myself for the useful faunistic studies on the earthworms of Great Britain, now being pursued by the Rev. Hilderic Friend, for, if I mistake not, I put him in the way of recognizing their specific characters, when, some years ago, I named for him, with remarks thereon, sundry consignments of some scores of worms which he sent to me for that purpose. WM. BLAXLAND BENHAM.

The Dept. of Comparative Anatomy, Oxford,
November 21.

Egyptian Figs.

THE accompanying sketch represents an instrument used in Egypt for removing the "eye" or top of the sycomore fig. It is a piece of hoop iron, blunt on one edge and tolerably sharp on the other, and fixed into the end of a stick. The fruit of *Ficus sycomorus*, or "Egyptian fig," seems to be invariably infested with the insect *Sycophaga crassipes*, Westw.; which I am informed by Rev. T. F. Marshall, who has kindly given me the name, is the same insect supposed to effect caprification in Malta, judging from specimens which I sent him. This fig never produces ripe seed in Egypt, though it has been introduced from the earliest times. Not only are the ancient coffins made of the wood, but it was adopted as the sacred "Tree of Life.

It probably came from Yemen, where Dr. Schweinfurth saw many seedling trees growing spontaneously. The tree bears three crops per annum, in May, June, and August—September. Boys cut off the top of the figs of the first two crops only. Dr. E. Sickenberger, one of the professors in the School of Medicine, Cairo, informs me that the figs have no pleasant flavour until the operation has been performed:—"They then become very sweet, but remain smaller than when not cut open. The object is *to let the insects escape*. Those that are left become watery and tasteless, and are full of *namoos* or sycophaga." In his first description Dr. Sickenberger described the instrument as "a kind of thimble made of iron plate ending in a spatula like a finger-nail. It is fixed on the thumb of the right hand. The operation is only made on fruits which shall be picked up the following day. The day after the operation the fig is quite ripe. The male flowers in those figs are all aborted, and the females have never perfect seeds. The figs of the third generation are larger, of an agreeable taste, and sweet-scented; but they are not operated upon, only because in August and September, though the trees are much fuller of fruit than in May and June, the people have so much to do at that time. They are seldom sold, and only eaten by the owners of the trees, or else they are abandoned to the field-mice, birds, and dogs, which latter are very fond of them. These *nilg* fruits are full of sycophaga."

It will be seen that the instrument he has sent me is of a different shape to the one he describes; and the chief interest lies in the fact that Pliny also describes the process as closely corresponding with this modern method. He even uses a similar term "nail" (ὄνυχας): πέπτειν οὐ δύναται ἂν μὴ ἐπικνισθῇ· ἀλλ' ἔχοντες ὄνυχας σιδηροῦς ἐπικνίζουσιν· ἃ δ' ἂν ἐπικνισθῇ, τετάρταια πέπτεται (*Nat. Hist.* xiii. 14). Further, the Prophet Amos describes himself as *bōlās siqmīm*; and the authors of the LXX, writing in Alexandria, appear to have understood the expression and translated these words by κνίζων συκάμινα. This is the same verb as that which Pliny uses; so that it would seem to be pretty certain that Amos performed identically the same operation on the figs as is still done in Egypt at this day. It will be noticed that the idea was to ripen the figs. It does not really do this, because there are no seeds; but it does make the fig sweeter. It also liberates the insects, and without doing this the figs would be uneatable. Jerome is the only author, as far as I know, who alludes to "grubs" being inside the fig.

GEORGE HENSLOW.

Iridescent Colours.

THE article "Iridescent Colours" on p. 92 puts me in mind of a notice which I published thirty years ago, while I lived in the United States. It was entitled "Harmonies of Form and Colour" (*Stettiner Entom. Zeitung*, 1862, pp. 412–414), and a portion of it refers to the subject of the above-mentioned article in NATURE, and may be of interest to its readers:—

"A fundamental observation, which proves the influence of the intensity of light upon colour, may be made on some insects of metallic coloration, inhabiting a large area from north to south. About six years ago, while in Southern Russia, I took a walk during sunset, and was struck by the brilliancy of some metallic red *Chrysomelæ*, abundant in that locality. I found that it was the common *C. fastuosa*, which I did not recognize at once, because in the environs of St. Petersburg, where I lived at that time, it occurs in its metallic-green variety, with an iridescent blue stripe on each of the elytra. Still farther north it assumes a more violet metallic colour. The same is the case with *Chrysomela cerealis* and *C. graminis*. The first of these species is represented in St. Petersburgh in the blue variety (*C. ornata*, Ahrens), while the typical variety, occurring farther south, has purplish-red metallic stripes. It is evident therefore that the metallic colouring of these wide-spread species is gradually intensified from north to south, in the order of the colours of the spectrum. We may imagine the area which these beetles occupy, like an immense rainbow, reflected from their backs, violet in the north, red in the south; the violet perhaps connected in some way with the magnetic phenomena prevailing in the polar regions. The longicorn beetle (*Callidium violaceum*) undergoes the same variation: violet in the north, blue in central Europe." C. R. OSTEN SACKEN.

Heidelberg, Germany, November 27.

The Afterglow.

THERE has been for three weeks past a very remarkable renewal of the afterglow. There is a quite deep secondary red glow after the stars are fully out. I should say that no such afterglow has been seen since 1886, or three years after the Krakatão eruption. There is also a great extension of the white hazy atmospheric corona around the sun, very marked also around the moon. I am unable, however, to make out any of the pink colour on the outer edge of the haze, which was so char-

acteristic of "Bishop's Ring," and distinguishable at Honolulu for two years. Apparently there has recently been a great reinforcement added to the material in the upper atmosphere, which produces the afterglows.

Is this owing to the August eruption in Alaska, which is said to have distributed ashes at a distance of 250 miles?

Prof. C. J. Lyons, in charge of tidal observations in Honolulu, reports the period of highest mean tide to have extended itself this year into November, or fourteen months later than the last similar period. The mean sea level is now over ten inches higher than it was last April. It is also somewhat higher than has been shown by any previous tide registers in Honolulu. Mr. Lyons regards this as of special importance, taken in connection with the oscillation of the earth's axis, now established by the combined observations at Berlin and Honolulu.

Honolulu, November 8. SERENO E. BISHOP.

OSMOTIC PRESSURE.

OF the various properties which have found a common explanation in the new theory of solutions, there are none perhaps to which more interest attaches than to osmotic pressure; and although, on account of the experimental difficulties, the observations as yet accumulated on this subject are but scanty, they have so largely contributed to the novel ideas involved in the new theory, that they merit special attention.

Since accounts of osmotic pressure are finding their way into few English text-books, it may be worth while glancing at the main features which have led up to the present state of the question.

It has long been known that if an aqueous solution—say, of sugar—be separated from pure water by a piece of animal membrane, that movements of the water and of the sugar take place through the membrane. If the solution be contained in an open vessel, the base of which is composed of membrane, on partially immersing the vessel in water it is easy to see that more water enters the vessel than solution leaves it. The level of liquid within rises above that without the vessel, different pressures being thus set up on opposite sides of the membrane.

To this process wherein currents pass through a membranous septum, the terms "osmosis," "osmose," and "diosmose" have been applied. The last of these is perhaps to be preferred, as it serves to indicate that two currents are involved in the phenomena. Investigations carried out as indicated above were concerned with the measurement of what was termed the "endosmotic equivalent." That is the ratio of the amount of water passing *into* the solution to the amount of dissolved substance passing in the opposite direction. Consistent measurements of this quantity could not be obtained, however, for it was found that the nature of the membrane exercised a marked influence upon its magnitude. The kind of membrane employed, or, with the same membrane, its thickness or freshness, or even the direction in which water passed through it, was of importance. Thus in illustration of the last point, water passes more readily outwards through eel's-skin, more readily inwards through frog's-skin.

To obtain quantitative relations in this field it thus became essential to eliminate the influence of the membrane, and more recently this end seems to have been attained by the use of membranes artificially prepared.

These artificial membranes differ from those of animal origin in the remarkable particular that although they allow water to pass through, they present a barrier to the passage of certain dissolved substances. On this account they have been termed semi-permeable membranes, and by their use measurements of osmotic pressure have been made possible.

To carry out such measurements the first point to be solved was to obtain a membrane of sufficient strength. The substance which has been found to be most satisfactory as a membrane-former is copper ferrocyanide. When aqueous solutions of potassium ferrocyanide and copper sulphate are carefully brought into contact a pellicle of copper ferrocyanide is formed where the two solutions meet. In this condition the pellicle is much too fragile to sustain even slight differences of pressure; but by the following simple device, employed first of all by W. Pfeffer, satisfactory results have been obtained.

If a cell similar to the ordinary porous pot of a voltaic battery be lowered into a solution of copper sulphate while at the same time a solution of potassium ferrocyanide be poured into its interior, the two solutions meet somewhere within the walls of the cell and deposit a film of copper ferrocyanide. Little diaphragms of membrane are thus produced stretching across the pores of the cell-wall, which furnishes the necessary support, and by taking suitable precautions a membrane may thus be obtained capable of withstanding a pressure of several atmospheres.

The behaviour of a solution when separated from pure solvent by such a semi-permeable membrane differs markedly from what takes place when an animal membrane is employed. In the latter case, at the outset water adds itself to the solution; the level of liquid and the pressure on the solution-side of the membrane thus rise until a maximum pressure-head is attained, which, roughly speaking, is greater the stronger the solution used. Seeing, however, that dissolved substance is continually escaping from the solution through the membrane, as soon as the maximum is reached the pressure-head begins to fall until eventually it vanishes, the levels of liquid on either side of the membrane being the same.

If, on the other hand, a semi-permeable membrane be employed, as before, a maximum pressure is attained; but since dissolved substance cannot leave the solution, this maximum pressure as well as the concentration of the solution remain constant.

When this constant state of things is established the excess of pressure on the solution-side of the membrane over that on the solvent-side, whatever it may mean, is termed the "osmotic pressure" of the solution. It is therefore customary to reserve the term osmose to phenomena relating to semi-permeable membranes; diosmose being used in cases where, as with animal membranes, dissolved substance as well as solvent can traverse the membrane. It is obvious that when the pressure is established as indicated above, the original concentration of the solution has been altered by the entrance of solvent, and the observed osmotic pressure refers of course to the solution having the final concentration. If, however, we imagine the vessel containing the solution to be closed at the top, a quantity of air being imprisoned over the solution, pressure may be set up by compressing this air, only a small quantity of solvent being allowed to enter. If, further, the air enclosure be tapped by a manometer, measurements of the pressure may be taken, and by making the air enclosure and the volume of the manometer small enough the quantity of solvent entering while pressure is being established may be neglected, the original concentration of the solution remaining practically unaltered. This is the principle of the method employed in measuring osmotic pressure in absolute units.

The question now arises, "Are these measurements really independent of the nature of the membrane? Has the difficulty which beset the older experiments been overcome?" To this question an immediate answer is for thcoming, for, as pointed out by Prof. Ostwald, it follows from theoretical considerations that if the membrane employed is really semi-permeable, the observed osmotic pressure of a given solution must be the same, no matter of what material the membrane is com-

posed. For suppose we have a quantity of solution enclosed in a tube, one end of the tube being closed by a membrane A, the other by a membrane B, and suppose it possible that a pressure P can be developed on the membrane A when it separates the solution from pure water, which is higher than the pressure p similarly developed when B separates the solution from pure water. On immersing the tube in water, the latter will begin to pass through both membranes into the solution. When the pressure p is attained passage through B will stop, but that through A will continue; but as soon as the pressure on the solution rises above p, water will be forced out through B. The pressure P will thus never be attained, water will continuously enter through A, and pass out at B. We will thus have a machine capable of doing an infinite amount of work, which is impossible. Similar reasoning shows that p cannot be greater than P; it follows therefore that the pressure developed on each membrane is the same, that the osmotic pressure must be independent of the nature of a truly semi-permeable membrane.

Actual observations are on record in which the osmotic pressure did appear to vary with the membrane employed. A sugar solution, for example, exhibited a much lower osmotic pressure with a membrane of Prussian blue or calcium phosphate than with copper ferrocyanide. From the preceding argument it is concluded, however, that these membranes giving the lower values were not quite firm or not quite impermeable to the dissolved substance; the highest value is thus taken as the measure of the osmotic pressure which is nearest the truth.

On glancing at the results which have been obtained, the first point which strikes one is the extraordinary magnitude of the pressures thus set up. In the case of a 1 per cent. aqueous solution of nitre the pressure attains the value of 2½ atmospheres. This value increases with the strength of the solution till at 3·3 per cent. it is no less than 6 atmospheres, this pressure being the highest which any membrane yet prepared has been able to withstand. With substances like sugar, other things being the same, the pressure is not so great, but in all cases, in order to keep it within workable limits, the solutions employed have to be dilute.

Striking as the results are themselves, their explanation is not less remarkable. The original measurements of osmotic pressure were made with the purpose of elucidating the movement of liquids in plant cells, and naturally the substances examined were such as occur in the vegetable organism—aqueous solutions of sugar, gum, dextrin, and the nitrate, sulphate, and tartrate of potassium. For some years after these observations were made, they lay comparatively unnoticed, until Prof. van't Hoff, of Amsterdam, turned them to a use undreamt of by their discoverer. From a study of the properties of dilute solutions van't Hoff came to the conclusion that the osmotic pressure was due to the bombardment of the molecules of the *dissolved substance* on the semi-permeable membrane. For when the osmotic pressure is established and equilibrium exists between solvent and solution, in the same time, equal amounts of solvent, must pass in either direction through the membrane and the impacts of the solvent molecules on the membrane will then be equal and opposed on either side, and therefore negligible. On this reasoning the pressure recorded on the manometer is taken to be that exerted by the substance in solution.

On examining the magnitude of the pressure thus attributed to the dissolved substance, in the case of a solution of sugar van't Hoff next showed that it bore the closest resemblance to the pressure of a gas. Indeed, if we calculate the pressure of a gas which at the same temperature contains as many molecules per unit volume as there are molecules of sugar per unit volume of solution, then the pressure of the gas and the osmotic pressure are the same. Moreover, on thermodynamical grounds it was established that on the above hypothesis as to the nature of osmotic pressure its magnitude should be quantitatively connected with measurements of other physical properties of solutions, more especially those on the lowering of the vapour-pressure, and of the freezing point of a solvent produced by the presence of dissolved material. In this way a mass of evidence was collected, a general survey of which led to the foundation of the new theory of solutions. On this theory the dissolved substance, if the solution be dilute, is supposed to behave as if it were gaseous, the pressure it exerts—the osmotic pressure—being equal to the pressure which it would exert if it were gasified, and occupying, at the same temperature, a volume equal to the volume of the solution.

Unfortunately measurements of osmotic pressure have only been made on few substances, and only for solutions in water, but on turning to all the available observations to see how they support this novel conclusion, the most superficial examination serves to show that an agreement does not exist. Unless in the case of sugar, for no substance of known formula which has yet been investigated does the osmotic pressure agree with the corresponding gaseous pressure. These substances consist of salt solutions, and they invariably give higher osmotic pressures than theory demands. Similar disturbing influences have been observed when other physical properties of these solutions were measured, and to account for the facts an additional hypothesis has been put forward by Dr. Svante Arrhenius.

Salt solutions are electrolytes, they conduct the electric current, and undergo simultaneous chemical decomposition into their constituent ions. Experiment shows that such electrolytic solutions give high osmotic pressures, more particles appear to bombard the semi-permeable membrane than if the dissolved substance behaved as a gas. The new hypothesis states that this is really the case, the additional number of particles being produced from the breaking up of the dissolved substance. It states that in a solution which can be electrolyzed a portion at least of the dissolved substance exists already decomposed or dissociated into its ions, and that although these ions cannot be separated by diffusion they are so far independent that each can exercise an effect on the semi-permeable membrane.

The extent of this electrolytic dissociation is supposed to vary with the chemical nature of the dissolved substance, and to increase with the dilution. In very dilute solutions it may be complete, the whole of the dissolved substance being supposed to exist in the state of ions.

The second hypothesis gives, therefore, some explanation why the osmotic pressure of a salt solution is greater than that of a non-electrolytic solution of sugar; it further fixes the limits between which the osmotic pressure ought to vary in the case of an electrolyte, for the lower limit should be that of undissociated gas, the higher should be that of completely dissociated gas, each original molecule having decomposed into as many sub-molecules as there are ions in each molecule of salt.

