THURSDAY, NOVEMBER 8, 1894.

ANCIENT METEOROLOGY.

Theophrastus of Eresus, on Winds and on Weather Signs. Translated, with an Introduction, and an Appendix, by Jas. G. Wood, M.A., LL.B., F.G.S., and edited by G. J. Symons, F.R.S. (London: Stanford, 1894.)

THIS book owes its appearance in an English dress to the action of Mr. G. J. Symons, who believed its contents to be of such value and interest, that he offered to defray the expenses of publication provided a competent authority would prepare a translation of this neglected author. An able and willing translator was found in Mr. J. G. Wood, sometime Fellow of Emmanuel College, Cambridge, and we are thus put in easy possession of the thoughts and the science of Theophrastus, or it may be the wisdom of Aristotle, filtered through the mind of his favourite pupil. It need scarcely be said that the book possesses a greater interest for the archæologist than for the pupil of modern science, whose habit of thought is so different from that of the old Greek author, that he will have a difficulty in attempting to follow him.

A main object that Mr. Symons had in his generous proposal was to offer the means for the study of the gradual growth of our knowledge of meteorology, as exhibited in the literature of past ages. He has, therefore, begun at the fountain-head, or as near as was possible or desirable. Mr. Wood seems to have been animated by a somewhat similar ambition. He is afraid that in the study of meteorology, as at present existing, the student may be tempted to forget "the far-off and small but necessary beginnings which have conduced to such an end." In this sentence there are several words to which one might, if in a captious mood, take exception. For instance, can meteorology, in any sense, be said to have its beginning in the school of Aristotle or Theophrastus? Certainly not in the same sense in which astronomy could be said to have its rise in the work of Hipparchus or Ptolemy, for whatever errors may have vitiated their reasoning and impaired their results, they were in an advanced position compared with those who taught or who studied meteorology before they had an adequate conception of the existence of an atmosphere. Again, is it necessary that science should have its origin in error? Hasty generalisations, imperfect judgment from insufficient facts, one must expect, but there will always be a central thought which successive students will develop and render fruitful, and in Theophrastus this germ seems to be absolutely wanting. It is rare, if not impossible, to find any paragraph which is scientifically correct, or in which any train of reasoning is sound, so that we fail to see how the efforts of Theophrastus and his predecessor have in any way conduced to the position, imperfect as it is, in which meteorology now stands. Mr. Symons has told us that he hoped to capture some new thought from the study of this author. We venture to say he has been disappointed, for whatever interest the book may have for the curious and the literary student, it has little or none for the scientific.

We have in this little book two treatises, or (as Mr. Wood says we should now call them) "papers," of Therophrastus, one on "The Winds," the other on "Weather Signs." Both are marked by traces of haste in their original compilation, and assume a better acquaintance with the writings of Aristotle than most people at the present day possess. But even with this knowledge, the author is difficult enough to follow; accordingly Mr. Wood in his introduction has endeavoured to give the English reader a notion of Aristotle's views on Wind. This it will be admitted is no easy task, within the small limits permitted to the translator; and if the explanation is not everywhere so clear nor so full as could be wished, the fault lies not with Mr. Wood, but in the intricacy of the subject, and in the difficulty the reader finds in endeavouring to follow the subtleties of Aristotle, and of accommodating modern thought and knowledge to the ancient methods of expression. It is a treat, after wandering through the mazes of "dry sublimation" and "moist sublimation," to come to Mr. Wood's summing up of the whole matter, in which he endeavours to concentrate his intimate knowledge of this subject, as it presented itself to the Greek mind. "The winds"—and Mr. Wood draws a necessary and picturesque distinction between πνοή, ἄνεμος, and πνεῦμα—"are separate and distinct entities, flowing in definite courses, and not mere movements of the same air hither and thither: that to produce wind matter has to be formed, and the more matter the greater the wind: and this matter is derived from the earth, and is distinct from vapour."

With these misconceptions influencing the Greek mind, and giving rise to infinite confusion, it would be tedious to point out all the errors into which Theophrastus fell. He was apparently not the kind of man to substitute patient and exact observation for the assertion and teaching of authority, or we might have had to hail him as the founder of exact meteorology. One example will suffice to illustrate his success as an original investigator. We select the subject of annual or periodic winds (ἐτήσιαι), which Mr. Wood renders not very happily by "monsoons." The origin of these winds our author teaches us is to be traced in the melting of the snow. As the sun breaks up the frost, it sets the air in motion, giving rise to the "monsoons," and inasmuch as the thaw does not proceed with perfect regularity, so the wind varies in constancy. At night, when the action of the sun is less powerful and the thaw does not proceed, the wind ceases to blow, but under exceptional circumstances the thaw may be so rapid that the wind is perceived at night. Did none of his pupils seek to verify these statements?

The attempts at weather forecasting are naturally not more happy than those dealing with meteorological science, as now generally understood, but possibly quite as accurate as many of the predictions quoted in our days, having for their object the determination of the weather for a considerable period in advance. Certainly they rest on a foundation quite as sound, and doubtless assume an equal ignorance in the public, that circulate them from mouth to mouth, or it may be from newspaper

to newspaper. "Whatever," says Theophrastus, "be the condition of the air at the setting of the Pleiades, such it continues for the most part, until the winter solstice." This would cover practically nine months of the year, if by the setting of the Pleiades is meant the setting with the sun. The moon, too, is either the cause of a change or the prognostication of it. "The change takes place for the most part on the fourth day, and if not then on the first quarter, and if not then at the full." A weather prophet of to-day would be discredited if he hedged in this way. A clear crisp statement is now necessary to secure credence, and attach disciples to the school of the modern weather prophet. As one turns over the pages that give the signs of fair or foul weather, signs all more or less puerile, one is reminded of the saying that Plato has preserved for us, Ἕλληνες ἀεὶ παῖδές ἐστε.

We can have no hesitation in asserting that the appendix is the most valuable part of the book. Herein, Mr. Wood has given an excellent account of the gradual changes introduced in the nomenclature and in the subdivision of the winds from the time of Homer and Hesiod, through the Middle Ages, down to the present time. Such an account is not only of great assistance to the correct apprehension of old authors, but gives a great deal of information on the introduction of fresh terms in the description of the winds. Mr. Wood seems distressed as to the exact localisation of a wind that is defined by reference to the azimuth of the sun, at rising or setting at the summer and winter solstice. Of course the azimuth varies with the latitude of the place of observation, but Aristotle, writing for Greeks, described positions as they were seen in Greece. Mr. Wood might as well have taken into account the effect of refraction at the horizon, or the alteration in the obliquity of the ecliptic. In these days, we rarely attempt to determine the direction of the wind within 20°, and it is scarcely likely that greater accuracy was attempted in Greece. But whether Aristotle spoke of the equator or Athens, the whole difference is only about 6°, so that the question of accuracy hardly enters. We congratulate Mr. Wood upon the amount of well-digested information he has been able to give in this chapter. W. E. P.

TWO BOOKS ON AMERICAN ANTIQUITIES.

Travels amongst American Indians, their Ancient Earthworks and Temples; including a Journey in Guatemala, Mexico, and Yucatan, and a visit to the Ruins of Patinamit, Utatlan, Palenque, and Uxmal. By Vice-Admiral Lindesay Brine. (London: Sampson Low, 1894.)

Journal of the Academy of Natural Sciences of Philadelphia. Second series, vol. x. part I. (Philadelphia: Academy of Natural Sciences, 1894.)

ADMIRAL BRINE'S pleasantly written book is the record of a journey made through the United States, Guatemala, and Yucatan in the years 1869–70. It is to be regretted that his notes were not published at once on his return home, as in those days Guatemala and Yucatan were still almost unknown lands, and since that date half a dozen books—few of them, it must be admitted, of great value—have made the country more familiar to us.

The particular object of Admiral Brine's journey was the examination of the earthworks and temples of the American Indians, and the first portion of the book is devoted to the red man and his works. Several months were occupied in examining the mounds and earthworks in Ohio.

On the difficult question of age, the author favours the view that the circular and octagon enclosures are of comparatively late date.

"But the figure which would have been absolutely impracticable to construct without proper surveying appliances for making accurate measurements, and fixing the true angles, is that of the octagon. Even under the most favourable circumstances, with the help of suitable instruments, it would have required much skill and calculation to trace a true octagon, whose embankments contained within them an area exceeding forty acres. It is difficult to suppose that an accurately designed work of this shape and magnitude could have been planned by Indians, or that the construction of a figure so essentially scientific and unusual, could have been originated by them. It is therefore possible to conclude that the geometrical earthworks in Ohio may have been raised by native tribes, acting under the direction of European surveyors, or men who had received a mathematical education."

Concerning the Indian tribes who actually did the work of raising the embankments, the author adds in a note that—

"Nothing has been found amongst the ornaments or weapons that were placed in their burial mounds, which supports the hypothesis that they were different in race or intelligence from the tribes that surround them."

From San Francisco, Admiral Brine sailed down the Pacific Coast to Guatemala. He tells a story of Carrera, that remarkable Indian of pure blood, who was for so long the President of the Republic, and of whom mention is often made in "Stephens' Incidents of Travel in Central America."

"Colonel Garcia told us that Carrera always had on his writing-table a toy representing Louis Philippe with his hat in his hand. This toy had a rounded base, and was so weighted that, when it was touched, it rolled backwards and forwards, and would thus represent Louis Philippe constantly bowing, hat in hand. Carrera when engaged in official work would frequently make the toy move, and then would say to those who stood near him, 'It seems in that way, by too much bowing, that Louis Philippe lost his throne. I shall take care that I do not make the same mistake.'"

A journey in Guatemala in 1870 was by no means as free from risk as it is at the present day, "pronunciamientos" and Indian risings were not of uncommon occurrence, and Admiral Brine was fortunate in escaping any serious danger; but he, no doubt, principally owed his immunity from trouble to tact and good temper in his dealings with the Indians. He was usually indebted to the "padres" for hospitality on the road, and learnt from the priests themselves how independent the Indians had become in matters of religion.

"'The Indians come and go as they please,' said Father Hernandez, 'light their own candles, hold their own services before the altar, and frequently take one of the saints out of the church, and carry it away to

some hut, where for several days they will perform musical ceremonies before it, and then the saint will be brought back to its proper altar'—and again, 'they come from afar to make offerings of blossoms and leaves, light candles before the altars of those saints they wish to honour, and then silently return to their huts.'"

There can be little doubt that in pre-Christian times they were accustomed to an elaborate ritual, and it was partly for this reason that they took so readily to the ceremonies of the Roman Church, but they never quite abandoned their old beliefs. The twenty-four years that have elapsed since Admiral Brine's journey have not made much difference in this respect; and little rough altars may any day be found on the tops of abandoned temple mounds with the scent of incense still hanging about them.

Admiral Brine camped for a few days in the ruined temples at Palenque, and then travelled northwards to Yucatan and visited the ruins of Uxmal. The last two chapters give an interesting summary of the author's notes and the conclusions to which he has come. With these conclusions it is not always possible to agree; but that is not much to be wondered at, when dealing with a subject which is so closely enveloped in mystery as the civilisation and migrations of the races of America.

Happily we can feel assured that a distinct advance in our knowledge of the subject is being made, and that there is a fair prospect that, within the next few years, some at least of the mystery will be rolled away.

A good example of the very careful work which is being done by numerous scientific societies in America, in collecting and examining prehistoric remains, can be seen in Mr. Clarence B. Moore's account of his excavations in the sand mounds of the St. John's River in Florida, and Mr. W. H. Holmes's notes on the pottery from these mounds, which was submitted to him for examination, both published in the *Journal* of the Philadelphia Academy of Sciences.

The sand burial mounds occur frequently in the neighbourhood of large shell deposits. They are usually stratified, the layers consisting of different coloured sand, with sometimes a slight admixture of shell, and the human bones and other objects are most frequently found in a layer of sand of a pinkish colour, due to the presence of powdered hematite.

It is not unusual to find in Indian burial mounds pottery which has been purposely broken before burial, as though in observance of some ceremonial rite, but in these sand mounds Mr. Moore found mortuary pottery in which the breakage or perforation had been made before the pottery was fired.

With some of the surface and intrusive burials were associated iron and brass objects, showing them to have been post-Columbian; but nothing indicating contact with Europeans was found associated with the deeper interments, and many of the mounds were entirely free from evidence of contact with white men.

At Thursby Mound a number of very curious rough pottery figures were found, representing squirrels, turkeys, fish, turtles, &c., as well as some vegetal forms, which are extremely rare in the normal art of the United States. The illustrations which accompany these notes are numerous and excellent.

As we hear that Mr. W. H. Holmes, whose admirable work is so well known, is leaving the Bureau of Ethnology at Washington, in order to take charge of the new and liberally endowed museum at Chicago, which is the outcome of the great World's Fair, we may look for steady and increasing contributions to our knowledge of the Indian races and their arts, which will not be limited to the result of investigations in the territory of the United States, but will include the whole American continent.

The Peabody Institute of Massachusetts (principally owing to the liberal support afforded it by Mr. C. Bowditch, of Boston) has been able to set a good example in commencing systematic work on the central civilisations, by the investigations now being carried on at the ruins of Copan, the site of which has been acquired on lease from the Government of Honduras for a period of ten years. The Peabody Museum at Cambridge, with its fine collections of pottery, original sculpture and casts, is fast becoming a centre for the study of American antiquities.

WATTS' DICTIONARY OF CHEMISTRY.

Watts' Dictionary of Chemistry. Revised and entirely re-written. By M. M. Pattison Muir, M.A., and H. Forster Morley, M.A., D.Sc. Assisted by eminent contributors. Vol. IV. With Addenda. 8vo. Pp. 922. (London and New York: Longmans, Green, and Co., 1894.)

THE completion of the grand work before us renders it possible to form a fair estimate of its features and its general character. No candid reader can fail to appreciate the industry displayed by the editors and contributors, in bringing together and sifting out the vast mass of existing matter, in a science which is experiencing so rapid a growth. Perhaps a greater difficulty has been encountered in compressing within reasonable limits the facts which must claim insertion. This end has been reached by a style laudably laconic, but at the same time free from obscurity, and by an ingenious system of abbreviations, the editors—or we might better say the authors, since the entire work has been re-written—have confined themselves to the pure science, leaving its thousand and one applications in manufactures, metallurgy, and agriculture, to be dealt with in the "Dictionary of Applied Chemistry," issued by the same publishers. Without this limitation, the cost of producing the work would have been simply prohibitive.

Many of the articles included in this volume are, in their value and extent, almost worthy to rank as independent works. As instances we may mention the section on the Proteids; that on the Ptomaines—which might have been a little more extensive—the article on Phosphorus; and, above all, that on the Physical Methods used in Chemistry. This article, which extends to 100 pages, treats separately of methods based on capillarity, of crystallographic methods, of dialysis and diffusion, of dynamical methods, of electrical methods, of procedures based on the freezing-points of solutions, of optical methods, of methods based on osmotic pressure, of photographic methods, of methods turning on the specific

heats of solids, of thermal methods, of those based on the vapour-pressures of solutions, of the viscosity of liquids, and of methods based on volume-changes.

The chapter on electrical methods is supplied by Prof. Dr. Ostwald, of the University of Leipzig. The author gives an account of the rise of electro-chemistry and of its development by Berzelius and Hisinger, and of its dominance down to 1840. It is remarked that, after his first investigations, Berzelius did not undertake any experimental work on the action of electricity upon chemical compounds. After 1840 this theory was found incapable of explaining facts which were being brought to light in the region of organic chemistry, whilst its physical foundations were shaken by the researches of Faraday. More recently, Hittorf, Arrhenius, Helmholtz and others have founded a new electro-chemical theory. Mention is made of the discussion—not yet decided—as to the origin of the current in the pile. The conception of ions as the material conveyance of the current has been gradually introduced since the researches of Clausius, and is taken into account in our views of decomposition. Not less interesting is the account of optical methods. The first part, from the pen of Mr. G. Gladstone, discusses refraction and dispersion; the second, on spectroscopic methods, is contributed by Prof. W. N. Hartley, F.R.S.; and the third part, on the rotation of the plane of polarisation of light, is by Prof. Pattison Muir. In the part treating of the spectroscopic methods we find studies of the infra-red and ultra-violet absorption spectra, with notices of the researches of V. Schumann, Waterhouse, Crookes and Gladstone. In connection with the absorption spectra—a subject by no means fully explored—we have a notice of Witt's views on the cause of colour in organic compounds.

Among the elements admitted or supposed, we find in this volume, notices of phosphorus, platinum, potassium, rhodium, rubidium, ruthenium, samarium, scandium, selenium, silicon, silver, sodium, strontium, sulphur, tantalum, tellurium, terbium, thallium, thorium, tin, titanium, tungsten, uranium, vanadium, yttrium, ytterbium, zinc and zirconium, with compounds or derivatives.

The authors and contributors are noticeable for a sobriety of statement; they do not indulge in premature conclusions and in speculations for which evidence is lacking.

As regards the elements, the Mendelejeff classification is adhered to, and in the accounts of their preparation the recent results of Moissan have not been overlooked.