So far as these limiting conditions go, the facts support the hypothesis. In all cases the observed osmotic pressure is either equal to one or other of the limits, or lies between them. A closer scrutiny leads, nevertheless, to apparent discrepancy. It is evident that a measure of the amount of dissociation can be obtained from osmotic pressure observations. For if we divide the observed osmotic pressure by the corresponding pressure of undissociated gas we have obviously, if the preceding hypotheses are valid, the ratio of the actual number of bombarding molecules to the theoretical number had no dissociation occurred. The ratio of these two numbers is denoted by the letter "i," a factor first used by van't Hoff. Now, on the new theory, the value of "i" can be

obtained by measurements of other properties of salt solutions, the electric conductivity, the depression of the freezing point, &c., and the theory is compared with practice by seeing if the values of "*i*," as determined, say, from freezing-point observations, agree with those deduced from the osmotic pressure. The comparison shows that in some cases, some half-a-dozen in all, the two sets of values correspond; in others, and in by far the majority, no such correspondences exist. In these latter instances it is argued, and with a certain amount of experimental evidence, that the salts were not without action on the membrane employed, and that, therefore, diosmose really took place, the membrane was not truly semi-permeable. In this way the discordant observations have been put out of court.

It is thus apparent that the leading hypotheses of the new theory do not receive confirmation of the weightiest kind from observations on osmotic pressure. Indeed, were they supported by such measurements alone, they would hardly be entertained. Their mainstay, however, ies in the mass of experimental work on many other properties—evidence which it is much easier to obtain than the difficult measurements on osmotic pressure—which has been correlated and explained by their use.

It is only fair to add that both hypotheses, from physical as well as chemical standpoints, have met with a measure of adverse criticism. The *rôle* played by the membrane has also been questioned. It has been suggested that it is not really semi-permeable, allowing solvent only to pass, but just as a porous plug behaves towards a mixture of gases, it allows molecules with different momenta to traverse it at different rates. Or, again, its action has been likened to that of a palladium film towards hydrogen, compounds being formed with the membrane substance on one side, these becoming diffused and dissociated on the other. If either of these views be correct the pressures exerted by dissolved substances have probably never been measured.

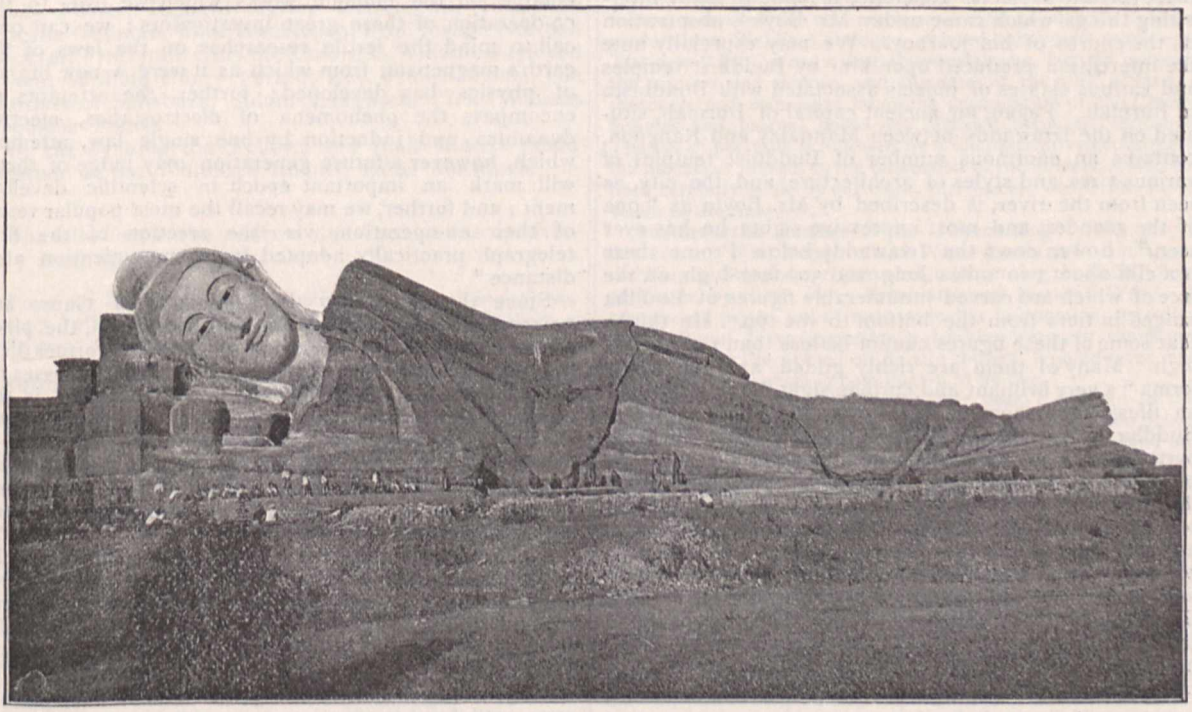
On the other hand, important theoretical support has been put forward in favour of the gaseous analogy. Several physicists, starting from entirely different points of view, have arrived at the result that in a dilute solution the dissolved substance should obey laws similar to those which hold for gases. At present the attitude of the prominent upholders of the new theory is one of indifference as to the exact mechanism of osmotic pressure. The numerical agreement between the measurements on solutions and those on gases is regarded as ample justification for considering dissolved substances to be in a *pseudo*-gaseous condition.

Whatever the ultimate explanation of the facts may be, there can be no doubt that the existing speculations on the nature of osmotic pressure and allied phenomena have infused new life into the study of solutions. Indeed, as instigators to fresh inquiry these hypotheses must take rank as the most fruitful of recent times.

J. W. RODGER.

A SANITARIAN'S TRAVELS.

MR. ROBERT BOYLE has travelled round the world no fewer than four times for the purpose of studying sanitary science and preparing the way for the introduction of the ventilating and sanitary appliances he has invented. An interesting account of his fourth journey is given in a little book entitled "A Sanitary Crusade through the East and Australasia," consisting of a series of papers reprinted from the *Building News*. In the course of this "crusade" Mr. Boyle visited Burmah, the Malay native states, Sumatra, Siam, Borneo, Java, Australia, New Zealand, Samoa, the Sandwich Islands, and America. Of all the facts noted by him as a sanitarian the most remarkable are those relating to leprosy, a disease which he believes to be spreading to an alarming extent all over the world. He was particularly struck by the gigantic proportions the evil has assumed in Burmah. The steps of the great Shwedagon pagoda at Rangoon, the Mecca of the Indo-Chinese Buddhists, he found to be



GREAT RECUMBENT FIGURE OF BUDDHA, PEGU, BURMAH.

"closely lined from top to bottom with lepers, suffering from that loathsome disease in its worst forms and most advanced stages." A number of the victims examined by Mr. Boyle "presented a most sickening and awful spectacle." Yet no provision worthy of the name appears to be made for the maintenance or treatment of these poor lepers, who are thus compelled to resort to begging to keep themselves in existence. At Mandalay Mr. Boyle came in contact with horrors of a similar nature. During times of high festival the entrances of the great Arakan pagoda in that city are crowded by hundreds of lepers, so that the visitor has to pick his way carefully among them. In the Sandwich Islands also Mr. Boyle was strongly impressed by the terrible effects of the curse of leprosy, which, he says, has nearly decimated the native population.

He has a curious theory to the effect that the propagation of leprosy has been to a large extent connected with cannibalism, the disease "being spread wholesale through the eating of infected bodies." He has frequently seen in New Caledonia and the South Sea Islands human bodies "hanging up in the natives' huts, intended for future repasts, though then in an advanced stage of decomposition and exhaling a sickening odour."

The little book is by no means occupied only with these terrible subjects. Reference is made to many interesting things which came under Mr. Boyle's observation in the course of his journey. We may especially note the impression produced upon him by Buddhist temples and various classes of objects associated with Buddhism in Burmah. Pagan, an ancient capital of Burmah, situated on the Irrawaddy between Mandalay and Rangoon, contains an enormous number of Buddhist temples of various sizes and styles of architecture, and the city, as seen from the river, is described by Mr. Boyle as "one of the grandest and most impressive sights he has ever seen." Lower down the Irrawaddy below Prome there is a cliff about two miles long and 300 feet high, on the face of which are carved innumerable figures of Buddha ranged in tiers from the bottom to the top. He thinks that some of these figures cannot be less than twenty feet high. Many of them are richly gilded, and the whole forms "a very brilliant and curious sight." We reproduce an illustration showing the great recumbent figure of Buddha, in the province of Pegu, of which Mr. Boyle reports that "it is said to measure about 270 feet in length by 70 feet at the shoulder." In a paper read lately before the Anthropological Institute (see NATURE, November 10, p. 46) Major R. C. Temple gives the length as 181 feet and the height at the shoulder as 46 feet. This remarkable monument is built of brick, and Major Temple speaks of it as "well proportioned throughout." It is supposed to have been produced in the fifteenth century. It was hidden from view by jungle until 1881, when it was accidentally discovered by a railway contractor.

GAUSS AND WEBER.

IN bringing before our readers the contents of a circular we have received with respect to the erection of a monument, in Göttingen, to the two world-renowned scientific workers and friends, Charles Frederick Gauss and William Weber, we do so, knowing that every scientific man, whether he be astronomer, mathematician, or physicist, will be only too glad to have a chance of paying some tribute, however slight, to their memory.

Only about a year has gone by since the younger of the two, William Weber, passed away, having brought glory to the University of Göttingen, which was radiated throughout the whole scientific world. The work which both have done in the service of science cannot be said to be the property of their followers alone, but is a precious heirloom of mankind, which has proved, and will continue to prove in the future, valuable in many ways in the service of technics, in methods of communication, and in civilization generally.

Gauss, who is almost unequalled among the scholars of the century, has not only left imposing landmarks of his great mind in all domains of pure mathematics, but he has also by his work furthered all departments of its applications in astronomy and physics, while his investigations have become standard for the theoretical as well as for the observational side.

What Gauss did for magnetism, Weber, whom Gauss had chosen for his fellow-worker, attracted by his useful work on acoustics, did for the strength of galvanic currents, for their impelling electromotive forces, and for their resistances.

Further, in teaching how to measure these quantities in absolute units, he has furnished extremely important methods for their investigation. In this way not only has the science itself been furthered, but a firm basis for the development of electro-technics has been formed, the soundness of which is proved by its general adoption and which has contributed greatly to the tremendous advance witnessed during the last ten years. The pamphlet then goes on to say: "It is not the purpose of these lines to enlarge on the eminent works which we owe to the co-operation of these great investigators; we can only call to mind the fertile researches on the laws of the earth's magnetism, from which as it were a new branch of physics has developed; further, the attempts to encompass the phenomena of electrostatics, electrodynamics, and induction by one single law, attempts which, however a future generation may judge of them, will mark an important epoch in scientific development; and further, we may recall the most popular result of their co-operation, viz. the erection of the first telegraph practically adopted for communication at a distance."

Since the year 1877 the birthplace of Gauss has possessed a memorial of him, but Göttingen, the place where he and Weber worked, and where the former died, and which consequently became celebrated, possesses no such memorial. That this should be remedied is the object of this circular, and one has only to glance down the list of names attached to it—about 275 altogether—to see that it includes most of the learned men in Germany, and those of many distinguished foreigners. Among these we are glad to see the name of Lord Kelvin, President of the Royal Society.

The acting committee is composed of Prof. Klein, E. v. Meier (Curator of the University), F. Merkel (Prorector of the University), G. Merkel (Over-burgomaster), Profs. E. Riecke, E. Schering, W. Schur, W. Voigt, H. Weber, and S. Benfey (banker), and it is to the last mentioned that subscriptions should be addressed (S. Benfey, Bankgeschäft, Göttingen). The list will remain open until April 1, 1893.

THE ANNIVERSARY OF THE ROYAL SOCIETY.

YESTERDAY being St. Andrew's Day the anniversary meeting of the Royal Society was held in their apartments at Burlington House. The auditors of the Treasurer's accounts having read their report, and the Secretary having read the list of Fellows elected and deceased since the last anniversary, the President (Lord Kelvin) proceeded to deliver the anniversary address. The medals were then presented as follows:—The Copley Medal to Prof. Rudolf Virchow, For.Mem.R.S. (received by the Foreign Secretary), for his investigations in Pathology, Pathological Anatomy, and Prehis-

toric Archæology ; the Rumford Medal to Mr. Nils C. Dunér (received by the Swedish Minister), for his Spectroscopic Researches on Stars ; a Royal Medal to Mr. J. N. Langley, F.R.S., for his work on Secreting Glands, and on the Nervous System ; a Royal Medal to the Reverend Prof. Pritchard, F.R.S., for his work on Photometry and Stellar Parallax; the Davy Medal to Prof. François Marie Raoult, of Grenoble, for his researches on the Freezing Points of Solutions, and on the Vapour Pressures of Solutions ; and the Darwin Medal to Sir J. D. Hooker, F R.S., on account of his important contributions to the progress of Systematic B t ny, as evidenced by the "Genera Plantarum" and the "Flora Indica," but more especially on account of his intimate association with Mr. Darwin in the studies preliminary to the "Origin of Species."

The Society next proceeded to elect the Officers and Council for the ensuing year. The following is a list of those elected:—President: The Lord Kelvin. Treasurer: Sir John Evans. Secretaries: Prof. Michael Foster, The Lord Rayleigh. Foreign Secretary: Sir Archibald Geikie. Other Members of the Council: Capt. William de Wiveleslie Abney, Sir Benjamin Baker, Prof. Isaac Bayley Balfour, William Thomas Blanford, Prof. George Carey Foster, Richard Tetley Glazebrook, Frederick Ducane Godman, John Hopkinson, Prof. Joseph Norman Lockyer, Prof. John Gray McKendrick, William Davidson Niven, William Henry Perkin, Rev. Prof. B. Price, The Marquis of Salisbury, Adam Sedgwick, Prof. William Augustus Tilden.

In the evening the Fellows and their friends dined together at the Whitehall Rooms, Hôtel Métropole.

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The following is the address delivered at the anniversary meeting by Lord Kelvin:—

Since our last Anniversary Meeting, the Royal Society has lost 27 Fellows on the Home list, and 5 Foreign Members, a sadly great number.

Pedro (Dom) II. (d'Alcantara), Emperor of Brazil, December 5, 1891.
Ramsay, Sir Andrew Crombie, December 9, 1891, aged 77.
Stas, Jean Servais, December 13, 1891, aged 78.
Bennett, Sir James Risdon, December 14, 1891, aged 82.
Devonshire, William Cavendish, 7th Duke of, December 21, 1891, aged 83.
Russell, William Henry Leighton, December 28, 1891, aged 68.
Kronecker, Leopold, December 29, 1891.
Wood, John, December 29, 1891, aged 66.
Airy, Sir George Biddell, January 2, 1892, aged 90.
Henry, William Charles, January 7, 1892, aged 88.
Quatrefages de Bréau, Jean Louis Armand de, January 12, 1892, aged 81.
Adams, John Couch, January 21, 1892, aged 72.
Paget, Sir George Edward, January 29, 1892, aged 83.
Caird, Right Hon. Sir James, February 9, 1892, aged 76.
Dittmar, William, February 9, 1892, aged 59.
Grant (Lieut.-Col.), James Augustus, February 11, 1892, aged 65.
Hunt, Thomas Sterry, February 12, 1892, aged 66.
Bates, Henry Walter, February 16, 1892, aged 67.
Hirst, Thomas Archer, February 16, 1892, aged 61.
Kopp, Hermann Franz Moritz, February 20, 1892, aged 75.
Gregory, Right Hon. Sir William Henry, March 6, 1892, aged 75.
Knowles, Sir Francis Charles, March 19, 1892, aged 90.
Bowman, Sir William, Bart., March 29, 1892, aged 76.
Hofmann, August Wilhelm von, May 5, 1892, aged 74.
Thomson, James, May 8, 1892, aged 71.
Bramwell, George William Wilsher, Lord, May 9, 1892, aged 84.
Aitken, Sir William, June 25, 1892, aged 67.
Schorlemmer, Carl, June 27, 1892, aged 58.
Clark, Frederick Le Gros, July 19, 1892, aged 82.
Sherbrooke, Robert Lowe, Viscount, July 27, 1892, aged 81.
Sutherland, George Granville William Sutherland-Leveson Gower, Duke of, September 22, 1892, aged 64.
Tennyson, Alfred, Lord (Poet Laureate), October 6, 1892, aged 83.
Calver (Captain), Edward Killick, October 28, 1892.

Biographical notices will appear in the Proceedings.