The addenda comprise facts in mineral chemistry which have been observed since the appearance of Vols. I., II., and III. and the printing off the final proofs of the present volume. The addenda include nothing on organic chemistry; since to have noticed the recent discoveries in that department would, in the opinion of Mr. Pattison Muir, have required the addition of many hundred pages.

On comparing the present work with former dictionaries of chemistry, whether in English or in any other language, its superiority will appear beyond all question. It will be the obvious duty of all universities, colleges, &c., at once to add this new edition of "Watts" to their libraries.

DISEASES OF TREES.

Text-Book of the Diseases of Trees. By Prof. R. Hartig, of Munich University. Translated by W. Somerville, Professor of Agriculture and Forestry, Durham College of Science, Newcastle. Revised and edited by Prof. H. Marshall Ward, F.R.S. (London and New York: Macmillan and Co., 1894.)

"DER Lehrbuch der Baumkrankheiten von R. Hartig" has now appeared in English with all the admirable illustrative plates of the second edition, except the coloured plates at the end of the book, which represent spruce and oak wood decomposing under the influence of different fungi, and are therefore somewhat exterior to the proposed scope of the work, "the diseases of trees." The original, as Marshall Ward states in the preface to the present version, owes its great charm "to the simple method of exposition of the facts and principles conveyed, as well as to the astounding richness of the information it contains. This is unquestionably owing to Hartig's prominence as the leading investigator and authority on the fungoid diseases of forest trees."

The great superiority of Hartig's work in this subject has been acknowledged in France, by the publication there, in 1891, of a French translation by Profs. Gerschel and Henry, of the Nancy Forest School, which was entirely revised by the author.

Prof. Somerville, the translator of the present English edition, has followed a complete course of forestry at a German forest school, and has been for some time engaged in forestry instruction at Edinburgh and Newcastle. He has already written a valuable little book on the structure of European timbers. The translation of Hartig's book follows the original closely, and is smooth and free from Germanisms.

The editor, Prof. H. Marshall Ward, whose qualifications for the work need no comment, has written an excellent preface, besides revising the translation and supplying short foot-notes in explanation of all scientific terms, which might puzzle readers who have not studied vegetable physiology very deeply, and in a few cases giving his own opinion where he does not coincide with the authors.

In the preface, the bold but thoroughly justifiable statement is made that students of agricultural chemistry, or of the physics and chemistry of soils, must thoroughly master the facts of the structure and essential phenomena of life by experimental investigation, and that the chemistry of the soil taken alone is of less practical importance. The fact is, that although the want of sufficient suitable chemicals in a soil may render certain tree-growth stunted and unproductive, yet the physical nature of the soil, *i.e.* its degree of division and hygroscopicity, and the climate of the locality, are more important than the former to ensure a healthy and vigorous tree-growth; whilst a good coating of decomposing dead leaves will render a soil, which is chemically and physically poor, capable of producing a fair crop of timber. The influence of earthworms on soils has been dealt with by Darwin, whilst that of bacteria and other low organisms in decomposing organic débris to form

humus, and otherwise assisting in the nutrition of plants, has yet to be dealt with in a special treatise. Considering the exhaustive and expensive investigations which are carried out in the research of animal pathology, a large expenditure by the State on the influence of bacteria on soil and water would be justifiable, and would lead to highly important improvements in agriculture and gardening.

The editor meets possible objections from botanical critics to Hartig's classification of fungi, by remarking that it is not fungi which are being studied here, but their action on trees, and that students may obtain a thorough knowledge of fungi elsewhere; he refers the forester who may be anxious to know the remedies against disease to special works,[1] although Hartig has given many practical hints as to treatment in certain cases.

The book's great value lies in the way it teaches students how to investigate disease, and a wide field is still open to discovery in this respect.

The author's introduction chiefly deals with the causes of disease and the procedure for investigating them; and it is reassuring to read that the transmission by inheritance of disease is unknown in the vegetable kingdom, and that we may use without hesitation the seed of plants suffering from any conceivable disease, and that with them the law of inheritance is only involved in the case of marked peculiarities, such as twisted fibre, dwarfed habit, and other undesirable peculiarities. Superior individual growth, however, is recognisable in the size of the fruit, and large acorns produce vigorous oak saplings.

As regards the distribution of matter in the work, the first forty pages after the introduction deal with diseases caused by plants other than fungi. Hartig states that he has not noticed any appreciable damage done to forest plants by *Cuscuteæ* or dodders, but Hess states that osier willows are greatly damaged by *Cuscuta Gronovii*, Willd., an American species which has established itself in Germany. The places where the *haustoria*, or sucker-like roots of the parasite, pierce the cortex of the plants, are rendered brittle, and the osiers so attacked become useless for basket-making. The only remedy appears to be to cut down the affected shoots in June and July, when the dodder blossoms, and burn them. Bacteria which cause such terrible diseases in animals rarely harm plants, owing to the closed nature of their tissue elements as compared with the anastomosing veins and lengthy digestive apparatus of animals.

The main portion of the book—pages 40–224—deals with damage done by fungi; and after a general description of their mode of life, a very clear account is given of the life-history of each destructive fungus, and of its effects on its host. Fortunately, whilst several of these species may destroy a few hundred trees here and there, the only fungus which can be compared for its ravages on whole woods with certain destructive forest insects is *Peziza Willkommii*, which causes the widespread larch disease, and has rendered the cultivation of larch almost impossible in certain districts in Great Britain and the north of Germany, though it is said not yet to have occurred in Ireland. The best preventive measure is to plant larch only on suitable soils and in open airy situations, and to mix it with other trees, and especially with beech.

Besides dealing with fungi which infest living trees, there is a most interesting account of those which attack timber, and thoroughly practical suggestions are given for dealing with dry-rot caused by *Merulius lacrimans*.

Section ii. (pages 226–269) deals with wounds, and the mode nature adopts for healing them, and also with the dangers they afford by the admission of the spores of fungi to the interior of a tree. It is pointed out how branches should be pruned or shortened so as to avoid, as much as possible, the chances of future decay. Hartig states that he has never known an instance of coal-tar, when used for dressing wounds in trees, having proved hurtful to them, although some foresters have asserted the contrary.

Section iii. (pages 270–281) deals with diseases due to certain conditions of soil, the chief predisposing factor being the want of free circulation of air in the soil, which may cause root-rot in conifers, though, according to Hartig, never in broad-leaved species. This latter statement may not, however, be quite correct, as Spanish chestnut appears sometimes to suffer from root-rot, owing to this cause.

Section iv. (pages 281–304) deals with diseases caused by atmospheric influences, frost, insolation, want of light, hail, fire, coal-smoke, and lightning, and the book terminates with a classified list of diseases arranged according to the species of tree attacked, and the respective organs which suffer.

W. R. FISHER.

[1] For instance, a translation of Hess's "Forest Protection" is now in the press, and deals with these questions in detail.

OUR BOOK SHELF.

Le Centre de l'Afrique. Autour du Tchad. Par P. Brunache. (Paris: Felix Alcan, 1894.)

THIS record of travel in a previously unknown region of north tropical Africa is published as volume 79 of *Bibliothèque Scientifique Internationale*, although there is nothing scientific about it, and the standpoint of the author, so far from being international, is exclusively and almost obtrusively French. The words "Autour du Tchad," which are repeated as the running title of the book, are entirely misleading, for the writer never came into the vicinity of Lake Chad at all, but passed more than 200 miles to the south of it. These are all the adverse criticisms we have to offer. For the rest, the book is lively reading, and has the merits of brevity and point. M. Brunache went out in 1891, as second in command to M. Dybowski, in an expedition for the relief of M. Paul Crampel, who had set out a year before, with small resources, from French Congo, to try to reach Lake Chad. Landing at Loango, the Dybowski expedition went to Brazzaville, on the Congo, and thence up the Mobangi and through a blank area of the map, peopled by Dakoas and N'Gapus, across the watershed between the Congo and Shari systems to nearly 8° N. The place of Crampel's murder was found, and a good deal of punitive fighting was carried on with the Mohammedan negroes; but here, at Crampel Peak, Dybowski found that it was impossible to go farther, and the expedition returned to the French outposts on the Mobangi. M. Brunache is careful to show how much better qualified he was for the command than the appointed leader, of whose wishes he seems not to have been too considerate. On his way to the coast our author met the expedition of

M. Maistre, to which he transferred 'himself, and again crossed the Congo-Shari watershed, made friends of many of the native tribes, obtained treaties in the usual way, and, pushing onwards, in spite of considerable hardships, descended one of the tributaries of the Shari, struck westwards to the Benue, and so returned by the Niger. The expeditions, which were two of the most important of the last few years, did much valuable work in geography and natural history; indeed, M. Brunache insinuates that Dybowski was too much devoted to collecting specimens to make an ideal commander.

The book contains many interesting but unsystematic notes on a number of tribes which were visited for the first time by Europeans. Except the Bonjios on the lower Mobangi, and the Mohammedanised natives of the Sudan, they were all cannibals, eating their enemies killed in battle, and occasionally their slaves. Amongst all the tribes, women were well treated and consulted on affairs of importance. The costume and habits of the Saras, a particularly tall tribe, who inhabit the Shari basin between 8° and 9° N., are described, we believe, for the first time, and with such fulness and tact as only a Frenchman can employ. In their country the surveys of the expedition touched those of Nachtigal, who had penetrated so far southward across the Sahara, and thus completed the chain of modern European itineraries in West Africa from the Mediterranean to the Cape of Good Hope.

A number of reproductions of sketches exhibit types of the natives encountered, and specimens of their art and manufactures.

Helical Gears. By a Foreman Pattern Maker. (London: Whittaker and Co., 1893.)

THIS little book belongs to "The Specialists' Series"; it is entirely of a practical nature, and deals with a subject little understood by engineers who do not happen to be machine-tool makers. As there is probably no other text-book on this subject, the work will fill a useful purpose. The author observes that a large proportion of so-called helical gears are incorrectly made, and are therefore far worse than common gears. With this observation we certainly heartily agree. Cases are known where an otherwise good machine has been spoiled by the use of badly designed helical gearing.

The arrangement of the information is good. Illustrations and diagrams are freely used, so that what would otherwise be difficult to understand becomes clear and apparent. Patterns are clearly dealt with, and their manufacture fully described. It is here the hand of the practical man becomes evident. Many hints are given, and instructions formulated, which flavour strongly of the "works." The author does not pretend to deal with the purely theoretical side of his subject, excepting in so far as the fundamental relationships of the helical gears to the true screw or helix is concerned. Beyond this the book is entirely of a practical character, being eminently fitted to fulfil the requirements of the drawing-office and the works. N. J. L.

The Nests and Eggs of Non-Indigenous British Birds. By Charles Dixon. Pp. 360. (London: Chapman and Hall, 1894.)

"THE present work," remarks Mr. Dixon in his preface, "forms the companion volume to 'The Nests and Eggs of British Birds,' and renders the subject of British Oology complete, so far as our knowledge now extends. It deals exclusively with the nidification of the birds that do not breed in the British Archipelago, but visit our islands regularly in winter, pass our coasts on passage, or pay them their more or less irregular visits as wanderers from their normal areas of disposal." Nearly two hundred species are described as belonging to this class. For each bird, information is given as to the breeding area, breeding habits, range of egg colouration and measurement, and the diagnostic characters of the eggs. In an appendix, the author states his reasons for believing that the nests and eggs of the following species are at present unknown to science:—Rustic bunting, Pallas's grey shrike, Siberian ground thrush, needle-tailed swift, solitary sandpiper, Siberian pectoral sandpiper, curlew sandpiper, knot, Ross's gull, great shearwater, collared petrel, capped petrel, Cape petrel, and white-billed diver. A list of forty species, individuals of which have been said to occur within the limits of the British Isles, but which Mr. Dixon regards as doubtful British species, is also appended to the volume. It remains for the scientific naturalist to collect some definite information on the species enumerated in these lists.

Commercial Geography. By E. C. K. Gonner, M.A. Pp. 200. (London: Macmillan and Co., 1894.)

COMMERCIAL geography, dealing as it does with the facts that affect manufactures, commerce, and agriculture, ought to be widely studied in a nation having such pronounced shopkeeping proclivities as the English. It is right and proper that those who are to be the custodians of our trade in future should know something about the manner in which physical and political surroundings affect industry and commerce, and about the conditions of success in the various industrial branches. Prof. Gonner treats these matters in a way likely to impress students. His manual is divided into three parts, the respective subjects of which are (1) commercial geography and its principles; (2) the geography of the chief products and others; (3) countries, their agriculture, industries, and commerce. Trustworthy statistics are plentifully distributed throughout the book, and they serve to give an idea of the relative importance of different countries as regards different commodities, as well as being useful for reference. Of course, no student would be expected to commit these tabular statements to memory. If the main facts contained in this volume are grasped by students intended for commercial careers, British commerce will undoubtedly be benefited.

Dynamometers and the Measurement of Power. By John J. Flather, Professor of Mechanical Engineering, Purdue University. (New York: John Wiley and Sons, 1892.)

A USEFUL practical treatise on this subject, in a convenient form for Technical Students, containing also the mechanical theory required in the calculations.

The author has himself carried out a notable experiment in the measurement of the power of a full-sized American locomotive, which was jacked up, and the power taken off by heavy supporting wheels; a valuable object-lesson for the pupils of his Experimental Laboratory of Purdue University. The long-continued measurement of the power, coal and water consumption, &c., of a large engine in full work—for instance of a steamer, the *Meteor* and others—is one of the most interesting and instructive that can be provided for a class of enthusiatic students of mechanical engineering. G.

Electric Light and Power. By Arthur F. Guy, A.M.I.E.E. Pp. 346. (London: Biggs and Co., 1894.)

SOME books, like the pedlar's razors, are made to sell rather than for use. Mr. Guy's volume is not one of these. It has been issued "for the purpose of placing on record useful practical knowledge obtained by the author during several years' experience of central-station work, together with brief explanations of the laws which govern the action of electrical apparatus in general use for electric lighting." This brief description shows clearly the ground covered. There are many similar works in the market, but we do not know of one better suited to give the manipulator of electric dynamos an intelligent knowledge of the forces with which he has to deal.

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.*]

Prof. Boltzmann and the Kinetic Theory of Gases.

IN the discussion which followed the communication of my Report on Thermodynamics to the British Association at Oxford this year, Prof. Boltzmann made some remarks which appear to have been interpreted in a different light to what he doubtless intended. In the absence of any shorthand writer's verbatim report of the discussion, it is of course impossible to recall his exact words, but I feel sure that Prof. Boltzmann will be much astonished to learn that his statements are now widely circulated and quoted as being an authoritative admission that the Kinetic Theory of Gases is nothing more than a purely mathematical investigation, the results of which are not in accord with physical phenomena; in short, a mere useless mathematical plaything.

Is it likely that such an able physicist would have devoted so many years to the development of the theory, and would continue to work at it now if he regarded it in that light? Having had several conversations with him, both during and after the British Association meeting, I gather that his views are not nearly so pessimistic as the opponents of the kinetic theory would wish to maintain.

The statements were made in reply to a question as to how far the ratios of the specific heats of gases as given by theory accorded with the results of experiment. What I understood Prof. Boltzmann to imply was that his investigations treated the matter purely from a mathematical standpoint, but that the values he obtained by regarding the molecules of a gas as rigid bodies, viz. 1·6̇ for smooth spheres, 1·4 for smooth solids of revolution, and 1·3 for solids of any other form, accorded on the whole *very fairly* with the results of experiment. In that respect the kinetic theory stands on exactly the same footing as any other theory of mathematical physics. The evidence in favour of the fundamental assumptions of *any* theory necessarily rests on the agreement or want of agreement of the deductions with experience after due allowance is made for the fact that the conditions imposed by the mathematical difficulties of the investigation necessarily differ from those occurring in nature. I need only refer to Prof. Boltzmann's paper, "Ueber die Natur der Gasmolekülle" (*Sitzungsberichte der Wiener Akademie*, lxxiv. ii. 1876), for a more detailed account of his views on the question of the specific heats.

The objection which has been regarded by some as most antagonistic to the kinetic theory is that it does not afford an explanation of the spectra of gases. But is this duty required of it? If the luminosity of gases were due to vibrations of the atoms in the molecules, certainly there *would* be a difficulty about regarding the molecules as rigid bodies; but then such a hypothesis would preclude a gas whose molecules were monatomic from having any optical properties whatever. To my mind, the electromagnetic theory of light entirely relieves the kinetic theory from the burden which has been imposed on it by its opponents, since if (for example) we regard the molecules of a gas as perfectly conducting hard spheres, spheroids, or other bodies moving about in a dielectric "vacuum" (*i.e.* space devoid of *ordinary* matter), we shall be able to account for the spectra by means of electromagnetic oscillations determined by surface-harmonics of different orders without interfering with the assumptions required for explaining the specific heats of gases. There are, however, other questions on which I should be glad to see a continuation of the brilliant discussion which had to be curtailed from want of time at Oxford.

G. H. BRYAN.

Peterhouse, Cambridge, October 23.

Instinctive Attitudes.