During the past year, in the mathematical and physical section of the "Philosophical Transactions," eighteen papers have been published, and in the biological section, eleven ; the two sections together containing a total of 1235 pages of letterpress and 50 plates. Of the "Proceedings," fourteen numbers have been issued, containing 1223 pages and 20 plates. This unusually large bulk is partly accounted for by the publication in the "Proceedings" of certain extra matters which the Council deemed likely to interest the Fellows. One part (No. 307), which forms an appendix to volume l., contains results of the Revision of the Statutes, to which I alluded in my Anniversary Address last year. It consists of a summary of the second and third chapters, and a copy of the Statutes as now revised, followed by an interesting note on the history of the Statutes, which has been drawn up by our senior secretary, Prof. Michael Foster. In addition to these matters, the same number contains a complete list of the portraits and busts at present in the apartments of the Society, compiled by order of the Library Committee, a work which was much needed, as no such list had been made since Weld's Catalogue, printed thirty-two years ago. The new "list" is not a descriptive catalogue, but the names of the painters and donors, and the dates of the gifts, so far as a thorough and somewhat laborious examination of the Council minutes and Journal books has revealed them, are furnished. The list of portraits is followed by a full descriptive catalogue of the medals at present in the possession of the Society, which has been carefully made by our clerk, Mr. James, under the supervision of the treasurer.

Another extra number of the "Proceedings" (No. 310) is devoted to a First Report of the Water Research Committee on the Present State of our Knowledge concerning the Bacteriology of Water, by Profs. Percy Frankland and Marshall Ward. It contains 96 pages, full of most valuable information regarding the vitality of micro-organisms in drinking water, to which in a large measure the spread of Asiatic cholera, typhoid fever, and other zymotic diseases is now known to be due.

In my Presidential Address of last year, I referred to this Water Committee as having been appointed by the Royal Society, in alliance with the London County Council ; and this first instalment of its work seems amply to justify its originators in their expectations of results, most valuable for the public health, from the investigation which has been commenced.

A third extra number (No. 311) contains the report of the Committee on Colour Vision. This Committee, from the time of its appointment in March, 1890, held over thirty meetings, in course of which it examined more than 500 persons as to their colour vision, and tried various methods and many kinds of apparatus for colour testing. The report of the results of the whole inquiry contains a large mass of most interesting matter, and the Committee's work ends in a set of practical recommendations, from which we may hope that much benefit will come, in the prevention of inconvenience and disaster liable to be produced by mistake of colour signals, both at sea and on railways.

Mr. Ellis's communication (Roy. Soc. Proc., November, 1892, vol. lii., p. 191) to the Royal Society of last May, and Prof. Grylls Adams' communication (Phil. Trans., vol. clxxxiii. 1891–92, p. 131) of June, 1891, both on the subject of simultaneous magnetic disturbances found by observations at magnetic observatories in different parts of the world; the award of a Royal medal two years ago to Hertz, for his splendid experimental work on electro-magnetic waves and vibrations; and Prof. Schuster's communication (Phil. Trans., vol. clxxx., 1889, p. 467) to the Royal Society, of June, 1889, on the "Diurnal Variations of Terrestrial Magnetism," justify me in saying a few words on the present occasion regarding terrestrial magnetic storms, and the hypothesis that they are due to magnetic waves emanating from the sun.

Guided by Maxwell's "electro-magnetic theory of light," and the undulatory theory of propagation of magnetic force which it includes, we might hope to perfectly overcome a fifty years' out-

standing difficulty in the way of believing the sun to be the direct cause of magnetic storms in the earth, though hitherto every effort in this direction has been disappointing. This difficulty is clearly stated by Prof. W. G. Adams, in the following sentences, which I quote from his Report to the British Association of 1881 (p. 469) "On Magnetic Disturbances and Earth Currents":—"Thus we see that the magnetic changes which take place at various points of the earth's surface at the same instant are so large as to be quite comparable with the earth's total magnetic force; and in order that any cause may be a true and sufficient one, it must be capable of producing these changes rapidly."

The primary difficulty, in fact, is to imagine the sun a variable magnet or electro-magnet, powerful enough to produce at the earth's distance changes of magnetic force amounting, in extreme cases, to as much as 1/20 or 1/30, and frequently, in ordinary magnetic storms, to as much as 1/400 of the undisturbed terrestrial magnetic force.

The earth's distance from the sun is 228 times the sun's radius, and the cube of this number is about 12,000,000. Hence, if the sun were, as Gilbert found the earth to be, a globular magnet, and if it were of the same average intensity of magnetization as the earth, we see, according to the known law of magnetic force at a distance, that the magnetic force due to the sun at the earth's distance from it, in any direction, would be only a twelve-millionth of the actual force of terrestrial magnetization at any point of the earth's surface in a corresponding position relatively to the magnetic axis. Hence the sun must be a magnet[1] of not much short of 12,000 times the average intensity of the terrestrial magnet (a not absolutely inconceivable supposition, as we shall presently see) to produce, by direct action simply as a magnet, any disturbance of terrestrial magnetic force sensible to the instruments of our magnetic observatories.

Considering probabilities and possibilities as to the history of the earth from its beginning to the present time, I find it unimaginable but that terrestrial magnetism is due to the greatness and the rotation of the earth. If it is true that terrestrial magnetism is a necessary consequence of the magnitude and the rotation of the earth, other bodies comparable in these qualities with the earth, and comparable also with the earth in respect to material and temperature, such as Venus and Mars, must be magnets comparable in strength with the terrestrial magnet, and they must have poles similar to the earth's north and south poles on the north and south sides of their equators, because their directions of rotation, as seen from the north side of the ecliptic, are the same as that of the earth. It seems probable, also, that the sun, because of its great mass and its rotation in the same direction as the earth's rotation, is a magnet with polarities on the north and south sides of its equator, similar to the terrestrial northern and southern magnetic polarities. As the sun's equatorial surface-velocity is nearly four and a half times the earth's, it seems probable that the average solar magnetic moment exceeds the terrestrial considerably more than according to the proportion of bulk. Absolutely ignorant as we are regarding the effect of cold solid rotating bodies such as the earth, or Mars, or Venus, or of hot fluid rotating bodies such as the sun, in straining the circumambient ether, we cannot say that the sun might not be 1000, or 10,000, or 100,000 times as intense a magnet as the earth. It is, therefore, a perfectly proper object for investigation to find whether there is, or is not, any disturbance of terrestrial magnetism, such as might be produced by a constant magnet in the sun's place with its magnetic axis coincident with the sun's axis of rotation. Neglecting for the present the seven degrees of obliquity of the sun's equator, and supposing the axis to be exactly perpendicular to the ecliptic, we have an exceedingly simple case of magnetic action to be considered: a magnetic force perpendicular to the ecliptic at every part of the earth's orbit and varying inversely as the cube of the earth's distance from the sun. The components of this force parallel and perpendicular to the earth's axis are, respectively, 0·92 and 0·4 of the whole; of which the former could only be perceived in virtue of the varying distance of the earth from the sun in the course of a year; while the latter would give rise to a daily variation, the same as would be observed if the red ends of terrestrial magnetic needles were attracted towards an ideal star of declination 0° and right ascension 270°. Hence, to discover the disturbances of terrestrial magnetism, if any there are, which are due to direct action of the sun as a magnet, the photographic curves of the three magnetic elements given by each observatory should be analysed for the simple harmonic constituent of annual period and the simple harmonic constituent of period equal to the sidereal day. We thus have two very simple problems, each of which may be treated with great ease separately by a much simplified application of the principles on which Schuster has treated his much more complex subject, according to Gauss' theory as to the external or internal origin of the disturbance, and Prof. Horace Lamb's investigation of electric currents induced in the interior of a globe by a varying external magnet. The sidereal diurnal constituent which forms the subject of the second of these simplified problems is smaller, but not much smaller, than the solar diurnal term which, with the solar semi-diurnal, the solar ter-diurnal, the solar quarter-diurnal constituents form the subjects of Schuster's paper. The conclusion at which he has arrived, that the source of the disturbance is external, is surely an ample reward for the great labour he has bestowed on the investigation hitherto; and I hope he may be induced to undertake the comparatively slight extension of his work which will be required for the separate treatment of the two problems of the sidereal diurnal and the solar annual constituents, and to answer for each the question:—Is the source external or internal?

But even though external be the answer found in each case, we must not from this alone assume that the cause is direct action of the sun as a magnet. The largeness of the solar semi-diurnal, ter-diurnal, and quarter-diurnal constituents found by the harmonic analysis, none of which could be explained by the direct action of the sun as a magnet, demonstrate relatively large action of some other external influence, possibly the electric currents in our atmosphere, which Schuster suggested as a probable cause. The cause, whatever it may be, for the semi-diurnal and higher constituents would also probably have a variation in the solar diurnal period on account of the difference of temperature of night and day, and a sidereal and annual period on account of the difference of temperature between winter and summer.

Even if, what does not seem very probable, we are to be led by the analysis to believe that magnetic force of the sun is directly perceptible here on the earth, we are quite certain that this steady force is vastly less in amount than the abruptly varying force which, from the time of my ancestor in the Presidential Chair, Sir Edward Sabine's discovery,[1] forty years ago, of an apparent connection between sunspots and terrestrial magnetic storms, we have been almost compelled to attribute to disturbing action of some kind at the sun's surface.

As one of the first evidences of this belief, I may quote the following remarkable sentences from Lord Armstrong's Presidential Address to the British Association at Newcastle, in 1863:—

"The sympathy also which appears to exist between forces operating in the sun and magnetic forces belonging to the earth merits a continuance of that close attention which it has already received from the British Association, and of labours such as General Sabine has, with so much ability and effect, devoted to the elucidation of the subject. I may here notice that most remarkable phenomenon which was seen by independent observers at two different places, on September 1, 1859. A sudden outburst of light, far exceeding the brightness of the sun's surface, was seen to take place, and sweep like a drifting cloud over a portion of the solar face. This was attended with magnetic disturbances of unusual intensity, and with exhibitions of aurora of extraordinary brilliancy. The identical instant at which the effusion of light was observed was recorded by an abrupt and strongly-marked deflection in the self-registering instruments at Kew. The phenomenon as seen was probably only part of what actually took place, for the magnetic storm in the midst of which it occurred commenced before, and continued after the event. If conjecture be allowable in such a case, we may suppose that this remarkable event had some connection with the means by

[1] The moon's apparent diameter being always nearly the same as the sun's, the statements of the last four sentences are applicable to the moon as well as to the sun, and are important in connection with speculation as to the cause of the lunar disturbance of terrestrial magnetism, discovered nearly fifty years ago by Kreil and Sabine.

[1] Communication to the Royal Society, March 18, 1852 (*Phil. Trans.*, vol. clxii. p. 143).

which the sun's heat is renovated. It is a reasonable supposition that the sun was at that time in the act of receiving a more than usual accession of new energy; and the theory which assigns the maintenance of its power to cosmical matter, plunging into it with that prodigious velocity which gravitation would impress upon it as it approached to actual contact with the solar orb, would afford an explanation of this sudden exhibition of intensified light, in harmony with the knowledge we have now attained, that arrested motion is represented by equivalent heat."

It has certainly been a very tempting hypothesis, that quantities of meteoric matter suddenly falling into the sun is the cause, or one of the causes, of those disturbances to which magnetic storms on the earth are due. We may, indeed, knowing that meteorites do fall into the earth, assume without doubt that much more of them fall, in the same time, into the sun. Astronomical reasons, however, led me long ago to conclude that their quantity annually, or per century, or per thousand years, is much too small to supply the energy given out by the sun in heat and light radiated through space, and led me to adopt unqualifiedly Helmholtz's theory, that work done by gravitation on the shrinking mass is the true source of the sun's heat, as given out at present, and has been so for several hundred thousand years, or several million years. It is just possible, however, that the outburst of brightness described by Lord Armstrong may have been due to an extraordinarily great and sudden falling in of meteoric matter, whether direct from extra-planetary space, or from orbital circulation round the sun. But it seems to me much more probable that it was due to a refreshed brightness produced over a larger area of the surface than usual by brilliantly incandescent fluid rushing up from below, to take the place of matter falling down from the surface, in consequence of being cooled in the regular *régime* of solar radiation. It seems, indeed, very improbable that meteors fall in at any time to the sun in sufficient quantity to produce dynamical disturbances at his surface at all comparable with the gigantic storms actually produced by hot fluid rushing up from below, and spreading out over the sun's surface.

But now let us consider for a moment the work which must be done at the sun to produce a terrestrial magnetic storm. Take, for example, the magnetic storm of June 25, 1885, of which Adams gives particulars in his paper of June, 1891 (Phil. Trans., p. 139 and Pl. 9). We find at eleven places, St. Petersburg, Stonyhurst, Wilhelmshaven, Utrecht, Kew, Vienna, Lisbon, San Fernando, Colaba, Batavia, and Melbourne, the horizontal force increased largely from 2 to 2.10 p.m., and fell at all the places from 2.10 to 3 p.m., with some rough ups and downs in the interval. The storm lasted altogether from about noon to 8 p.m. At St. Petersburg, Stonyhurst, and Wilhelmshaven, the horizontal force was above par by 0·00075, 0·00088, and 0·00090 (C.G.S. in each case) at 2.10 p.m.; and below par by 0·0007, 0·00066, 0·00075 at 3 o'clock. The mean value for all the eleven places was nearly 0·0005 above par at 2h. 10m., and 0·0005 below par at 3h. The photographic curves show changes of somewhat similar amounts following one another very irregularly, but with perfectly simultaneous correspondence at the eleven different stations, through the whole eight hours of the storm. To produce such changes as these by any possible dynamical action within the sun, or in his atmosphere, the agent must have worked at something like 160 million million million million horse-power[1] (12×10^{35} ergs per sec.), which is about 364 times the total horse-power ($3{\cdot}3 \times 10^{33}$ ergs per sec.) of the solar radiation. Thus, in this eight hours of a not very severe magnetic storm, as much work must have been done by the sun in sending magnetic waves out in all directions through space as he actually does in four months of his regular heat and light. This result, it seems to me, is absolutely conclusive against the supposition that terrestrial magnetic storms are due to magnetic action of the sun; or to any kind of dynamical action taking place within the sun, or in connection with hurricanes in his atmosphere, or anywhere near the sun outside.

It seems as if we may also be forced to conclude that the supposed connection between magnetic storms and sun-spots is unreal, and that the seeming agreement between the periods has been a mere coincidence.

We are certainly far from having any reasonable explanation of any of the magnetic phenomena of the earth; whether the fact that the earth is a magnet; that its magnetism changes vastly, as it does from century to century; that it has somewhat regular and periodic annual, solar diurnal, lunar diurnal, and sidereal diurnal variations; and (as marvellous as the secular variation) that it is subject to magnetic storms. The more marvellous, and, for the present inexplicable, all these subjects are, the more exciting becomes the pursuit of investigations which must, sooner or later, reward those who persevere in the work. We have at present two good and sure connections between magnetic storms and other phenomena: the aurora above, and the earth currents below, are certainly in full working sympathy with magnetic storms. In this respect the latter part of Mr. Ellis's paper is of special interest, and it is to be hoped that the Greenwich observations of earth currents will be brought thoroughly into relation with the theory of Schuster and Lamb, extended, as indeed Professor Schuster promised to extend it, to include not merely the periodic diurnal variations, but the irregular sudden changes of magnetic force taking place within any short time of a magnetic storm.

In my Presidential address of last year I referred to the action of the International Geodetic Union, on the motion of Prof. Foerster, of Berlin, to send an astronomical expedition to Honolulu for the purpose of making a twelve months' series of observations on latitude, corresponding to twelve months' simultaneous observations to be made in European observatories; and I was enabled, through the kindness of Prof. Foerster, to announce as a preliminary result, derived from the first three months of the observations, that the latitude had increased during that time by ½ sec. at Berlin, and had decreased at Honolulu by almost exactly the same amount. The proposed year's observations, begun in Honolulu on June 1, 1891, were completed by Dr. Marcuse, and an elaborate reduction of them by the permanent Committee of the International Geodetic Union was published a month ago at Berlin. The results are in splendid agreement with those of the European observatories: Berlin, Prag, and Strasbourg. They prove beyond all question that between May 1891 and June 1892 the latitude of each of the three European observatories was a maximum, and of Honolulu a minimum, in the beginning of October, 1891: that the latitude of the European observatories was a minimum, and of Honolulu a maximum, near the beginning of May, 1892: and that the variations during the year followed somewhat approximately, simple harmonic law as if for a period of 385 days, with range of about ¼ sec. above and below the mean latitude in each case. This is just what would result from motion of the north and south polar ends of the earth's instantaneous axis of rotation, in circles on the earth's surface of 7·5 metres radius, at the rate of once round in 385 days.