MY attention has been called to Mr. H. M. Stanley's remarks on instinctive attitudes in NATURE of Oct. 18. I have been for some years studying children's attitudes and expressions from the evolution point of view; and have from time to time taken photographs as opportunity presented itself. I have now a considerable number which I hope to publish in that connection. One of the series accompanies this, and bears on Mr. Stanley's remarks. It was taken in May last, representing my youngest child, then ten months old. She never crawled, but always progressed on all-fours; and this photograph, taken instantaneously, shows her mode of travel to and fro on the garden path. The interesting thing about it is this: that the gait is front and back legs on opposite sides, like a dog or a cat, not on the same side, like a camel—a result which the evolutionist would have predicted; though of course we show a relic of the same habit in walking, by swinging the arm on the opposite, and not on the same, side as the leg. In this photograph, too, the heel and toe action of the hind limbs is instructive.

One of my children, in addition to the ordinary crawl, used to progress in a sort of three-legged fashion—it used the left hand

and the right foot for the forward step, rested itself on the shank of the left leg tucked under its body, and this it used as a foot to bring forward its body for the next step. Sometimes this developed into a three-step mode of progression.

The bandaging, swaddling, carrying and wheeling about, which the civilised infant has suffered for many generations, no doubt partly accounts for the rarity of the quadrupedal mode of progression, by having hindered development of muscularity. The quadrupedal mode of progression indicates greater strength than the ordinary knee-crawl.

S. S. BUCKMAN.

Cheltenham, October 24.

James Parkinson, the Author of "Organic Remains of a Former World."

IN a paper on the subject of museums, which was read in 1891 before the meeting of an association, James Parkinson is thus spoken of without any subsequent qualification of the statement made:—

"Finally, a private lottery was arranged for its disposal (the Leverian Museum), and in 1785 the prize was drawn by James Parkinson, *a dentist*, who took not the least interest in natural history or in museums."

As the scientific world seems profoundly ignorant as to what were the scientific qualifications and professional position of James Parkinson, the following facts may be worth publishing in NATURE:—

James Parkinson, who resided at No. 1 Hoxton Square, was not a dentist, but a surgeon. In Johnston's Directory for 1817 his address is thus given: "Parkinson and Son, Surgeons, No. 1 Hoxton Square." He had also an address in the Kingsland Road. His death is thus recorded in the *Gentleman's Magazine* of December 1824: "December 21st, in Kingsland Road, James Parkinson, surgeon, late of Hoxton Square." There *was* a firm of dentists in London, whose address in Johnston's Directory was as follows:—"Parkinson and Kidman, surgeon-dentists, 1 Racquet Court, Fleet Street"; but they had evidently no professional connection with James Parkinson.

The following list of works, &c., by James Parkinson, published by H. D. Symonds, Paternoster Row, is given at the end of a little book by him, of which the title is "Dangerous Sports; a Tale addressed to Children," printed for H. D.

Symonds, Paternoster Row, 1808. Their titles, which I briefly give, will amply prove his professional position :—

(1) "Medical Admonitions to Families." 5th edition.
(2) "Observations on the Excessive Indulgence of Children."
(3) "The Village Friend and Physician." 2nd edition.
(4) "The Way to Health."
(5) "The Chemical Pocket-Book."
(6) "Hints for the Improvement of Trusses."
(7) "The Hospital Pupil."
(8) "Observations on the Nature and Cure of Gout."
(9) "Remarks on Mr. Whitbread's Plan for the Education of the Poor."
(10) "Organic Remains of a Former World." Volume the First.

In addition to his "Organic Remains," Parkinson produced "Elements of Oryctology, an Introduction to the Study of Fossil Organic Remains," which appeared in 1822. A third edition was published in 1840.

Whatever may have been Parkinson's lack of interest in natural history when he acquired the museum, he certainly showed no deficiency in that respect when he produced his "Organic Remains of a Former World," one of the most valuable and interesting works of the kind that I know. For further information with regard to Parkinson, see the Introduction to Mantell's "Atlas of Fossil Remains," published by H. G. Bohn in 1850, in which Parkinson's splendid plates are reproduced. See also Allibone's "Dictionary of British and American Authors"; London, 1870.

SPENCER GEORGE PERCEVAL.

Henbury, Bristol, October 29.

On Chinese Beliefs about the North.

FROM a review in NATURE for the 27th ult. (p. 522) I have been led to conclude that the "Theory of the Northern Origin of the Chinese" enjoys the confidence of scientific men. Should this conclusion really be correct, the theory will give strong support to the view which occurred to me while reading the review.

By Sze-má Kwáng, a Chinese Prime Minister of great classic knowledge (died 1086), the Rite of "Fuh" (*i.e.* bringing back), anciently observed before changing the clothes of deceased parents, is detailed as follows :—"Take a clean suit of clothes prepared for the corpse up to the ridge of the roof; then *towards the north call three times 'Pray, return'*; then fold up and bring down the suit to clothe the corpse; *to detain the soul* thus brought back, fasten the suit with silk (silken band); before the burial offer to it viands and utensils with as much reverence as is due to the parents alive" (1). In this ritual I notice three primitive beliefs unitedly preserved: firstly, that the soul of the deceased could return if called, the belief current among the Hos, the Bank's Islanders, and the Fijians of modern times (2); secondly, that one could detain the soul from departing by fastening a garment while addressing to the deceased, as is meant by an old Japanese usage on occasion of meeting the *passing soul, i.e., ignis fatuus* (3). In the third place, as is the case with the Kookies (4), this ritual indicates the primitive Chinese belief in the *existence of their other world in the north.*

The Early Chinese system of cosmogony, which is now fragmentally but uniformly preserved in the books of two antagonistic religions, viz. Confucianism and Taôism, has its God of the North named "Hiuen-Ming," *i.e.* "Entering Other World" (5).

Cháng Hwá, a Prime Minister of encyclopædic erudition (killed 300 A.D.), mentions in his work a Taôist belief in the other world as extensive as 200,000 *lis* square, situated underground in the north (6). Another Taôist Eschatology, written in the 9th century A.D., relates that "the Emperor Yen-teh, who was created the 'Grand Imperial Master of the North,' governs all spiritual beings" (7). Most probably connected with these beliefs is a folk-tale of the "'South Dipper,' the life-registrar, and the 'North Dipper,' the death-registrar" (8), from which is derived a popular romance of Chau Yen's bribery to the latter star-god in order to have his destined longevity increased from nineteen years to ninety-nine (9).

The Yogâtchârya mystics of China define the north as "the point whereat all the works are doomed to finish," and hence "the point of entering Nirvâna" (10). A dispute about whether Chinese Buddhism in this case is entirely free from the taint of Celestial gloss, I am not qualified to decide.

Now let us return to Confucian literature. Confucius's own opinion regarding the other world appears of quite agnostic character, as is implied in his answer to Tze-lu (who inquired about the state of death)—"While you do not know life, what can you know about death?" (11); as well as in his answer to Tze-kung (whose question was about whether the deceased had consciousness)—"If you die, you will know; even then it will not be too late to know" (12). But it is in those ancient sages' tenets, which the great master preserved in his doctrine, that the early Chinese belief in the northern spirit-land had been so predominant, though tacitly implied, as to have caused an all-reaching *association of the North with everything related to Death.* So, early they styled the rooms containing ancestral tablets the "North Temples" (13), and by the name "North Hill" the graveyard has always been understood.

According to the "Tang-kung" (a portion of the *Book of Rites*), Confucius was buried in the northern part of the capital of Lu, and "the burial in the northern sides of towns was the persistent custom of the three 'classic dynasties,' *i.e.* Hia, Ying, and Chau" (14). Forcibly this statement reminds us of the Damaras, who place the corpse with the face towards the north, to remind them whence they originally came; and also of the Yncas, who, expecting to go to the east whence they came, turned the face of the corpse to the east; while the aboriginal Peruvians did not follow the same usage (15). In fact, we find in Chinese records certain abnormal examples, which indicate the stocks distinct from original Chinese; thus, two corpses of different sexes discovered from the mound of Prince Tsükü, a Hiung-nú by descent, are said to have had their heads turned eastwards (16).

Mr. Herbert Spencer, after reasoning from materials extensively collected, remarks: "Immigrant races have for their other-worlds the abodes of their fathers, to which they journey after death" (17); and unless they are an exception to this general rule, the Chinese, whose old customs and traditions have been shown to tend so much towards evincing their early belief in the northern spirit-land, *must have originally entered their present domain from the North.*

Also, in early Chinese speculations the north had been fixed on as the store and source of the originating principle "Yin" (or *Negativity*), and it has ever since been associated with everything of "negative" characters—*e.g.* reposing, obscuring, destroying, &c. Thus, in the symbolism of "Wu-háng" (the *Five Elements*), water and winter are posted at the north (18); of the nine divisions of the heavens the northern and the north-western are named respectively "Dark Heaven" and "Dusky Heaven" (19); of the five mountains worshiped by emperors the northernmost one is called "Eternal Mountain" (*Han Shan*), because all beings are doomed to eternal repose in the north (20); and referring to the then admitted axiom—"the north is the realm of slaughters and assaults"—Confucius once reproved Tze-lu for playing on a stringed instrument in the "northern tones" (21).