Sometime previously it had been found by Mr. S. C. Chandler that the irregular variations of latitude which had been discovered in different observatories during the last fifteen years seemed to follow a period of about 427 days, instead of the 306 days given by Peters' and Maxwell's dynamical theory, on the supposition of the earth being wholly a rigid body. And now, the German observations, although not giving so long a period as Chandler's, quite confirm the result that, whatever approximation to following a period there is, in the variations of latitude, it is a period largely exceeding the old estimate of 306 days.

Newcomb, in a letter which I received from him last December, gave, what seems to me to be, undoubtedly, the true explanation of this apparent discrepance from dynamical theory, attributing it to elastic yielding of the earth as a whole. He added a suggestion, specially interesting to myself, that investigation of periodic variations of latitude may prove to be the best means of determining approximately the rigidity of the earth. As it is, we have now, for the first time, what seems to be a quite decisive demonstration of elastic yielding in the earth as a whole, under the influence of a deforming force, whether of centrifugal force round a varying axis, as in the present case, or of tide-generating influences of the sun and moon, with reference to which I first raised the question of elastic yielding of the earth's material many years ago.

The present year's great advance in geological dynamics forms the subject of a contribution by Newcomb to the Monthly Notices of the Royal Astronomical Society of last March. In a later paper, published in the *Astronomische Nachrichten*, he examines records of many observatories, both of Europe and America, from 1865 to the present time, and finds decisive evidence that from 1865 to 1890 the variations of latitude were much less than they have been during the past year, and seeming to show that an augmentation took place, somewhat suddenly, about the year 1890.

When we consider how much water falls on Europe and Asia

[1] 1 horse power = $7{\cdot}46 \times 10^9$ ergs per second.

during a month or two of rainy season, and how many weeks or months must pass before it gets to the sea, and where it has been in the interval, and what has become of the air from which it fell, we need not wonder that the distance of the earth's axis of equilibrium of centrifugal force from the instantaneous axis of rotation should often vary[1] by five or ten metres in the course of a few weeks or months. We can scarcely expect, indeed, that the variation found by the International Geodetic Union during the year beginning June, 1891, should recur periodically for even as much as one or two or three times of the seeming period of 385 days.

One of the most important scientific events of the past year has been Barnard's discovery, on September 9, of a new satellite to Jupiter. On account of the extreme faintness of the object, it has not been observed anywhere except at the Lick Observatory in California. There, at an elevation of 4500 ft., with an atmosphere of great purity, and with a superb refractor of 36″ aperture, they have advantages not obtainable elsewhere. The new satellite is about 112,000 miles distant from Jupiter, and its periodic time is about 11h. 50m. Mr. Barnard concludes a short statement of his discovery with the following sentences:—"It will thus be seen that this new satellite makes two revolutions in one day, and that its periodic time about the planet is less than two hours longer than the axial rotation of Jupiter. Excepting the inner satellite of Mars, it is the most rapidly revolving satellite known. When sufficient observations have been obtained, it will afford a new and independent determination of the mass of Jupiter. Of course, from what I have said in reference to the difficulty of seeing the new satellite, it will be apparent that the most powerful telescopes of the world only will show it" (dated Mount Hamilton, September 21, 1892).

Sir Robert Ball, in calling my attention to it, remarks that "it is by far the most striking addition to the solar system since the discovery of the satellites to Mars in 1877." To all of us it is most interesting that during this year, when we are all sympathizing with the University of Padua in its celebration of the third centenary of its acquisition of Galileo as a professor, we have first gained the knowledge of a fifth satellite in addition to the four discovered by Galileo.

Rudolph Virchow (COPLEY MEDAL).

Professor Virchow's eminent services to science are known throughout the world, and they are far too varied and numerous for enumeration.

He survives Schwann, Henle, and the other pioneers in several branches of natural history who came from the school of Johannes Müller, and at the present time occupies a position of influence and honour equal to that of his great contemporaries Helmholtz, Ludwig, and Du Bois-Reymond.

His contributions to the study of morbid anatomy have thrown light upon the diseases of every part of the body,[2] but the broad and philosophical view he has taken of the processes of pathology has done more than his most brilliant observations to make the science of disease.

In histology he has the chief merit of the classification into epithelial organs, connective tissues, and the higher and more specialized muscle and nerve. He also demonstrated the presence of neuroglia in the brain and spinal cord, and discovered crystalline hæmatoidine, and the true structure of the umbilical cord.

In pathology, strictly so called, his two great achievements—the detection of the cellular activity which lies at the bottom of all morbid as well as normal physiological processes, and the classification of the important group of new growths on a natural histological basis—have each of them not only made an epoch in medicine, but have been the occasion of fresh extension of science by other labourers.

In ethnological and archæological science Professor Virchow has made observations which only the greatness of his other work has thrown into the shade; and, so far from confining himself to technical labours, he has been known since he migrated to Würzburg and returned to Berlin as a public-spirited, far-seeing, and enlightened politician.[3]

[1] See Brit. Assoc. Reports, 1876, Address to Section A, pp. 10–11.

[2] Among these may be mentioned his discovery of lucæmia, of lardaceous degeneration, and glioma; his reconstruction of the kind of tumour known as sarcoma, and his establishment of the important group of granulomata.

[3] A short pamphlet, "Ueber die Nationelle Bedeutung der Naturwissenschaften," may be mentioned as characteristic of the patriotism, the fairness and the broad judgment of the author.

Universally honoured and personally esteemed by most of the leading pathologists in this country, as well as on the Continent and in America, who had the good fortune to be his pupils, Prof. Virchow is a worthy successor of the many illustrious men of science to whom the Copley medal has been awarded.

Nils C. Dunér, Director of the Observatory of Lund (RUMFORD MEDAL).

Dr. Dunér has been continuously at work, since 1871, at astronomical observations (see "R.S. Catalogue").

He began to turn his attention to spectroscopic subjects in 1878, and commenced the publication of his systematic work on Stellar Spectra in 1882.

In 1884 he brought to a conclusion his wonderful observations of stars of Vogel's III Class. His memoir contains a detailed study of the spectra of nearly 400 stars, all which are the most difficult objects to observe. This volume is one of the foundations on which any future work in this direction must be based.

In 1891 he published another series of researches on the rotation of the sun, comparing true solar with telluric lines for regions up to 75° of solar latitude. The result showed a diminution of angular velocity with increasing latitude, thus spectroscopically confirming Carrington's results.

Professor Charles Pritchard, D.D., F.R.S., Director of the Oxford University Observatory (ROYAL MEDAL).

Professor Pritchard began his publications on astronomical subjects in 1852. His first paper and several others which have followed, have dwelt with the construction of object glasses and telescope adjustments.

He was president of the Royal Astronomical Society in the years 1867 and 1868.

He was appointed first Director of the newly-founded observatory at Oxford in 1874. It is now the most active University observatory in the kingdom, as many as fifteen students receiving instruction in observatory work at times. The services he has rendered to astronomy in devising, and keeping at a high standard, the work of the observatory in many directions, including its use as a school, are very noteworthy.

Immediately on the establishment of the observatory he saw the beneficial effects of photographic investigation, and first applied the method, with the old wet-plate photography, to the problem of the physical libration of the moon. He saw that this problem was encumbered in heliometric work by the fact that a set of the observations must take a considerable time, and therefore they were made on a constantly changing disc, necessitating great labour in reduction. By the observations being made in two or three seconds, the picture of the moon did not alter in the time. The result was to show important variations from Bouvard's work, which variations in their important particulars were confirmed by Dr. Hartwig.

Next (1885) the relative motions of the Pleiades were taken up with a view of tracing gravitational effects in the various members of the group. This question is not ripe for solving, but it induced heliometer observers to take up the question, and important progress is now being made.

The photometric work detailed in the "Uranometria Nova Oxoniensis," also published in 1885, consisted in measuring the light received from all stars visible to the naked eye, to 10° south declination, by means of a wedge photometer devised by Prof. Pritchard—a form of photometer now in the hands of many astronomers. In the course of this work Prof. Pritchard, at his own expense, took an assistant to Egypt to determine the effects of atmospheric absorption in a more constant climate than that of Oxford. This photometric work has been recognized by the award of the gold medal of the Royal Astronomical Society.

Having fully determined the capacity of photography for accurate measurement, Prof. Pritchard next applied it to parallax determinations of stars of the second magnitude. Some thirty stars altogether have been investigated, and this work has just been published. Thirty is a greater number than any other astronomer has attempted.

Prof. Pritchard is now working on the International Chart of the Heavens, and taking part in researches to ensure an accurate photometric scale.

John Newport Langley, F.R.S. (ROYAL MEDAL).

Some of the most important of Mr. Langley's researches have been upon the Physiology and Histology of Secreting Glands.

Extending the observations of Kühne and Lea on the pancreas, Mr. Langley showed in an elaborate series of researches, extending over the salivary and most of the important secreting glands of the body, that the formation, as a morphological element within the secreting cell, at the expense of its protoplasm, of the material to be used in the secretion is a general function of secreting cells. The dependence of this function upon the activity of nerves, and upon other forms of excitation, such as the action of drugs, has been greatly elucidated in the course of these researches. Concurrently with the morphological changes within the cells, the chemical changes which occur within the secretion as the result of nerve activity or inactivity have been investigated, and many important facts brought to light regarding the nature of the action or modifications of the action which may be brought to bear upon the secreting cell through the nervous system. These researches are published partly in the Philosophical Transactions, and partly in a long series of articles in the *Journal of Physiology*, which have extended over several years. It is not too much to say that these researches of Mr. Langley upon secreting glands give him a claim to occupy the highest rank as a physiological investigator.

The other most important researches which Mr. Langley has published have been—(1.) Upon the central nervous system, including especially an investigation into the anatomical changes which result from central lesions; (2.) Upon the sympathetic nervous system, and particularly a number of researches, based upon physiological methods, into its peripheral distribution to involuntary muscle and glands. Mr. Langley's eminence in those branches of physiology to which he has mainly devoted his attention is universally admitted, and has been publicly recognized by his having been requested more than once by international assemblies of physiologists to investigate and report on difficult cases submitted to them (*vide* "Transactions of the International Medical Congress," 1881, and "Proceedings of the Physiological Congress at Basel," 1890).

Prof. François Marie Raoult, of Grenoble (DAVY MEDAL).

For his researches on the freezing-points of solutions and on the vapour pressures of solutions.

Sir Joseph Dalton Hooker, F.R.S. (DARWIN MEDAL).

Although the regulations relating to the award of this medal direct that it is to be treated rather as a means of encouraging young naturalists to fresh exertion than as a reward for the life-long labours of the veteran, there would seem to be a special appropriateness in awarding it to one who was intimately associated with Mr. Darwin in the preparation of the "Origin of Species." That no one was more closely associated than Sir J. D. Hooker with Mr. Darwin in the work is abundantly proved by the following passage in the introduction to the "Origin of Species":—"I cannot, however, let this opportunity pass without expressing my deep obligations to Dr. Hooker, who, for the last fifteen years (1844–59), has aided me in every possible way by his large stores of knowledge and his excellent judgment."

NOTES.

MR. W. FLINDERS PETRIE has been appointed to the chair of Egyptology, founded at University College, London, under the will of the late Miss Amelia B. Edwards. He hopes to begin his new duties soon after Christmas, and to undertake the following work:—(1) Lectures on current discoveries, on history, and on the systematic study of Egyptian antiquities; (2) lessons on the language and philology of Egypt; (3) attendance in the library on fixed days for the assistance and direction of students working there; (4) practical training on excavations in Egypt.

THE American Philosophical Society, as we have already stated, proposes to celebrate next year the one hundred and fiftieth anniversary of its foundation. It has now been arranged that reunions will be held at the Hall of the Society in Philadelphia from May 22 to 26, 1893, "at which papers may be offered by title by such delegates as may honour the Society with their presence."

THE foundation stone of the new buildings of the Durham College of Science, Newcastle, will be laid by Lord Durham on Monday, December 5.

MR. EDGAR R. WAITE, curator to the Leeds Philosophical Society, has received from the Government of New South Wales the appointment of assistant curator in the Australian Museum at Sydney, where he will have special charge of the reptile and fish sections. The *Yorkshire Post* says that at Leeds Mr. Waite has in many ways actively identified himself with local scientific research and studies, having for some years been, in conjunction with Mr. Denison Roebuck, responsible for the secretarial work—an honorary position—of the Yorkshire Naturalists' Union, and also editor of the *Naturalist*.

ON November 1 an industrial school which seems likely to be of good service was opened at Lucknow by Sir Auckland Colvin. It is intended to provide a suitable education for children of the artizan class—an education which comprises instruction in reading and writing, arithmetic, elementary mechanics, physics, and drawing, the whole being in subordination to manual training in the workshop, under skilled instructors. Manual training will for the present be confined to carpentry, but ultimately training in iron and other metal work will be added to the curriculum. Drawing will be taught to every pupil from the outset.

VARIOUS members of the department of biology in connection with Columbia College, New York, are now delivering lectures which are addressed especially to persons who desire to keep abreast of the later advances in biology without entering any of the technical courses. The subjects of the lectures are the history of the theory of evolution; the cellular basis of heredity and development; the origin and evolution of fishes; and Amphioxus and other ancestors of the vertebrates.

THE so-called "Boxing Kangaroo" now being exhibited at the Westminster Aquarium is a fine male of *Macropus giganteus* There is, no doubt, a certain amount of humbug in attributing "boxing" qualities to this animal, but it is very interesting to find that a member of the low Mammalian order, "*Marsupialia*," can be so well trained and instructed.

THE weather during the past week has remained very dull in all parts of the country, with occasional fog in London and other places, while some heavy rain has fallen in the north and west. The anticyclone which for some time past had been situated over the eastern portion of the United Kingdom gradually dispersed, and the distribution of pressure became favourable to the passage of cyclonic disturbances across the country. Towards the close of the period an area of very high pressure formed to the southward of our islands, the barometer reading 30·5 ins. and upwards, while to the north of Scotland it was more than an inch lower. Under these conditions strong westerly winds became general, and gales were experienced on our exposed coasts. Temperature was at first mild and very uniform over the whole country, there being generally little difference between the day and night readings, while the air was very damp. On Tuesday, however, the thermometer fell several degrees, with some snow and hail in Scotland and Ireland. The *Weekly Weather Report* shows that for the period ending November 26 rainfall was deficient in all parts of the country except the south of Ireland, where more than twice the average amount fell. Bright sunshine was considerably below the mean in all districts, except in the north of Scotland, where there was 22 per cent. of the possible amount, while the Channel Islands had 16 per cent. It ranged from 3 per cent. in the south-west of England (where the amount quoted for the previous week should have been 20) and midland counties, to 1 in the east of England and less than 0·5 in the north-east of England.

ON the 18th ult. Captain H. Toynbee, late Marine Superintendent of the Meteorological Office, delivered a lecture before the Shipmasters' Society on "Weather Forecasting for the British Islands." The chief object of the lecture was to explain

how a careful observer in the British Islands may form a good judgment of the coming weather. The lecturer showed, with the aid of diagrams, the tracks followed by storm centres, with reference to the conditions of areas of low and high pressure. The reason why storms usually proceed in a north-easterly direction across or skirting these islands was explained as owing to the high barometer generally to be found in the Atlantic in the vicinity of the Azores, while in the neighbourhood of Iceland there is a region where the barometer is generally lower than in the space surrounding it. The storms generally advance so as to leave the low pressure on their left, and the high pressure on their right—moving round the south and east sides of the prevailing low pressure. Considerable stress was laid upon the importance of observing the cirrus clouds, the different motions of which, in conjunction with the indications of the barometer, are useful guides both as to the approach of a storm and the track along which the centre is moving. Several illustrations of these facts were given by the lecturer, who also gave many valuable hints as to what may be learnt from the published daily weather charts.

THE Leeds Naturalists' Club seems to be in no hurry about the publication of its Transactions, those for the year 1890 having only just been issued. The volume, however, has been prepared with great care, and shows that much good work is being done by the Club. Among the contents is a most interesting abstract of a lecture by the Rev. Edward Jones on relics found in Yorkshire caves. Reference was made to the cave at Kirkdale, near York, and the Victoria Cave of Settle, both of which have been well worked and have given valuable results; but attention was directed mainly to the cave found at Elbolton or Thorp, which is situated ten miles north of Skipton and two miles from Grassington. Through the energy of the president and members of the Skipton Natural History Society, this cave, which has been handed over to them, has been worked with great earnestness, and many bones have been turned up. Human remains, representing some thirteen bodies, have been found in an excellent state of preservation. These human beings must have been buried there, as they were all found in a sitting position, with the knees brought under the chin. The cave, however, was not used only as a burial-place, for the remains of charcoal fires, burnt bones, and pieces of pottery have been found. At the time when the lecture was delivered, the excavations had not revealed anything older than the Neolithic period. Among the finds are several specimens of bones of bears, red deer, foxes, dogs, badgers, grizzle and brown bears, &c. Some time after the delivery of the lecture the members of the Club made an excursion to this interesting cave, which was explored for a distance of a hundred feet, and to a vertical depth of thirty feet. The visitors saw many stalactites and stalagmites in course of formation, and the osseous remains of animals, including some now extinct. Mr. Jones pointed out the former location of several human skeletons.

MR. J. W. TOURNEY contributes to *Science* (November 11) an excellent paper on cliff and cave dwellings in Central Arizona. He refers especially to dwellings in cliffs rising a hundred feet or more above Beaver Creek, which flows into the Verde river. In the perpendicular walls of one of these cliffs is a well-preserved ruin known as Montezuma's castle. It is midway between the rim of the cliff and the bed of the stream, and is neither house nor cave, but a combination of the two. Not accessible from the summit of the cliff, it can only be reached from below, and even here not without the use of a ladder, which, if short, the climber must pull up from one ledge to another in making the ascent. The entire front is of artificial walls built of large, flat pieces of limestone, with openings here and there for doors and windows. The rooms are small, only about five feet to the ceiling. Generally a small opening two or three feet in diameter connects one room with another, and a small orifice in the ceiling gives access to the room above. The openings in the ceilings are never directly under one another, so that any one who might stumble could only fall the height of one story. The floors are mostly of flat stones supported on timber cut from the surrounding mountains. Many of the timbers are still sound. The rooms all show considerable skill in their construction. Those in the rear are dark, dungeon-like caves hollowed from the solid rock, and are now the abode of thousands of bats, which fly about in great numbers when disturbed by visitors. A few miles above Montezuma's castle, on the opposite bank of the creek, a conspicuous cone-like mountain rises a few hundred feet above the surrounding country. The summit is a narrow rim enclosing a crater some three hundred feet in diameter and with nearly perpendicular walls. Standing on the rim one can look down a hundred feet upon the dark-blue water of a small lake in the bosom of the mountain. The lake, a hundred yards in diameter and of unknown depth, is known as Montezuma's well. In the steep sides of the crater are a number of caves, which at one time were the abode of man. A few are natural, but the greater number are the result of human effort. The rim is crowned with the fallen walls of an ancient ruin more than a hundred feet long. Far down the mountain-side, below the level of the water in the crater, the outlet of the well flows from between an opening in the rocks. This stream is large and constant, and at present is used to irrigate a ranch in the valley below. Ages ago the builders of caves and castles utilized this same stream to irrigate portions of the neighbouring rich valley.

THE fourth volume of "Reports from the Laboratory of the Royal College of Physicians, Edinburgh," edited by J. B. Tuke and D. Noel Paton, has just been published. The work completed in the Laboratory during the past year was so large that an account of the whole of it could not be included in the present volume.

A LARGE dirigible balloon is being constructed (*La Nature* informs us) at the military balloon works at Chalais-Meudon, under the direction of Commandant Renard. It will be similar in form to the *La France* of 1884–5, but longer; measuring about 230 feet in length and 43 feet in its greatest diameter. By a new arrangement of motor it is expected to be able to make headway against air-currents not exceeding 40 feet per second (or 28 miles an hour). The motor is not fully described, but it will act either with gasoline or the gas of the balloon, giving an effective force of 45 horse-power on the shaft. The total weight of machinery, with supply of gasoline, &c., will be about 30 kilogrammes (or 66 lbs.) per horse power. Previously it has not been possible to make petroleum motors with a less weight than 150 to 200 kilogrammes per horse-power. The screw will be in front, and a large rudder behind; the former will make about 200 turns per minute. The first experiments with this balloon are to be made in the early spring.

DR. HEYDWEILER, of Würzburg, has constructed a new mirror electrometer for high potentials (*Zeitschr. für Instr.*). It is a kind of torsion-balance with bifilar suspension, the charged bodies being a sphere and a ring. The attraction between the two, when at different potentials, is zero when the sphere is at the centre of the ring, and also when it is infinitely removed. Hence at some intermediate distance it is a maximum. In the instrument as constructed there are two spheres of 2 cm. diameter attached to the ends of a conducting bar bent in the form of an S. The combination is suspended in a horizontal plane by two brass wires 0·1 mm. thick attached to the middle of the bar. Two brass rings 10 cm. across are fixed in a vertical position such that the spheres can be made to coincid

with their centres. In the zero position the spheres are at a distance of 3·1cm., this being a little less than the distance of maximum attraction. The deflections are indicated by those of a mirror carried by a thin glass rod attached to the curved arm below, and the motion is damped by a vane immersed in some vegetable oil. The tangents of the angle of deflection are proportional to the differences of potential to within 0·9 per cent., between the scale readings 0·05 and 0·4. The instrument is best adapted to potentials ranging from 6000 to 60,000 volts, but with potentials above 35,000 it is best to immerse it entirely in oil.

AN account of a series of experiments to determine the temperature of the flame of water-gas is given by Mr. E. Blass, of Essen, in *Stahl und Eisen*. The instruments employed were Wyborgh's air pyrometer, Chatelier's electric pyrometer, Hartmann and Braun's telephonic pyrometer, and others by Siemens, Seeger, and Ducretel. It was found that Chatelier's formula for the variation of the specific heat of water vapour and other gases at high temperatures was practically reliable. The temperatures of combustion were taken for various proportions of air and gas, beginning with a large excess of the latter. With 0·18 cubic metres of air to one of gas, the temperature was 425° C. Calculated according to the old formula this would have been 521. Allowing for variation of specific heat, the theoretical value becomes 409. For 0·714 of air, the temperature was 1170, for 4·18 it was 1218, for 9·79 it was 655, and for the proportion of air just sufficient for combustion the flame temperature was 1169°.

A NEW "shortened telescope," constructed by Dr. R. Steinheil, is described in the *Zeitschr. für Instr.* for November. The principle resembles that adopted by Dallmeyer and Dr. A. Steinheil in their telephotographic objectives. A negative system is introduced between the object-glass and the eye-piece, thus increasing its equivalent focal length. If a be the focal length of the objective by itself, r its distance from the negative lens, and the magnification m times that produced without the negative lens, the total length of the tube is given by $l = r + m(a - r)$. In a telescope actually constructed on this system, the object-glass had a focal length of 16·2 cm. Its distance from the nearest surface of the negative lens was 12 cm., the equivalent focal length 60·8 cm., and the total length 27·8 cm. Hence the magnification was 3·75 times that obtained by using the objective alone. In this case, then, a magnification of 22 diameters was obtained with an effective aperture of 4 cm., a total length of 27·8 cm., and a one-inch eye-piece. If the same magnification and illumination had to be obtained by a long-focus objective, the length would have to be 6·8 cm. Thus the length is reduced by more than one-half without the usual disadvantages of short telescopes and eye-pieces of high power.

ACCORDING to a writer in the *Pioneer Mail* of Allahabad, the thatch on Burmese houses gives a tempting shelter to snakes, especially during the rains, and many of the occupants of the houses would be surprised if they knew the number of snakes that share the shelter of their roof on a rainy night. One night an officer was wakened up by a noise in his room; and by the light of a lighted wick, floating in a tumbler of oil, he made out that two combatants were disputing the possession of the small space in the centre of the bedroom. The belligerents turned out to be a snake and a rat, that somehow had jostled against each other in the tiny tenement.

A VALUABLE report on the geology of north-eastern Alabama and adjacent portions of Georgia and Tennessee, by C. Willard Hayes, has been published as a Bulletin of the U.S. Geological Survey. Mr. Hayes explains that in writing the report he has tried to keep it as free as possible from technical terms, and, without sacrificing scientific accuracy, to present the facts in such a way as to make them intelligible to the largest possible number of readers in the region under consideration. Many details which would be of interest to the geologist have been purposely omitted, and only those which were considered essential are given. It is expected that the atlas sheets covering this region will shortly be published by the U.S. Geological Survey, and supply the details to those specially interested which are omitted from the report.

A SECOND edition of Prof. Oliver J. Lodge's "Modern Views of Electricity" has been published by Messrs. Macmillan and Co. A new chapter on recent progress has been added.

A VOLUME on "The Pharmacy and Poison Laws of the United Kingdom" has been issued from the office of *The Chemist and Druggist*. It contains also a brief account of the pharmacy laws in force in Australasia, Canada, and Cape Colony.

MR. CHARLES E. MUNROE, Torpedo Station, Newport, Rhode Island, U.S.A., has completed the manuscript of the second part of his index to the literature of explosives. The first part was issued in 1886. The second will be issued in pamphlet form if an adequate number of subscriptions is obtained.

MESSRS. FRIEDLÄNDER AND SON, Berlin, send us the latest of their lists of the books which they offer for sale. It is a list of works relating to ornithology.

PENTA-IODIDE and penta-bromide of cæsium, together with several other penta-halogen compounds of the metals of the alkalies containing mixed halogens, have been isolated by Messrs. Wells and Wheeler, and are described by them in the current number of the *Zeitschrift für Anorganische Chemie*. Cæsium penta-iodide, CsI_5, is obtained in an impure form when the crystals of the tri-iodide of cæsium, CsI_3, previously obtained by Prof. Wells and described in our note of February last, vol. xlv. p. 325, is treated with hot water, or when solid iodine is treated with a hot solution of cæsium iodide. Either of these processes produce it in the form of a black liquid, which solidifies in the neighbourhood of 73°. The tri-iodide of cæsium, moreover, which is only sparingly soluble in alcohol, is found to be much more readily soluble when a quantity of iodine, corresponding to two atoms for each molecule of the tri-iodide, is added. Upon cooling, crystals of the penta-iodide of cæsium are deposited. Remarkably well-formed crystals are obtained upon evaporation of a more dilute solution over oil of vitriol. The crystals are black and the faces extremely brilliant; they sometimes attain a diameter of a centimetre. They belong to the triclinic system according to Prof. Penfield, by whom they have been measured. They are at once distinguished from crystals of iodine by their form and brittleness. They melt at about 73°. When exposed to the air they lose iodine about as rapidly as crystals of free iodine. These crystals are anhydrous, and yield analytical numbers agreeing with the formula CsI_5. The penta-bromide of cæsium may be similarly obtained by agitating a concentrated solution of cæsium bromide with a large excess of bromine. When such a mixture is allowed to stand at a low temperature the excess of bromine slowly evaporates and the penta-bromide separates in the form of a dark red solid substance. Cæsium penta-bromide $CsBr_5$, is a very unstable substance, losing bromine rapidly at the ordinary temperature. Anothe interesting compound is cæsium tetrachloriodide, $CsCl_4I$, which was obtained by dissolving forty grams of cæsium chloride in mixture of six hundred cubic centimetres of water and two hundred cubic centimetres of concentrated hydrochloric acid, adding

thirty grams of iodine, and then saturating the liquid with chlorine gas. The temperature was raised slightly during the operation, and upon subsequent cooling the compound $CsCl_4I$ was deposited in the form of pale orange-coloured prismatic crystals belonging to the monoclinic system. The compound is only slightly soluble in water, but, with a little loss due to decomposition, may be recrystallized from that liquid. It is, however, quite stable in the air, and only decomposes upon heating, thereby producing the tri-halogen compound, $CsCl_2I$, fusing at 238°, the melting-point of this latter compound. A similar compound, containing rubidium instead of cæsium, $RbCl_4I$, may be obtained in like manner in large orange-coloured tabular crystals, likewise belonging to the monoclinic system, but of different habitus to the crystals of the cæsium compound. An analogous compound containing potassium, KCl_4I, was prepared so long ago as the year 1839, by Filhol. Messrs. Wells and Wheeler finally describe sodium and lithium salts of this description, both of which, however, contain water of crystallization. They are represented by the formulæ $NaCl_4I.2H_2O$ and $LiCl_4I.4H_2O$. Both crystallize well, the former in rhombic prisms; the latter, however, is so extremely deliquescent that measurements of the crystals have not been obtained.

THE additions to the Zoological Society's Gardens during the past week include two Common Marmosets (*Hapale jacchus*) from South-east Brazil, presented by Mrs. Comolli; an Otter (*Lutra vulgaris*) British, presented by Mr. Frederick Collier; a Black-backed Jackal (*Canis mesomelas*, jv.) from South Africa, presented by Miss Thornton; a Common Jackal (*Canis aureus*, ♀) from Fao, Persian Gulf, presented by Mr. W. D. Cumming, C.M.Z.S.; two Short-headed Phalangers (*Belideus breviceps*, ♂ ♀) from Australia, presented by Capt. S. M. Orr; a —— Lemur (*Lemur* ——) from Madagascar; six Crab-eating Opossums (*Didelphys caucrivorus*), four Ypecha Rails (*Aramides ypecha*) from South America, a Green-cheeked Amazon (*Chrysotis viridigenalis*) from Columbia, a Yellow-cheeked Amazon (*Chrysotis autumnalis*) from Honduras, purchased; a Nilotic Monitor (*Varanus niloticus*) from Africa, received in exchange; two Shaw's Gerbilles (*Gerbillus shawi*) born in the Gardens.

OUR ASTRONOMICAL COLUMN.

COMET HOLMES (NOVEMBER 6, 1892).—The elements and ephemeris of this comet have been the subject of much computation during the present month. The first result obtained gave a place resembling in many particulars that of the long-sought-for Biela comet; but owing to an error in one of the observations, the corrected elements stated otherwise. The current number of *Astronomische Nachrichten* (No. 3129) gives four different systems of elements which have as yet been deduced, and it is quite worth while to produce them here, showing also the difference between the observed and reduced places for each in particular:

Elements, Berlin M.T.

	1892.	1892.	1892.	1892.
T =	Feb. 28·362	Mar. 19·630	May 6·301	June 6·841
ω =	340 25′82	339 11′87	334 46 90	328 19′09
Ω =	329 21′15	332 7′30	339 37′87	346 23′01
i =	24 55′15	24 54′91	24 55′33	25 6′06
log *q* =	0·27766	0·26144	0·20868	0·14910
Mean place (O − R) $d\lambda$... ...	−1′04	−0′81	−0′47	+0′20
Mean place (O − R) $d\beta$... ...	+0′86	+0′84	+0′58	+0 41

The latest information about the elements is that which has originated from Prof. Kreutz, who has found *elliptic* elements for the comet; he also says that the elements indicate that perturbations have taken place on account of the comet's proximity to the planet Jupiter. The elements are reduced from the three places observed on November 9, 13, and 17, and are as follows:—

Epoch 1892 Nov. 17·5 M.T. Berlin.

$$\left.\begin{aligned} M &= 22^\circ\ 18'\ 37''.1 \\ \omega &= 13\ 37\ 49\cdot0 \\ \Omega &= 331\ 31\ 3\cdot7 \\ i &= 20\ 54\ 8\cdot1 \\ \phi &= 24\ 39\ 30\cdot7 \\ \mu &= 500''\cdot407 \\ \log u &= 0\cdot567123 \\ U &= 7\cdot09 \text{ years.} \end{aligned}\right\} 1892.0$$

Further observations of this comet are reported (*Comptes rendus*, No. 21). At Algiers, MM. Trépied, Rambaud, and Sy found its position on November 15, at 8h. 53m. 41s., Algiers mean time, to be: App. R.A. oh. 43m. 22·28s. App. Decl. +37° 43′ 3″·9. The corresponding values found at Lyon by M. G. Le Cadet at 8h. 47m. 33s., Paris mean time, were: App. R.A. oh. 43m. 22·72s. App. Decl. + 37° 43′ 5″·9. The comet presented a bright nebulosity in the form of an elliptic segment with its axis directed in the position angle 150°, its length and breadth both being 10′. The northern edge appeared rounded and well defined. At the focus of the ellipse a condensation could be distinguished, about 20″ broad, with a prolongation inclined to the axis of the ellipse. An attempt at calculating the elements of the orbit has been made by M. Schulhof. The slow motion of the comet renders this task very difficult. Among the various systems of elements tentatively fixed there is only one which fairly agrees with all observations. In this the excentricity is as small as 0·355386, so that it will probably be possible to follow the comet throughout its orbit with the most powerful instruments. The other elements thus determined are: $\pi = 0^\circ 0' 39''.1$, $\Omega = 328^\circ 32' 40''.7$, $i = 20^\circ 26' 46''.8$, and $\log g = 0\cdot360966$.