As there should be nothing other than Death that might combine in itself all conceivable characters of Negativity, it would seem quite reasonable to trace the origin of these associations of North and Negativity of Chinese speculations into the old custom of burying in grounds lying towards the north, which custom in its turn is easily traced to the early Chinese entrance from the north.

Bibliography.—(1) Kúmazawa, "Sôsai Benron," Tokio, 1890, p. 4. (2) Spencer, "Principles of Sociology," 3rd edition, vol. i. § 83. (3) Terashima, "Wakan Sansai-dzue," 1713, tom. lviii. sub. "Hitotama." (4) Spencer, § 112. (5) Pan Kú, Peh-hú-tùng," 79 A.D. tom. ii. chap. i. (6) "Póh-wuh-chì," tom. i. chap. ii. (7) Twan Chìng-shih, "Yú-yáng Tsáh-tsú," tom. ii. (8) Sie Tsái-kang, "Wu-tsáh-tsú," *circa* 1610, tom. i. (9) "Yen-i-Sán-kwóh-chì," Kin's edition 1644, tom. xxxv. pp. 4–5. (10) In-yú, "Mandara Shishô," 1491, tom. i. (11) "Confucian Analects," chap. xi.; "Encyclopædia Britannica," 9th edition, vol. vi. p. 265. (12) Ying Chau, "Fung-süh-tùng," 2nd cent. A.D., tom. ix. chap. ix. (13) "Siun-tze," *circa* 255 B.C. xxviii. (14) "Peh-hú-tùng," tom. iv. chap. x. (15) Spencer, § 112. (16) Li Shih, "Süh Póh-wuh-chì," 13th cent. A.D. tom. viii. (17) Spencer, § 115. (18) "Peh-hú-tùng," tom. ii. chap. i. (19) "Lü-shi Chùn-tsiú," *circa* 239 B.C. tom. xiii. chap. i. (20) "Fung-süh-tùng," tom. x. chap. i. (21) Liu Hiáng, "Shwoh-yuen," 1st cent. B.C. tom. xix.

KUMAGUSU MINAKATA.

15 Blithfield Street, Kensington, W., October 16.

The Planting of Timber Trees.

IN Traill's sketch of the life of Shaftesbury (the first Earl), the following passage occurs in a letter from the Earl to the steward of his estates in Dorsetshire :—

"The best planting of timber trees is with nuts, acorns, seeds, and footsets, and not with young trees removed . . . In setting of chesnuts, acorns, and seeds [it is desirable] to steep them twenty-four hours in milk, which gives them a great advantage. . . . If siccamores [are planted] near my gardens, they will spoil all my fruit with the flies they breed. Therefore pray pluck up all the siccamores that are in the dry meadow behind my kitchen-garden, and in the room of every one of them plant a chesnut, a walnut, or a honey-broke oak."

Can any of your readers inform me whether the soaking of seeds in milk is now, or ever has been, extensively practised, also what is meant by a "honey-broke oak"?

ALFRED W. BENNETT.

Rhynchodemus Terrestris in England.

THE credit of the first discovery of this land-planarian in England lies not with Sir John Lubbock, as Dr. Scharff stated, but with the late Rev. L. Jenyns (Blomefield), who, in his "Observations in Natural History," 1846 (p. 315), makes some interesting remarks on the "Ground Fluke" (*Fasciola terrestris*) and its occurrence in the woods at Bottisham Hall, a locality searched with success by Mr. Harmer.

Rhynchodemus terrestris is widely distributed in England, and I have found it in Derbyshire, North Lancashire, and Westmoreland, under moist conditions and on a limestone substratum.

Any additions to the limited number of land-planarians in Europe are of considerable interest, and mention may therefore be made of Prof. v. Graff's description (*Bull. Soc. Zool. France*, xviii. 1893, pp. 122–3), of *Rhynchodemus pyrenaicus*, n. sp., from St. Jean de Luz, which is not alluded to by Dr. Scharff.

F. W. GAMBLE.

Owens College, Manchester, October 26.

Tan-Spots over Dogs' Eyes.

THE shepherds in some of the east counties of Scotland used to call their black-and-tan collies four-eyed dogs, which agrees so far with Mr. Peal's observations. These collies, twenty years ago, were much in demand. Now they are hardly allowed prizes at shows, and are becoming scarce; black and white, pure white, and, more commonly, brown dogs being greater favourites.

J. SHAW.

A CRITICISM OF THE ASTRONOMICAL THEORY OF THE ICE AGE.

IN a communication to the British Association at Oxford, I gave an outline of a method of obtaining a limit to the direct effect on terrestrial temperature of the diminished winter sun-heat during epochs of great eccentricity, the conclusion being that that effect had been enormously exaggerated, and that the astronomical theory of the Ice Age was really but a vague hypothesis, having no sound physical foundation.

It will be remembered that Dr. Croll's theory is shortly this: In the long northern winters in the time of great eccentricity, far less sun-heat is received than at present; the *direct* effect of this decrease in sun-heat is a *proportionate* decrease in terrestrial temperatures, or, more properly, a proportionate decrease in the excess of terrestrial temperature over the temperature to which the earth would fall in the absence of all sun-heat. So far Croll and Sir Robert Ball, the later expounder of the theory, agree. But now they part company. Croll affirms that the lowering of temperature thus calculated would be quite insufficient, and that it is the *indirect* effect of this fall of temperature (chiefly the effect in disturbing oceanic circulation) which gives rise to the additional lowering of temperature necessary for the production of an Ice Age. Ball, on the other hand, affirms that the direct lowering of temperature due to diminished sun-heat is amply sufficient to cause an Ice Age. I use the word *affirms* advisedly, because neither writer assigns any reason. Apparently Croll's reason was that he thought he could see additional causes, which if they existed must have contributed to the effect, and also that previous writers had said that the direct effect of the change in sun-heat would not be sufficient; while Ball seems to have considered that he had strengthened Croll's argument so much that the new form of the theory was as strong without the ocean currents, as Croll's was with ocean currents. It does not seem to have occurred to either writer to ask what change in temperature would be necessary in order to produce an Ice Age, so that they might see if the cause they assigned would be sufficient; yet one would have thought this was the first step towards formulating a theory.

The point in reference to which the two authors employ numerical calculation is in obtaining the fall of terrestrial temperature due to a reduction of sun-heat. The problem is, of course, very complicated, and one would expect that the most approved principles of physics would be employed. Not at all. The physics is founded on an incidental remark of the astronomer Herschel in his "Outlines of Astronomy" (edition of 1869), where he assumes that the radiation of a body in space is *proportional* to its absolute temperature. Yet it has for many years been known to physicists that the radiation increases faster than the temperature, and in 1880 or 1881 what is now known as Stefan's law was published, namely, that the radiation increases as the fourth power of the absolute temperature. This would make an enormous reduction in the calculated fall of temperature due to a diminished supply of heat—*it would reduce it to one-fourth* of the amount obtained on the erroneous assumption employed by Croll and Ball alike. For if temperature be solely due to sun-heat, the heat radiated, say $A\theta^4$, where θ is the absolute temperature, must be equal to that received, say S, or

$$A\theta^4 = S,$$

hence

$$\frac{d\theta}{dS} = \frac{1}{4}\frac{\theta}{S},$$

whereas the law of direct proportionality assumed by Herschel, and adopted by Croll and Ball, gives

$$\frac{d\theta}{dS} = \frac{\theta}{S},$$

a result four times as great as that obtained above—

Turning now to Croll's form of the argument, we find one very remarkable inconsistency, which I think is no bad illustration of the special pleading which characterises that ingenious writer. When, in the first place, he desires to show how great may be the midwinter fall in temperature due to diminished sun-heat, he thus employs the argument I have criticised above :—

Let T_p be the present excess of midwinter temperature at the latitude of the British Isles above the temperature of space, *i.e.* above the temperature to which the earth would fall if all sun-heat were to cease, and S_p the quantity of sun-heat at present received on that latitude on Midwinter Day, and let T_g and S_g be the corresponding quantities for the supposed glacial winter. Then, on Herschel's hypothesis, T_g is to T_p as S_g is to S_p. Having in that way got an enormous fall of temperature, Dr. Croll goes on to say that a vast proportion of our midwinter temperature in these isles is due, not to sun-heat received by us, but to heat carried to us by ocean currents. These ocean currents, he argues, will be diverted in the supposed glacial period, and thus there will be a *further* great fall in temperature. The argument for this double diminution of temperature is, of course, utterly invalid. If a great proportion of our winter-heat be not due to sun-heat, then a considerable

loss of sun-heat would not affect our winter temperature very much, and the first argument is wrong; if it be all due to sun-heat, then the first argument is right, and the second wrong.