At Bordeaux, M. F. Courty succeeded in photographing the brighter portions of the comet on November 13, with one hour's exposure. Another photograph, taken by MM. Paul and Prosper Henry at Paris, was presented to the Academy by M. Tisserand. It was obtained on November 14, with the chart photographic equatorial. The exposure lasted two hours. It is a very fine photograph, showing a well-defined and nearly circular contour. The nucleus is bright, excentric and lengthened out. Several stars can be seen through it. There is no tail except the lengthening of the nucleus, which does not extend beyond the limits of the nebulosity.

A BRIGHT COMET.—A telegram from Kiel states that Mr. W. R. Brooks has discovered a bright comet. As determined at Cambridge, U.S., its place was, on November 21, at 16h. 44·6m. Cambridge M.T.

R.A. 12h. 59m. 15·6s.
Decl. +13° 50′ 27″·0
Daily motion +1m. 32s., and +25′ respectively.

Another telegram, also from Kiel, gives the position, as obtained at Vienna on November 24, at 15h. 49·7m. (Vienna M.T.), as

R.A. 13h. 3m. 6·4s.
Decl. +15° 0′ 36″.

ASTRONOMICAL INSTRUMENTS UP TO DATE.—We have received a circular signed by Dr. L. Ambronn, of the Göttingen Observatory, and Herr Julius Springer, publisher in Berlin, setting forth the contents of a work which they propose to publish with regard to the general principles, constructions, and methods of using astronomical instruments in general. Such a book, of course, to be of the greatest value to science, must be completely done, but any one who is acquainted with the compiler and publisher mentioned above will be sure that each will do his share thoroughly and honestly. In constructing such a compendium of instruments as this is proposed to be, we might say it would be impossible for one man to do it alone, for the present state of the *feintechnik* has reached such a high pitch and the branches of astronomy are so numerous, that such an undertaking would simply be out of question. The object of this circular, besides stating the lines on which the work will be written, is to request the co-operation of all observatories. Astronomical science, especially the theoretical side, owes much, as we all know, to German workers, so that we can rely on a good response being given to this request. What is

asked is that descriptions, together with drawings or photographs not only of typical instruments but of the important parts of them, should be sent. Technical drawings also are requested, if obtainable, and these very probably could be obtained from the makers of the instruments in question. Of course it is not required that each observatory should send say a description, &c., of the transit instrument there in use, but it is hoped that any instrument of peculiar construction or special merit should be referred to. It is needless to add that all drawings, &c., if requested, will be returned with as little delay as possible, and the undersigners of the circular thank in advance all those who respond towards the completion of this undertaking. The address to which the drawings, &c., may be sent is as follows :—Dr. L. Ambronn, Göttingen, Kgl. Sternwarte.

MOTION OF β PERSEI.—*Astronomical Journal*, No. 277, contains a short note calling the attention of transit observers to the importance of observation of this variable, to confirm the irregularity in its proper motion. At the present time Algol and his neighbouring stars are conveniently situated, and it is hoped that the following list of stars will be added to working lists generally where their observation is not inconsistent with other work. The places are for the year 1875 :—

	R.A.			Decl.	
	h.	m.	s.	°	′
γ Andromedæ ...	1	56	14	41	43·7
β Trianguli ...	2	2	7	34	23·7
θ Persei ...	2	35	40	48	41·9
41 Arietis ...	2	42	38	26	44·6
γ Persei ...	2	55	45	53	0·9
φ Persei ...	2	57	10	38	21·3
β Persei ...	3	0	2	40	28·3
α Persei ..	3	15	24	49	24·9
δ Persei ...	3	34	2	47	23·1
ν Persei ...	3	36	42	42	10·9
η Tauri ...	3	40	3	23	43·0
ζ Persei ...	3	46	17	31	30·6
ϵ Persei ...	3	49	28	39	38·8
ξ Persei ...	3	50	51	35	25·8

PROPER MOTIONS.—M. Deslandres, in *Comptes rendus* of November 14, communicates the recent work he has been carrying out with regard to the spectroscopic determinations of proper motions. The first part contains a description of the apparatus employed, showing how he has completely altered one instrument specially for this work. During the ten months of the year he has obtained several proofs of stars susceptible of furnishing radial velocity. The following are among some of the important methods of procedure :—(1) The luminous "faisceaux" of the star and of the source of light have the same aperture, and are thus as identical as possible, a condition necessary to the absolute measure of displacements. (2) The displacements of spectra is measured not only with the Hy line of hydrogen, but with all the hydrogen, calcium, and iron lines. (3) The large surface of the mirror renders the possibility of measuring the velocities of 250 stars. Some of the results already obtained show that the work, when finished, will be of a very reliable and accurate kind. For instance, the velocity of Venus has been obtained instrumentally as 15 kilometers, while that calculated amounted to 13·55 k.m. The velocity of α Auriga on February 5, employing 30 lines of comparison, came out as 43·5 k.m., and the velocities of the components of β Auriga, a spectroscopic double, were obtained on the same day as − 845 k.m. and + 97 k.m.

GEOGRAPHICAL NOTES.

THE measurement of an arc of the meridian between Dunkirk and the Spanish frontier, which has recently been completed with the highest precision by the French Government, shows that the measurement by Delambre and Méchain in determining the length of the metre was 146·6 feet, or $\frac{2}{10000}$th too short. The new measurement accords very closely indeed with the value as deduced from Clarke's ellipsoid.

A NEW weekly paper devoted to African geography, under the title of Kettler's *Afrikanische Nachrichten*, was started at Weimar in July last, with the object of collecting and publishing the most recent information on all matters connected with Africa and the Africans. An ingenious feature is that of giving a sketch map of parts of Africa, with a small section of a map of some well-known part of Germany on the same scale below it, for the purpose of ready comparison of distances.

MR. AND MRS. THEODORE BENT have arranged to spend the winter in Abyssinia studying the ancient monuments of Axum. They will leave this country about the middle of December. We understand that Mr. Bent would welcome a scientific man who might wish to work at any of the natural conditions of eastern Abyssinia, and take advantage of the arrangements which have been made for the safety and comfort of the party. It would, of course, be necessary for such a companion to pay his own expenses and provide his own outfit.

A SPECIAL general meeting of the Royal Geographical Society was held on Monday afternoon to consider some alterations in the rules, recently decided on by the Council. It was agreed to raise the entrance fee to the Society from £3 to £5, and to augment the life-composition accordingly, relief being, however, granted by a diminution of the commutation fee to members of long standing. Other changes were made to bring the laws into harmony with the present practice of the Society in several minor matters. The meeting also passed a resolution associating itself with the act of the Council in no longer withholding the Fellowship of the Society from women.

MR. JOSEPH THOMSON'S JOURNEY TO LAKE BANGWEOLO.

MR. JOSEPH THOMSON read a paper on his expedition to Lake Bangweolo in 1890–91 to the Royal Geographical meeting on Monday night. The paper was not only of a thoroughly scientific character, but also a model of literary grace, Mr. Thomson having the trained eye which enables him to detect and throw into prominence the really important features. The expedition went up the Zambesi by way of the Kwakwa creek, encountering considerable hostility and obstruction from the Portuguese authorities on the way. Mr. Thomson speaks warmly of the great work done by the Scottish missionaries in the Blantyre and Nyassa districts. Under the kind but firm control of the missionaries the warlike Angoni tribes came in thousands to cultivate the fields, which formerly they visited only for plunder, and for the first time in all his African travels Mr. Thomson found a spot where the advent of the white man was an unmitigated blessing to the natives.

Barometric observations made while waiting for porters on the western coast of Lake Nyassa made the elevation of the lake 1430 feet, a somewhat lower result than was formerly arrived at. On August 23, 1890, the expedition, comprising Mr. Grant, Mr. Charles Wilson, and 153 porters, started from Kotakota and struck westward through unmapped country, a rough and sparsely wooded plateau with little running water. The route lay along a strip of debateable ground, inhabited by an excitable, warlike tribe, and raided equally by Mwasi's people from the north and Mpeseni's from the south. Great tact was required to avoid bloodshed, but the expedition passed safely. Then crossing the fine fertile plain of the Loangwa river, they passed over and climbed the steep Muchinga mountains to the high plateau beyond. So far the rocks had been metamorphic, with intruded masses of granite, overlaid in the valley by sandstones, shales, and marls. At one place great fossil-tree trunks were found. The Loangwa-Kafue plateau was magnificent country, glorious with the tints of early spring on the stunted trees which formed a scraggy forest over most of the surface. But no sign could be seen of the Lokinga mountains, nor was any word heard from the natives of that range so conspicuous on the maps; but on the watershed of the plateau, 5000 feet above the sea, rose the Vimbe hills in a series of isolated domes, perhaps rising 1000 feet higher. A new lake, thirty square miles in area, was found in a dip of the plateau, and named after the Moirs. Then troubles began. Small-pox broke out amongst the porters, and when Chitambo's was reached no trace could be found of the lake, on the margin of which it was supposed to stand. While the white members of the expedition were attending to their sick followers some of the healthy Swahilis marched to Old Chitambo's (which is not in Ilala but Kalinde), now deserted, and twenty miles distant from the present village, finding the tree under which the heart of Livingstone was buried still standing, and the inscription on it legible. In the dry season the Chambeze does not enter Lake Bangweolo at all, but flows direct across the marsh to the Luapula, but in the wet season

the whole of the great marsh to the south is flooded up to Chitambo. The level at that time was made out to be 3750 feet, about 250 feet lower than Livingstone's estimate. After a rest for recovering health the expedition followed the Luapula eastward through fertile country, and leaving it where the curve from the north occurs, struck across for the Kafue, but small-pox reappeared, the land was ravaged by half-caste Portuguese slave-raiders, Mr. Thomson himself fell ill, and the course had to be changed to the south with the hope of turning west again. But matters got worse instead of better, and after touching the borders of Manica, a return had to be made to Lake Nyassa, along the southern margin of the plateau, through deep valleys, and climbing the steep slopes of the Muchinga Mountains, here separated by the great parallel valley of the Lukosashe from the plateau. All the way the land was seen to be of immense possibilities for cultivation, but neglected, and inhabited by a wretched people governed by Mpeseni, himself the vilest of them all. Kotakota on the lake was reached again on January 4th, 1891, after a total journey of 1200 miles, which resulted in many important rectifications of position and much information as to the future possibilities of the plateaux.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Dr. Hobson, late deputy Lowndean Professor, has been elected a representative of the Mathematical Board on the General Board of Studies.

Plans for a handsome building to serve as the Sedgwick Memorial Museum of Geology have been submitted to the Senate, the estimated cost being £26,000. Four members of the Syndicate appointed to prepare the plans dissent from the report of the majority, chiefly on the ground that the internal arrangements are unsatisfactory, and that the cost, initial and annual, of the proposed building will be excessive. The divergent views held on the subject will be discussed by the Senate on Saturday, December 3.

The Senate have agreed to confer on Sir R. S. Ball, the new Lowndean Professor, the complete degree of M.A., *honoris causa*.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, November 11.—Mr. Walter Baily, M.A., Vice-President, in the chair.—The discussion on Mr. Williams's paper, the dimensions of physical quantities, was resumed by Dr. Burton. He remarked that the idea that so-called "specific quantities," such as specific gravity, are pure numbers was an erroneous one, and liable to lead to difficulties. The specific gravity of a substance was of the nature of density, and was only a simple number on the convention that the density of water was taken as unity. If dimensions be given to specific quantities their interpretation would, he thought, be easy when the rational dimensional formulæ were found. Referring to Prof. Fitzgerald's comments, he said, although the contention that all energy is ultimately kinetic could not be gainsaid, the distinction commonly drawn between kinetic and potential energy involved nothing contrary to this view, and was useful and convenient in many cases. As to the dimensions of μ and k he was inclined to favour Mr. Williams's views, for several considerations suggest that the two capacities of the medium are essentially different. Arguments to show that μ was probably absolutely constant in the ether, whilst k might be variable, were brought forward. Of the two systems of dimensions for μ and k suggested by Mr. Williams, that which made μ a density seemed preferable.—Prof. A. Lodge said he was greatly interested in propagating the idea that physical quantities are concrete, and therefore welcomed Mr. Williams's paper. He thought it desirable to keep some names for abstract numbers, and "specific gravity" should be one. If another name involving dimensions was required "specific weight," or "weight per unit volume," might be used. Speaking of the dimensions of the various terms of an equation he did not think it was usually recognized that in ordinary algebra or Cartesian geometry the principle of directed terms was rigidly adhered to, for if directed at all every term of such an equation was directed along the same line. In this respect ordinary algebra was more rigid than vector algebra. Even if circular functions were involved, as in polar co-ordinates, they had the effect of making the directions of the terms the same. Other instances of problems bringing out the same fact were mentioned. Mr. Boys thought Mr. Madden had been arguing in a circle when he spoke of the astronomical unit of mass, and deduced the dimensions of mass as L^3/T^2 from the equation $MLT^{-2} = M^2/L^2$, for it was quite impossible that this equation could be true unless γ, the gravitation constant, was introduced on the right-hand side. Mr. Williams's method was quite the reverse, for he maintained that unless k and μ were introduced in the dimensions of electric and magnetic quantities, their dimensional formulæ could not indicate the true nature of those quantities, and hence were open to objection. Mr. W. Baily, whilst agreeing with Mr. Williams on most essential points, thought the total omission of L from dimensional formulæ made the expressions more complicated and less symmetrical. For example, such expressions as XY/Z, X^2 and XYZ, which respectively represent undirected length, area, and volume, might with advantage be written L, L^2, and L^3 respectively. The restriction of the dimensions of μ and k to those which give interpretable dimensional formulæ for electrical and magnetic quantities seemed scarcely justified. Both the systems proposed could not be right, and he thought it would be more in accordance with our present want of knowledge, if a quantity U of unknown dimensions were introduced such that μ or $k = U^2$. density and k^{-1} or $\mu^{-1} = U^2$. rigidity. This would keep in view the fact that the absolute dimensions of quantities involving U were unknown. A list of the dimensions of the various quantities based on this arrangement was given. Mr. Swinburne, referring to the conventional nature of many units, said great differences exist between the ideas held by different persons about such units. Starting with the convention that unlike quantities could be multiplied together, he might have six ampères flowing in an electric circuit under a pressure of ten volts, and he might say he had sixty volt-ampères. The term "volt-ampère" could be regarded as indicating that the sixty was the numerical result of multiplying a number of volts by a number of ampères, or on the other hand it might be understood as a new unit, a *watt*, compounded of a volt and an ampère. Before Prof. Rücker's paper on suppressed dimensions was published, an electrician might have suggested measuring the length of a bench by sending an alternating current through it and determining its self-induction, which he regarded as a length. Prof. Rücker, however, would say that this could not give the right result, for μ must be taken into account. He was inclined to think that dimensions were liable to mislead. Referring to scientific writers as authorities, he said Maxwell had been careless in some cases, for he had sometimes given dimensional formulæ as zero, which really ought to have been $L^0\ M^0\ T^0$, or unity. In French text-books the errors had been corrected. Mr. Williams, in reply to Mr. Madden's remarks about self-induction being a length, pointed out that the subject might be looked at in two different ways, depending on whether one thinks of the *standard* of self-induction as the practical standard of measurement, or the *unit* of self-induction as a physical quantity. In the former case the *standard* was a length, but in the latter the *unit* was a quantity of the same *species* as self-induction, the nature of which was as yet unknown. If its dynamical nature was known, then the absolute dimensions of all other magnetic and electric quantities would also be determined. In answer to Prof. Fitzgerald's remarks he said it was hardly likely that he should be unacquainted with the common view that kinetic and potential energies were ultimately quantities of the same kind, for it was a view with which he was quite familiar. The fact that they have the same dimensions was sufficient to show their identity, and the idea that all energy is ultimately kinetic was fundamental to his paper. This, however, did not imply that electrification and magnetization are of necessity the same, and the suggestion that they may be the same was only one of several "probable suggestions," all of which were entitled to consideration. His chief reason for regarding Prof. Fitzgerald's suggestion as probably incorrect was that it led to a system of dimensional formulæ incapable of rational mechanical interpretation, and containing fractional powers of the fundamental units. Prof. Fitzgerald's system would make resistance an abstract number, and μ and k directed quantities, whereas the former was a concrete quantity and the two latter must be scalar in isotropic media. If he (Mr. Williams) had erred in treating electrification and magnetization as different phenomena he could only plead that he had