Nor do we find much greater accuracy in Sir R. Ball's exposition of the theory. He is, indeed, much fairer than Croll in taking the winter temperature as proportional to the *average* daily supply of winter sun-heat, instead of the Midwinter Day sun-heat, for it is evident that the adjustment of temperature to sun-heat could not take place instantaneously. But in another particular he seems greatly to *understate* the case for the theory. His method of calculating the average daily sun-heat is to take the winter heat over the *whole northern hemisphere*, and divide it by the number of days in winter, and similarly for the daily summer sun-heat. He applies the average thus obtained to calculate variations in temperature in the latitude of the British Islands. But when we remember that the theory of the Ice Age is the theory of the temperature of the latitudes from about 45° N. to lat. 70° N., or, if you like, to the pole, it appears quite misleading to use numbers obtained from the sun-heat received by the *whole hemisphere*. For the proportion which the total winter sun-heat we receive in these Isles bears to the total summer-heat is expressed, not by Ball's numbers 37 and 63, but by the very different numbers 25 and 75. The great disparity between these numbers, contrasted with the temperate character of our climate, enables us to see how futile it is to appeal to our imagination, as Ball does, to conceive what vast differences of climate must be produced by differences in the daily receipt of sun-heat.

"If," he says, "a double supply of heat [63 measures] be poured in like a torrent during the short season [the 166 days of the short summer] while the single supply [37 measures] is constrained to do duty over the long season [the 199 days of the long winter], then an intolerable climate is the result. The total quantity of heat received on the hemisphere in the course of a year is no doubt the same in each case, but its unsuitable distribution bespeaks a climate of appalling severity—an Ice Age, in fact."

How untrustworthy this style of argument is, will appear when it is pointed out that in order to get a latitude in which as large a proportion as 37 per cent. of the annual sun-heat is received in the coldest 199 days, we have to go as far south as Madrid, Naples, Constantinople, New York, or Pekin! Yet we are asked to believe that this distribution, approximately two measures in 166 days, and one in 199 days, will produce "a climate of appalling severity—an Ice Age, in fact." ("Cause of an Ice Age," p. 135.)

There is another form in which the numerical method is applied by Ball, the result of which, so far from supporting the astronomical theory, would, if true, appear to me to be conclusive against it. The present mean annual range of temperature in Great Britain is about 20° F., and this, according to Ball, is caused by the disparity in the daily receipt of winter and summer sun-heat, acting against the mitigating causes. In the epoch of great eccentricity the disparity will be much greater, and instead of the range of 20° F. we shall have a range of 28° F. ("Cause of an Ice Age," p. 131.) Ball then goes on to say that such proportionate changes "are quite large enough to imply profound differences in the climatic condition. It is to be observed that, generally speaking, the coldest places are those of the greatest mean annual range. We are therefore entitled to infer that the effect of such a change in the eccentricity as we have supposed, would be to increase the range, lower the temperature of the hemisphere, and thus induce the glacial period."

One would not consider such a statement out of place in a popular series if it embodied the result of an inquiry too complicated to be explained except in technical language; but that is not the case here, nor can the conclusion be admitted as in the slightest degree probable. In fact, so far from our being entitled to infer that such an increase in the mean annual range would induce a glacial period, it appears to me that the mere fact that in all continental climates north of Lat. 40°, the present range is greater than 28° F., entitles us to infer that such a range would have no power whatever to induce an Ice Age.

The problem of ascertaining the effect of different astronomical conditions upon terrestrial temperatures is too complicated for accurate solution. How far the temperature at any place depends on the sun-heat falling on the outer layers of the atmosphere at the place (which is all that we can find by calculation), and how far on the transference of heat by ocean or air currents, must always remain to some degree uncertain, but that the latter exert a preponderating influence seems evident for two reasons—first, that while the sun-heat in each season remains the same from year to year, the seasons themselves vary enormously (we have cold summers and hot summers, warm winters and cold winters, all with unchanged conditions of sun-heat); and second, the difference between summer and winter temperatures is, in northern latitudes, but slight when compared with the difference between the quantities of winter and summer sun-heat received. Hence it appeared to me that no modification of Croll's method of calculating differences of temperature due to differences of sun-heat could be relied on, for our knowledge of the transference of heat from one region to another is too slight to enable us to allow for its effect in our equations. But there is another method which seems very reliable, especially when applied to the British Isles, or any region where warm ocean currents flow from the south. Not, indeed, that the method enables us to calculate the lowering, if any, of temperature in the epoch of great eccentricity, but it appears to enable us to fix, with some degree of certainty, *a limit to the direct effect of the diminished winter sun-heat.*

The method depends on comparing those regions which now receive given allowances of summer and winter sun-heat with the regions which, in the epoch of great eccentricity, received the same allowances. If, following Croll, we suppose the temperature on Midwinter Day to depend on the sun-heat received on that day, we find that latitudes 90°, 80°, 70°, 61°, 52°, and 43° now receive the same sun-heat on Midwinter Day as latitudes 90°, 80°, 70°, 60°, 50°, and 40° received on the Midwinter Day of the most extreme eccentricity. In other words, instead of Dr. Croll's fall of 45° F. (I omit his decimal point), the midwinter temperature of London would, in the supposed glacial epoch, be lowered to that of Manchester at present, for Manchester is about 2° north of London. If, following Ball, we take the average daily heat in winter as the basis of comparison, we should find that latitudes 90°, 81°·3, 71°·3, 61°·7, 52°·4, and 43°·3 receive in the present winter the same daily average of sun-heat as latitudes 90°, 80°, 70°, 60°, 50°, and 40° received in the long winters of greatest eccentricity. Or, finally, if we adopt the hypothesis, too favourable to the astronomical theory, that the widwinter temperature depends on the daily average through the 199 coldest days of the year, we find that latitudes 84°·5, 74°, 63°·5, 54°, and 44°·2 ought now, so far as direct sun-heat is concerned, to have the same midwinter temperature as 80°, 70°, 60°, 50°, and 40° had in the supposed glacial epoch; and when it is observed that the summers in these latitudes were then considerably hotter than the summers in the former latitudes, 84°·5, 74°, 63°·5, 54°, and 44°·2 now are, the utter inadequacy of the astronomical theory to explain the vast differences in temperature must surely be admitted by any reasonable mind.

But when we take account of the ocean currents, it

seems probable that instead of being lowered the winter temperature in the British Isles would be raised in the long winter of the supposed glacial epoch. For the Gulf Stream flows at about four miles per day between the Azores and Norway—that is, about ten degrees of the earth's surface in six months, so that we may fairly suppose the midwinter heating of these countries to be dependent on the summer heating at about Lat. 40°–45°. Now during the 166 days of the short summer in the epoch of great eccentricity, these latitudes received a greater daily average of heat than any latitude, even the equator, now receives in an equal time. Hence it is likely that the midwinter receipt of ocean heat in that epoch was much greater than at present. This seems to harmonise with the present condition of Mars. So far, indeed, as the evidence from the condition of Mars is admissible, it seems to be quite inconsistent with Croll's view.

A paper dealing more fully with the mathematical portion of the subject will shortly appear in the *Philosophical Magazine*, and a more exhaustive criticism of Croll's and Ball's works will be found in the January number of the *Geological Magazine* for 1895.

It is satisfactory to know that although the astronomical theory of the Ice Age has been steadily gaining an assured position among the semi-scientific public—one sees it referred to as the most generally accepted explanation in such diverse works as Nansen's "Journey across Greenland," and Laing's "Human Origins"—the rising school of geologists are strongly opposed to it, as contradicting the geological evidence.

EDWARD P. CULVERWELL.

NOTES.

THE President and Council of the Royal Society have this year awarded the medals as follows:—The Copley Medal to Dr. Edward Frankland, for his eminent services to theoretical and applied chemistry; the Rumford Medal to Prof. James Dewar, for his researches on the properties of matter at extremely low temperatures; the Davy Medal to Prof. Cleve, of Upsala, for his researches on the chemistry of the rare earths; and the Darwin Medal to Prof. Huxley, for his researches in comparative anatomy, and especially for his intimate association with Mr. Darwin in relation to the Origin of Species. The Royal Medals have been awarded to Prof. J. J. Thomson in recognition of his contributions to mathematical and experimental physics, especially to electrical theory; and to Prof. Victor Horsley for his important investigations relating to the physiology of the nervous system and of the thyroid gland, and to their applications to the treatment of disease. We learn as we go to press that the Queen has signified her approval of these awards.