done nothing more than follow such authorities as Lord Kelvin, Dr. Lodge, and Mr. O. Heaviside in the matter.—The discussion on Mr. Sutherland's paper, on the laws of molecular force, was reopened by Prof. Perry reading a communication from the President, Prof. Fitzgerald. He objected to discontinuous theories, especially when Clausius had given a continuous formulæ much more accurate over a very long range than Mr. Sutherland's discontinuous ones. The introduction of Brownian motions without carefully estimating the rates required and energy represented, and without giving any dynamical explanation of their existence, was not satisfactory. It would, he said, be most interesting if Mr. Sutherland would calculate the law of variation of temperature with height of a column of convectionless gas, under conduction alone (for Maxwell thought the inverse fifth power law of molecular attraction was the only one that gave uniformity of temperature under these conditions), and if necessary make tests with solid bars. Referring to the statement that molecular attraction at one cm. was comparable with gravitation at the same distance, he thought Mr. Boys would question this, and he suggested an *experimentum crucis* of the inverse fourth power law. Both the inverse fourth and inverse fifth power laws, assumed symmetry which did not exist. He also took exception to other parts of the paper. Dr. Gladstone, referring to the relative dynic and refraction equivalents given in Table XXVIII. of the paper, said he thought it interesting to make a similar comparison between dynic and dispersion and magnetic rotation equivalents. The result as exhibited in a complete table showed a certain proportionality between the four columns but the differences were beyond the limits of experimental error. Mr. Sutherland, however, sometimes reckoned the dynic equivalent of hydrogen as 0·215, and at other times looked upon it as negligible. The analogies between the optical equivalents did not depend on the proportionality of the numbers so much as upon the fact that the refraction, dispersion, and magnetic rotation equivalents of a compound was the sum of the corresponding equivalents of its constituent atoms, modified to some extent by the way in which they were combined. Whilst a somewhat similar relation held true for the dynic equivalents, the effect of "double-linking" of carbon atoms, so evident in the optical properties, was scarcely perceptible. The result of calculating the constants from Ml instead of from M^2l was next discussed, the effect of which was to quite upset the proportionality before noticeable. Mr. S. H. Burbury said that on referring to the author's original paper, on which the present one was based, he found that a uniform distribution of molecules was assumed. On this supposition the demonstrations given were quite correct, and the potential was a maximum. If, however, the molecules were in motion the average potential must be less than the maximum, and the deductions in the present paper being based on wrong assumptions were liable to error. Prof. Ramsay remarked that many statements in the paper, on the subject of critical points, were very doubtful. Separate equations for the different states of matter were not satisfactory, neither was the artificial division of substance into five classes. The predicted differences in the critical points due to capillarity, had not been found to exist. Speaking of the virial equation, he said that hitherto R had been taken as constant. Considerations he had recently made led him to believe that R was not constant. The whole question should be reconsidered regarding R as a variable. Mr. Macfarlane Gray said he had been working at subjects similar to those dealt with in Mr. Sutherland's paper, but from an opposite point of view, no attraction being supposed to exist between molecules. In the theoretical treatment of steam he found that no arbitrary constants were required, for all could be determined thermo-dynamically. The calculated results were in perfect accord with M. Cailletet's exhaustive experiments except at very high pressures, and even here, the theoretical volume was the mean between those obtained experimentally by Cailletet and Battelli respectively. Prof. Herschel pointed out that Villarçeau had discussed the equation of the virial, where the chemical and mechanical energies were not supposed to balance each other. Mr. Sutherland's paper all turns on the existence of such a balance, and he (Prof. Herschel) could not understand why this balancing was necessary. The discussion was then closed, and the meeting adjourned.

Geological Society, November 9.—W. H. Hudleston, F.R.S., President, in the chair.—The following communications were read:—A sketch of the geology of the iron, gold, and copper districts of Michigan, by Prof. M. E. Wadsworth. After an enumeration of the divisions of the azoic and palæozoic systems of the upper and lower peninsulas of Michigan, the author describes the mechanically and chemically formed azoic rocks, and those produced by igneous agency, adding a table which shows his scheme of classification of rocks, and explaining it. The divisions of the azoic system are then described in order, beginning with the oldest—the cascade formation, which consists of gneissose granites or gneisses, basic eruptives and schists, jaspilites and associated iron ores, and granites. The rock of the succeeding republic formation are given as nearly as possible in the order of their ages, commencing with the oldest:—Conglomerate, breccia and conglomeratic schist, quartzite, dolomite, jaspilite and associated iron ores, argillite and schist, granite and felsite, diabase, diorite and porodite, and porphyrite. The author gives a full account of the character, composition, and mode of occurrence of jaspilite, and discusses the origin of this rock and its associated ores, which he at one time considered eruptive; but new evidence discovered by the State Survey and the United States Survey leads him to believe that he will have to abandon that view entirely. In the newest azoic formation, the Holyoke formation, the following rocks are met with:—Conglomerate, breccia and conglomeratic schist, quartzite, dolomite, argillite, greywacke and schist, granite and felsite (?), diabase, diorite, porodite, peridotite, serpentine, and melaphyre or picrite. The conglomerates of the Holyoke formation contain numerous pebbles of the jaspilites of the underlying republic formation; a description of the Holyoke rocks is given, and special points in connexion with them are discussed. The author next treats of the chemical deposits of the azoic system, gives a provisional scheme of classification of ores, and discusses the origin of ore deposits. The rocks of the palæozoic system are next described, and it is maintained that the eastern sandstone of lower silurian age underlies the copper-bearing or Keweenawan rocks. The veins and copper deposits are described in detail, and the paper concludes with some miscellaneous analyses and descriptions, as well as a list of minerals found in Michigan. After the reading of this paper, the President noted that it presented three sets of questions of much importance, viz., those bearing on the archæan rocks, the iron deposits and jaspilites, and the copper and gold deposits respectively. As regards the classification of the archæan rocks, some might wonder what the terms used by the author meant. The words laurentian and huronian used in Canada seemed not to be tolerated in Michigan. The officers of the United States Geological Survey have described all the archæan formations noticed by the author; the cascade as the fundamental complex, the republic as the lower marquette, and the Holyoke as the upper marquette. Was each State of the Union going to divide these archæan rocks after its own fashion? With regard to the iron rocks, he would observe that the author, after enumerating all the views in favour of their volcanic origin, now admitted that he was wrong, and that Irving and others were correct. The most important question was how the iron ores were really formed, and to this it was difficult to find a complete answer in the paper. Sir Archibald Geikie remarked that it was hardly possible to criticize a voluminous paper of this nature, in the reading of which much of the detailed statement of facts was necessarily omitted. One of its most interesting points related to the nature and classification of the rocks intermediate between the base of the Cambrian system and the oldest or fundamental gneisses. The plan which Prof. Wadsworth followed of adopting local names for the several subdivisions of the series in each region was no doubt in the meantime of advantage, until some method of correlation and identification from region to region could be discovered. But it unavoidably led to temporary confusion, for the same rock-group might turn out to have received many different names. He thought it would be of service if geologists could agree upon some general term which would denote the whole of the sedimentary groups or systems which intervene between the old gneisses and the *Olenellus*-zone. Various names had been proposed, such as azoic, eozoic, proterozoic, algonkian, to each of which some objection may be raised. The existence of a number of very thick systems of sedimentary deposits between the base of the Cambrian formation and the gneisses was now well established in this country and in North America. In the upper members of this series fossils had been found, and it might eventually be possible to group the rocks by means of palæontological evidence. But in the meantime it would be convenient to class them under one general name which would clearly mark them off from the true archæan gneisses, &c., below them and the palæozoic rocks

above. Dr. Hicks congratulated Prof. Wadsworth on his important communication; but he strongly objected to the application of the term Silurian, instead of Cambrian, to the lower palæozoic rocks of America. Dr. Hicks did not think that the author had proved his case with regard to the Keweenawan rocks, and he was still inclined to believe that they would prove to be, as suggested by other American geologists, of pre-Cambrian age—the apparent superposition being due to overthrust faults. The term eozoic, now that worm-tracks have been discovered in the pre-Cambrian rocks, is more correct than azoic for the sedimentary rocks of that age. Moreover, other organic remains will certainly be found, for it is inconceivable that ancestors of the forms comprising the rich fauna at the base of the Cambrian should not have been entombed in earlier rocks. Mr. H. Bauerman, considering the three hypotheses as to the origin of the iron ores—namely, dehydration of limonites in sandy beds, transformation from siderite, and the breaking-up of highly ferriferous igneous masses into quartz and hæmatite—thought that the first was the most likely, although there were certainly difficulties in connexion with it which made it desirable that the newer views upon the subject should be presented. He was therefore glad that they were likely to have a detailed exposition of the author's views in the journal. As regards the origin of the copper deposits, he believed that Dr. Wadsworth agreed with the views brought before the society several years since. In conclusion, he called attention to the gold deposits, which were of comparatively recent discovery, and interesting from the large number of minerals associated with the auriferous quartz veinstuff. Sir Lowthian Bell and Mr. Marr also spoke.—The gold quartz deposits of Pahang (Malay Peninsula), by H. M. Becher.—The Pambula gold-deposits, by F. D. Power.

Zoological Society, November 15.—Dr. A. Günther, F.R.S., Vice-President, in the chair.—The Secretary read a report on the additions that had been made to the Society's Menagerie during the month of October 1892, and called special attention to a very fine male Ostrich (*Struthio camelus*) presented by Her Majesty the Queen, and to a specimen of what appeared to be a new and undescribed Monkey of the genus *Cercopithecus*, obtained by Dr. Moloney at Chindi, on the Lower Zambesi, for which the name *Cercopithecus stairsi* was proposed. Attention was also called to the receipt of a series of specimens of mammals, birds, and reptiles, brought by Mr. Frank Finn, on his recent return from a zoological expedition to Zanzibar, and received from several correspondents of the Society at Zanzibar and Mombasa.—The Secretary exhibited (on behalf of Mr. T. Ground) a specimen of the Siberian Pectoral Sandpiper (*Tringa acuminata*) killed in Norfolk.—Mr. G. A. Boulenger read a paper describing the remains of an extinct gigantic tortoise from Madagascar (*Testudo grandidieri*, Vaill.), based on specimens obtained in caves in South-west Madagascar by Mr. Last, and transmitted to the British Museum. The species was stated to be most nearly allied to *Testudo gigantea* of the Aldabra Islands.—Mr. W. Bateson and Mr. H. H. Brindley read a paper giving the statistical results of measurements of the horns of certain beetles and of the forcipes of the male earwig. It appeared that in some of these cases the males form two groups, "high" and "low"; the moderately high and the moderately low being more frequent than the mean form in the same locality. It was pointed out that this result was not consistent with the hypothesis of fortuitous variation about one mean form.—A communication was read from Mr. O. Thomas containing the description of a new monkey of the genus *Semnopithecus* from Northern Borneo, which he proposed to call *S. everetti* after Mr. A. Everett, its discoverer.—Mr. G. A. Boulenger read a description of a Blennioid fish from Kamtschatka belonging to a new generic form, and proposed to be called *Blenniophidium petropauli*. The specimen had been obtained in the harbour of Petropaulovski by Sir George Baden Powell, M.P., in September 1891.

Royal Meteorological Society, November 16.—Mr. A. Brewin, Vice-President, in the chair.—An interesting paper by Mr. J. Lovel was read on the thunderstorm, cloudburst, and flood at Langtoft, East Yorkshire, July 3, 1892. The author gives an account of the thunderstorm as experienced at Driffield on the evening of this day; the full force of the storm was, however, felt in the wold valleys, which lie to the north and north-west of Driffield, where great quantities of soil and gravel were removed from the hillsides and carried to the lower districts, doing a large amount of damage. Many houses in the lower parts of Driffield were flooded, and a bridge considerably injured. The storm was most severe in a basin of valleys close to the village of Langtoft, where three trenches, sixty-eight yards in length and of great width and depth, were scooped out of the solid rock by the force of the water from the cloudburst. From the appearance of the trenches it is probable that there were three waterspouts moving abreast simultaneously. This particular locality seems to be favourable for the formation of cloudbursts, as there are records of great floods having previously occurred at Langtoft, notably on April 10, 1657, June, 1857, and June 9, 1888. The author gives, in an appendix, a number of observations made on similar occurrences, together with particulars and opinions as to the cause of such outbursts by several eminent authorities.—Mr. W. H. Dines also read a paper, remarks on the measurement of the maximum wind pressure, and description of a new instrument for indicating and recording the maximum. For some years the author has been conducting a large number of experiments with various forms of anemometer; and in the early part of the present year recommended the adoption of the tube anemometer for general use, as it appeared to possess numerous advantages. The head is simple in construction, and so strong that it is practically indestructible by the most violent hurricane. The recording apparatus can be placed at any reasonable distance from the head, and the connecting pipes may go round several sharp corners without harm. The power is conveyed from the head without loss by friction, and hence the instrument may be made sensitive to very low velocities without impairing its ability to resist the most severe gale. In the present paper the author describes an arrangement of this form of anemometer which he has devised for indicating very light winds as well as recording the maximum wind pressure.

Linnean Society, November 17.—Prof. Stewart, President, in the chair.—The President having announced a proposal by the council to present a congratulatory address to the Rev. Leonard Blomefield (formerly Jenyns) on the occasion of the seventieth anniversary of his election as a Fellow of the Society, and in recognition of his continuous and useful labours as a zoologist, it was moved by Sir Wm. Flower and seconded by Dr. St George Mivart, that the address be signed and forwarded as proposed. This was carried unanimously. In moving the resolution, Sir Wm. Flower took occasion to sketch the scientific career of Mr. Blomefield, who is now in his ninety-third year, and to recapitulate the works of which he is the author under his earlier and better known name of Jenyns. The address, which was beautifully illuminated on vellum, was then signed by those present.—Mr. George Murray exhibited and made remarks upon a genus of Algæ (*Halicystis*) new to Britain, the species shown being *H. ventricosa* from the West Indies, and *H. ovalis* from the Clyde Sea area.—Mr. Buxton Shillitoe exhibited an artificial cluster of the fruit of *Pyrus sorbus*, as put up for ripening by cultivators in Sussex.—A paper was then read by the Rev. Prof. Henslow on a theoretical origin of endogens through an aquatic habit based on the structure of the vegetative organs. The lecture, which was very fluently delivered, was profusely illustrated, and drew forth some interesting criticism from Prof. Boulger, Messrs. Henry Groves, H. Goss, and Patrick Geddes, to which Prof. Henslow replied.—On behalf of Mr. George Lewes, who was unable to be present, a paper was read by Mr. W. Percy Sladen on the *Buprestidæ* of Japan, upon which some criticism was offered by Mr. W. F. Kirby.

Royal Microscopical Society, November 16.—Dr. R. Braithwaite in the chair.—Mr. T. F. Smith read a note on the character of markings on the *Podura* scale.—An account of Mr. W. West's paper on the freshwater algæ of the English lake district was given by Mr. A. W. Bennett, who thought it was an exceedingly important contribution to our knowledge of the algæ of that district.—Mr. F. Chapman gave a *résumé* of Pt. 3 of his description of the foraminifera of the Gault of Folkestone.—Mr. C. Haughton Gill read a paper on a fungus internally parasitic in certain diatoms, illustrating his subject with specimens and photomicrographs. Mr. Bennett said that he had observed structures which might be of a similar character in desmids. He should like to enquire if by the term "spores" Mr. Gill did not mean zoospores? Had he observed them to be possessed of vibratile cilia? And could he form any idea as to how they came to be inside the diatoms? It was possible that they might be transmitted in some way by inheritance, and if so that might account for their great abundance in particular species. Mr. Gill said

that the question how these things got into diatoms was one still under consideration. As to the movements of the spores he was not at present perfectly certain that they moved at all more than a very short distance from the orifice of the beak, but he had not yet had time to examine them sufficiently to be able to answer the question as to whether they were ciliated. Diatoms were by no means the tightly shut-up boxes which they were supposed to be; they could not live or absorb nutriment unless there was some sort of passage, and he thought there was very likely a means of penetration all over them to admit of the diffusion of fluid throughout.—Mr. E. M. Nelson called attention to the fine adjustment of Messrs. W. Watson's Van Heurck microscope, which he said had been wrongly described as being on Zentmayer's plan; he found that Messrs. Watson's adjustment was provided with spring stops, which obviated all the evils complained of in Zentmayer's system; the adjustment-screw was also left-handed, so that the apparent and real motions were made to coincide, which was a great advantage when working with high powers.

OXFORD.

University Junior Scientific Club, November 9.—The President, Dr. J. Lorrain Smith, in the chair.—The President gave an exhibit to illustrate the relation of ventilation to respiratory products, after which he called on the Rev. F. J. Smith for his paper on the inductoscript and spark photography. The paper, which was illustrated with experiments, and a large and varied selection of lantern slides, dealt with the recent researches of the writer and others in an exhaustive manner. It was shown how impressions of coins, &c., could be taken on photographic plates and paper by means of the electric spark, and the various results produced by changes of pressure, &c., in the atmosphere. The second part of the paper dealt more with the instantaneous photography produced by the electric spark, and the exhibits included photographs of bullets and other rapidly-moving objects, which had been taken by the reader of the paper.—Mr. G. C. Bourne read a paper on Bütschli's researches on protoplasm, which was followed by an animated discussion in which Prof. Burdon-Sanderson and others took part.

CAMBRIDGE.

Philosophical Society, November 14.—Prof. T. McKenny Hughes, President, in the chair.—The President exhibited (1) a live tarantula, (2) quartz crystals of unusual form. The following communications were made:—(1) Preparations were exhibited showing the division of nuclei in the sporangium of a species of *Trichia*, one of the Myxomycetes. The nuclei divide throughout the sporangium, with clearly recognizable karyokinetic figures, immediately before the formation of the spores, by J. J. Lister. (2) On the reproduction of *Orbitolites*. Mr. H. B. Brady has described specimens of Orbitolites, which he obtained in Fiji, showing the margin of the disc crowded with young shells. Mr. Brady's material was worked at in the dry state, and it was at his suggestion that the author collected specimens preserved in spirit from the Tonga reefs. Examination of this material shows that large brood chambers are formed at the margin of the disc during the later stages of growth. These are at first lined with a thin layer of protoplasm. At a later stage the central region of the disc is found to be empty, and the whole of the protoplasm is massed in the brood chambers in the form of spores. The spores have the structure of the "primitive disc," which during the early stages of growth of the Orbitolites occupies the centre of the shells. They are liberated by absorption of the walls of the brood chambers, and each becomes the centre of a new disc, which is built up by additions of successive rings of chamberlets at the margin. The reproduction of Orbitolites therefore takes place by spore formation. The spore contains a single nucleus, lying in its "primordial chamber." After several rings of chamberlets have been added, a stage is reached at which the nucleus appears to be represented by numbers of irregular, darkly staining masses scattered through the protoplasm of the central part of the disc. In the later stages numbers of oval nuclei are found in the protoplasm, often arranged in pairs, and in favourable preparations they may be seen to be undergoing amitotic division.—The fragmentation of the oosperm nucleus in certain ova, by S. J. Hickson.—On Gynodiœcism in the Labiatæ (second paper), by J. C. Willis.—The observations made in 1890–91 on *Origanum* (see *Reporter*, No. 937, June 7, 1892) were continued, chiefly on female plants. Six of these, derived from seed of the hermaphrodite plants of 1890, were observed, and their variations noted. It seems possible that some of the six, at any rate, were derived not from the normal, but from the abnormal (female) flowers of the parent. Attempts were made to determine if the occurrence of female flowers or flowers with one, two or three stamens only, on hermaphrodite plants, was due to lack of nourishment. A string was tied tightly round the main stalk of an inflorescence, about the middle, and it was found that more variations (12 : 1) occurred above than below. Analysis of the three years' observations shows that the abortion of the stamens tends to occur symmetrically rather than not, *i.e.* most commonly all four abort, and next in frequency is the abortion of the two anteriors: then of the two posteriors. These observations are still in progress, and it is hoped to publish full details in 1896 or later.

PARIS.

Academy of Sciences, November 21.—M. d'Abbadie in the chair.—Observations of the minor planets, made with the great meridian instrument of the Paris Observatory, from October 1, 1891, to June 30, 1892, by M. Tisserand.—Determination of the centre of the mean distances of the centres of curvature of the successive developments of any plane line, by M. Haton de la Goupillière.—Observations of Holmes' comet (November 6, 1892) made at the great equatorial of the Bordeaux Observatory, by M. G. Rayet.—Exploration of the higher regions of the atmosphere by means of free balloons provided with automatic recorders, by M. Gustave Hermite. Small balloons were filled with coal-gas and provided with recording barometers and minimum thermometers. The former consisted of metallic aneroid boxes on Vidi's system, recording the pressure by the motion of a smoked plate in front of a glass style. These aneroids weighed less than 100 grs. The writer hopes to reduce their weight to 10 grs. Some of the balloons were lost or destroyed, but most of them were returned, after a journey exceeding in many cases 100 km. Two successful registrations of temperature have been made so far, giving a fall of 1° C. for every 260 m. and 280 m. respectively.—Observations of Holmes' comet made at the Algiers Observatory (*equatorial coudé*), by MM. Trépied, Rambaud, and Sy.—Observations of Holmes' comet (November 6) made with the *equatorial coudé* of the Lyon Observatory, by M. G. Le Cadet.—Elliptic elements of Holmes' comet of November 6, 1892, by M. Schulhof (see our Astronomical Column).—On the calculation of inequalities of a high order. Application to the long-period lunar inequality caused by Venus, by M. Maurice Hamy.—Distribution into four groups of the first n numbers, by M. Désiré André.—On electric oscillations, by M. Pierre Janet. A gap in a circuit containing a high resistance of some 20,000 ohms is bridged by another containing a coil resistance with self-induction and a bridge resistance without. The terminals in the same gap are also connected with a condenser, and a Mouton's *disjoncteur* is introduced in the circuit, rotating at a high speed. The differences of potential between the terminals of the two resistances are measured by an auxiliary condenser and a ballistic galvanometer. It is thus possible to determine the form of the oscillations. On suddenly breaking the short circuit in the gap, it was found that the ends of the resistance without self-induction reached a constant difference of potential in a series of oscillations which were always of the same sign, whereas those of the other showed a series of positive and negative oscillations.—On some results furnished by the formation of soap bubbles by means of a resinous soap, by M. Izarn. Very thin and permanent bubbles are obtained by pounding together 10 gr. each of colophonium and potassium carbonate, adding 100 gr. of water and completely dissolving by boiling. For use, it must be diluted with four times its bulk of water.—Action of piperidine upon the haloid salts of mercury, by M. Raoul Varet.—On the exchanges of carbonic acid and oxygen between plants and the atmosphere, by M. Th. Schlœsing, jun.—A new case of living *Xiphopage*, the Orissa twins, by M. Marcel Baudouin.—Notes on the feet of batrachians and saurians, by M. A. Perrin.—On asymmetric growth in polychætous annelids, by M. de Saint Joseph.—Influence of moisture on vegetation, by M. E. Gain. Experiments with soils kept in a given state of humidity have led to the following conclusions: For each plant there exists a certain proportion of moisture most favourable to its growth. A high comparative moisture in the soil accelerates the growth, especially of the stem and leaves. The air being dry, fructification is slower with a dry than with a humid soil. Inflorescence is retarded either by dry soil or by moist air, and is hastened by the reverse con-

ditions. The most favourable conditions for exuberant growth of flowers are a moist soil and dry air, especially the latter.—Researches on the mode of production of perfume in flowers, by M. E. Mesnard. By the action of pure hydrochloric acid on sections immersed in strongly-sweetened glycerine, the essential oils are easily separated. It is found that the oil is generally located in the epidermic cellules of the upper surfaces of the petals or sepals. In every case the oils appear to have been derived from chlorophyll. The perfume is not given off until the oil is sufficiently freed from the intermediate products, and it exhibits some inverse relation to the amount of tannin and pigment produced in the flower.—On the existence of a conidian apparatus in the *Uredinei*, by M. Paul Vuillemin.—On the presence of *Actinocamax* in the Pyrenæan chalk, by MM. Roussel and de Grossouvre.—Stratigraphic consequences of the preceding communication, by M. A. de Grossouvre.—On the formation of the Arve valley, by M. Emile Haug.—On an experiment which appears to produce an artificial imitation of the doubling of the canals of Mars, by M. Stanislas Meunier.

DIARY OF SOCIETIES.

LONDON.

THURSDAY, DECEMBER 1.

LINNEAN SOCIETY, at 8.—Notes on Œcodoma cephalotes and the Fungi it Cultivates: J. H. Hart.—On a Small Collection of Crinoids from the Sahul Bank, North Australia: Prof. F. Jeffrey Bell.—Descriptions of Twenty-six New Species of Land Shells from Borneo: E. A. Smith.

CHEMICAL SOCIETY, at 8.—On the Formation of Orcinol and other Condensation Products from Dehydracetic Acid: J. Norman Collie.—Isolation of Two Predicted Hydrates of Nitric Acid: S. U. Pickering.—Anhydrous Oxalic Acid: W. W. Fisher.—Observations on the Origin of Colour and of Fluorescence: W. N. Hartley.—The Origin of Colour—Azobenzene: H. E. Armstrong.—The Reduction Products of *aa'* dimethyl *aa'* diacetylpentane: Dr. Kipping.—The Products of the Action of Sulphuric Acid on Camphor: Drs. Armstrong and Kipping.—Methods for Showing the Spectra of easily Volatile Metals and their Salts, and of Separating their Spectra from those of the Alkaline Earths: W. N. Hartley.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Experimental Researches on Alternate Current Transformers: Prof. J. A. Fleming, F.R.S. (Discussion.)

LONDON INSTITUTION, at 6.—Photographs of Flying Bullets, &c. (Illustrated): Prof. C. V. Boys, F.R.S.

SUNDAY, DECEMBER 4.

SUNDAY LECTURE SOCIETY, at 4.—Bacteria and Infectious Diseases (with Oxy-hydrogen Lantern Illustrations): Dr. E. E. Klein, F.R.S.

MONDAY, DECEMBER 5.

SOCIETY OF ARTS, at 8.—The Generation of Light from Coal Gas: Prof. Vivian B. Lewes.

VICTORIA INSTITUTE, at 8.—Principles of Rank among Animals: Prof. Parker.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—A New Form of Filter Press for Laboratory Use: C. C. Hutchinson.—The Production of Acetic Acid from the Carbohydrates: Messrs. Cross and Bevan.—Electrolytic Soda and Chlorine; the Present Aspects of the Question: Messrs. Cross and Bevan.

LONDON INSTITUTION, at 5.—Reading as a Recreation: Edmund Gosse.

ROYAL INSTITUTION, at 5.—General Monthly Meeting.

ARISTOTELIAN SOCIETY, at 8.—Symposium—Does Law in Nature exclude the Possibility of Miracle? R. J. Ryle, Rev. C. J. Shebbeare, A. F. Shand.

TUESDAY, DECEMBER 6.

ZOOLOGICAL SOCIETY, at 8.30.—A Revision of the Genera of the Alcyonaria Stolonifera, with Descriptions of One New Genus and several New Species: Sydney J. Hickson.—Upon the Convolutions of the Cerebral Hemispheres in Certain Rodents: F. E. Beddard, F.R.S.—On a New Monkey from South-East Sumatra: Prof. Collett.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Monthly Ballot for Members.—The Manufacture of Small Arms: John Rigby. (Discussion.)

WEDNESDAY, DECEMBER 7.

GEOLOGICAL SOCIETY, at 8.—Note on the Nufenen-stock (Lepontine Alps): Prof. T. G. Bonney, F.R.S.—On some Schistose "Greenstones" and Allied Hornblendic Schists from the Pennine Alps, as Illustrative of the Effects of Pressure-Metamorphism: Prof. T. G. Bonney, F.R.S.—On a Secondary Development of Biotite and of Hornblende in Crystalline Schists from the Binnenthal: Prof. T. G. Bonney, F.R.S.—Geological Notes on the Bridgewater District in Eastern Ontario: J. H. Collins.

SOCIETY OF ARTS, at 8.—The Chicago Exhibition, 1893: James Dredge.

ENTOMOLOGICAL SOCIETY, at 7.—Further Observations upon Lepidoptera (Illustrated by the Oxy-hydrogen Lantern): Edward B. Poulton, F.R.S.—The Effects of Temperature on the Colouring of Pieris napi, Vanessa atalanta, Chrysophanus phlœas, and Tephrosia punctulata: Frederic Merrifield.—Notes on Hydroptilidæ belonging to the European Fauna, with Descriptions of New Species; Kenneth J. Morton. (Communicated by Robert McLachlan, F.R.S.)—On some Neglected Points in the Structure of the Pupa of Heterocerous Lepidoptera, and their Probable Value in Classification; with some Associated Observations on Larval Prolegs: Dr. Thomas Algernon Chapman.—Description of a New Species of Butterfly, of the Genus Calinaga, from Siam; James Cosmo Melvill.

THURSDAY, DECEMBER 8.

ROYAL SOCIETY, at 4.30.—On the Photographic Spectra of some of the Brighter Stars: Prof. J. Norman Lockyer, F.R.S.—Experiments in Examination of the Peripheral Distribution of the Fibres of the Posterior Roots of some Spinal Nerves: Dr. Sherrington.—Preliminary Account of the Nephridia and Body Cavity of the Larva of Palæmonetes varians: Edgar J. Allen.

MATHEMATICAL SOCIETY, at 8.—Note on Cauchy's Condensation Test for the Convergency of Series: Prof. M. J. M. Hill.—Additional Note on Secondary Tucker Circles: E. Griffiths.—Notes on Determinants: J. E. Campbell.—A Geometrical Note; R. Tucker.

LONDON INSTITUTION, at 7.—An Idea for Catholicity of Taste in Music (Illustrated): Sir Joseph Barnby.

SATURDAY, DECEMBER 10.

INSTITUTION OF CIVIL ENGINEERS, 2 to 4.—Students' Visit to the Machinery and Inventions Division, South Kensington Museum.

BOOKS, PAMPHLETS, and SERIALS RECEIVED

BOOKS.—Berzelius und Liebig, Briefwechsel 1831–1845 (München, Lehmann).—A Short Manual of Orthopœdy, Part I.: H. Bigg (Churchill).—Congrès International de Zoologie, Deux Session à Moscou: Première Partie (Moscou).—Congrès International d'Archéologie. 11-ème Session à Moscou, vol. 1 (Moscou).—A Catalogue of British Jurassic Gasteropoda: W. H. Hudleston and E. Wilson (Dulau).—Annuaire de l'Observatoire Municipal de Montsouris, 1892–93 (Paris, Gauthier-Villars).—Les Textiles Végétaux: H. Lecomte (Paris, Gauthier-Villars).—Essais d'Or et d'Argent: H. Gautier (Paris, Gauthier-Villars).—Past and Future: C. M. Jessop (K. Paul).—Toothed Gearing: A Foreman Pattern Maker (C. Lockwood).—Modern Views of Electricity, 2nd edition: Prof. O. J. Lodge (Macmillan).—The Universal Atlas, Part 21 (Cassell).—Grasses of the Pacific Slope, Part 1: Dr. G. Vasey (Washington).—Das Keimplasma, Eine Theorie des Vererbung: Prof. A. Weismann (Jena, Fischer).—Die Zelle und die Gewebe: Prof. O. Hertwig (Jena, Fischer).—Extinct Monsters: Rev. H. N. Hutchinson (Chapman and Hall).—The Algebra of Coplanar Vectors and Trigonometry: R. B. Hayward (Macmillan).—Science in Arcady: Grant Allen (Lawrence and Bullen).—The Chemical Basis of the Animal Body: Dr. A. Sheridan Lea (Macmillan).

PAMPHLETS.—Quelle est la Race la plus Ancienne de la Russie Centrale: A. Bogdanow (Moscou).—Descriptive Notes on certain Implements, Weapons, &c., from Graham Island, Queen Charlotte Islands, &c.: A. Mackenzie.—Notes on the Shuswap People of British Columbia: G. M. Dawson.—Some Laws of Heredity and their Application to Man: S. S. Buckman (Gloucester).—Sur la Constitution des Dépôts Quaternaires en Russie et leur relations au Trouvilles Résultant de l'Activité de l'Homme Prehistorique: S. Nikitin (Moscou).—Ueber die Entwicklung von Milz und Pankreas: Dr. C. von Kupffer (München).—Verg.-Anatomische Studien über die Nerven des Armes und der Hand: Dr. W. Höfer (München).—Die Lendennerven der Affen und des Menschen: Dr. A. Utschneider (München).—Ueber das Vorkommen Offener Schlundspalten: Dr. E. Tettenhamer (München).

SERIALS.—Mittn. der Deutschen Gesellschaft für Natur und Völkerkunde Ostasiens in Tokio, 50 Heft (Tokio).—Traité Encyc. de Photographie, Premier Supplément: *A cinquième fascicule*, C. Fabre (Paris, Gauthier-Villars).—Natural Science, Decr. (Macmillan).—A Monograph of Oriental Cicadidæ, Part 7: W. L. Distant (London).

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