THE following is a list of those who have been recommended by the President and Council of the Royal Society, for election into the Council for the year 1894–5, at the anniversary meeting on November 30:—President: Lord Kelvin. Treasurer: Sir John Evans, K.C.B. Secretaries: Prof. Michael Foster, Lord Rayleigh. Foreign Secretary: Sir Joseph Lister, Bart. Other members of the Council: Dr. Andrew Ainslie Common, William Crookes, Francis Darwin, Dr. Andrew Russell Forsyth, Sir Douglas Galton, K.C.B., Prof. Alexander Henry Green, Sir John Kirk, K.C.B., Prof. Horace Lamb, Prof. Edwin Ray Lankester, Prof. Alexander Macalister, Prof. John Henry Poynting, Prof. Arthur William Rücker, Osbert Salvin, Prof. J. S. Burdon Sanderson, Dr. Thomas Edward Thorpe, William Henry White, C.B.

WE regret to note the death of Prof. M. Duchartre, the eminent French botanist. He was in his eighty-fourth year.

THE Société nationale d'Horticulture de France is organising an international exhibition of horticultural products and industries, to be held in May 1895.

THE death is announced of Dr. Francesco Gasco, Professor of Comparative Anatomy and Embryology in the University of Rome.

SIR D. A. LANGE, who was appointed in 1858 the constructor of the Suez Canal, has just died, and was for some years director in England of that work. He was a Fellow of the Royal Geographical Society, the Society of Antiquaries, and of other learned societies, and the author of several important books connected with the Suez Canal.

A BLUE-BOOK has been issued containing Commissioner H. H. Johnston's report of the first three years' administration of the eastern portion of British Central Africa. The report deals with the physical geography of the country, its meteorology, agricultural conditions and resources, minerals, and fauna, with the characteristics of the native races, and is altogether of considerable scientific value.

AFTER the great earthquake shocks in Greece, last spring, a committee was appointed to make an examination of the Parthenon, in order to ascertain what damage the temple had sustained. The committee reported that the building had been seriously injured, and that there was great risk in allowing it to remain in its present dangerous condition. They recommended, therefore, that immediate steps be taken to strengthen it. Reuter's correspondent at Athens now reports that the Archæological Society, at a meeting called to consider the question, have voted an unlimited credit for the purpose of effecting the necessary repairs.

MR. H. C. RUSSELL, has sent us an account of the travels of three bottle-papers used for determining ocean currents. One was thrown into the sea near the Crozet Islands in March 1893, and was found in September 1894 between Cape Banks and Cape Northumberland. The mean daily rate of this appears to have been nearly eight miles. Two other papers travelled over much the same course on the south coast of Australia, at mean rates of six and nine miles a day. The interesting point is that three current papers should pass over more or less the same track, and agree so well as to the rate of the current. The paper that made only six miles a day was hampered with a heavy frame of wood, which had been put round it as a protection when it should reach the coast.

THE arrangements for the new session of the Society of Arts are now announced. The session commences on November 21 with an address from the Chairman of the Council, Major-General Sir John Donnelly. The first regular paper will be by Mr. Hiram Maxim, on his "Experiments in Aeronautics," and this will be followed the succeeding week by one by M. Hermite, on "The Electrical Treatment of Sewage." Two other papers—one by Mr. Thomas Ward on "Salt," and one by Gen. Michael on "Forestry"—will be read before Christmas. A number of papers for meetings after Christmas are also announced. Six courses of Cantor Lectures are promised, of which the first is by Prof. Vivian Lewes on "Explosives." There will be, as usual, a course of Juvenile Lectures after Christmas; the lecture this year is by Prof. C. V. Boys, F.R.S., his subject being "Waves and Ripples."

M. A. DELEBECQUE, of Thonon, sends us a small pamphlet on the lakes of Dauphiné. These lakes are very numerous, many of them being mere tarns or lagoons, and some, although figuring as sheets of water on the large-scale maps, are frequently dry. He gives an account of his soundings in the lakes of Bourget, Aiguebelette, Paladru, and the smaller lakes of the

plateau and mountain regions. As to the origin of these basins, M. Delebecque believes that many of the smaller are due to glacial action, either erosion or the irregular accumulation of moraine stuff. He does not confirm Forel's theory of the origin of the lake of Bourget by the barring of a lateral valley by the alluvium of the Rhone, but is inclined rather to look upon it as a result of movements in the crust. The origin of the other lakes is more obscure, but some appear to be probably due to movements of the strata, while others arose from the barring of lateral valleys by detritus. Particulars of temperature observations and analyses of the water of various lakes are given, and M. Delebecque concludes with an appeal to the local scientific societies of Dauphiné to initiate systematic observations on the lakes of the district.

MONSIEUR FAYE, the celebrated French astronomer, who lives in Paris, has recently received a handsome token of the admiration of his colleagues. All the members of the Bureau des Longitudes, together with their president,

Monsieur de la Grye, assembled in his house, and presented him with a silver enamelled tablet, on which Astronomy and History are represented offering a medallion to the most useful of careers. It bears the following inscription: "To Hervé Faye, President of the Bureau des Longitudes, 1874–1893. The homage of his colleagues." The two allegorical figures are sitting in the clouds, and Astronomy is pointing to the comet which was discovered by the illustrious astronomer. This interview greatly affected Monsieur Faye, who had only retired on account of the new law, opposing the perpetuity of the presidency.

MR. J. THEODORE BENT AND MRS. BENT leave London to-morrow, November 9, for an exploring journey in Arabia. They go first to Karachi, and thence by steamer to Muskat on the Gulf of Oman, where the land journey commences. It is Mr. Bent's intention to cross Arabia from east to west, and, in doing so, to revisit the Hadramut Valley, and continue his archæological researches there.

MR. TREVOR-BATTYE, to whose arrival at Archangel we referred last week, has telegraphed to the *Times* a detailed account of his experiences on his visit to Kolguef Island. He landed on the north-west coast of the island on June 21, at the mouth of the river Gosina, accompanied by Thomas Hyland (a bird-skinner) and a spaniel. A few days later they started to cross the island, and found the journey very difficult on account of the bogs and snow-filled ravines, and the severity of the weather, which was either cold and foggy or intensely hot, calling out swarms of mosquitoes. Birds were abundant, but the only mammal seen was a fox. At length, after a week's travelling, a party of Samoyedes and many reindeer were found near Chum. Mr. Trevor-Battye made this his headquarters until August 20, gaining much information as to the language and customs of his hosts, and assisting them in their hunting. He records the capture of 300 Brant geese in one net, and on another occasion the slaughtering of 300 reindeer. A Russian trader arrived who had visited the island for thirty-five successive years, and he remained a month transacting business with the Samoyedes. On September 18 Mr. Trevor-Battye sailed with the Russians for the mainland, and experienced bad weather on the way, and much difficulty in navigating the shallow water near shore. His orthodox companions attributed this difficulty to the presence of a Samoyede idol which was very displeasing to St. Nicholas; but Mr. Battye clung to his trophy, though at some personal risk. After landing, there was a four days' journey in sledges to Oksina, and a three days' boat trip up the Pechora to Ust Tsilma. It was the worst time of the year for travelling, as the land was marshy, and the rivers, unnavigable on account of floating ice, were not yet frozen over. However, Mr. Trevor-Battye and his companion struggled on in sledges or carts, and, after adventures with wolves and all manner of delays, ultimately reached Archangel in excellent health. Kolguef Island appeared to be of alluvial formation with no trace of massive rock, being possibly a remnant of the delta of a great river. The coast-line is quite different from that shown on the chart. Extensive zoological and botanical collections were secured.

AT the annual meeting of the Royal Cornwall Geological Society, held at Penzance, on November 2, Mr. Howard Fox, the President, reviewed the progress made during the past twelve months towards the elucidation of the many unsolved problems of Cornish rocks. Mr. F. J. Stephens had found radiolarian cherts in the Meneage conglomerate, and on the mainland near Mullion. Mr. Ussher, of the Geological Survey, had traced Upper Devonian strata in the St. Germans district, west of the Tamar. The President himself had found similar strata west of Padstow, and a peculiar rock at Dinas Head in the same district, which contained nearly ten per cent. of soda. In its compact form it might easily be mistaken for a chert, but it passed into a nodular variety showing spherulitic structure. Whether it were a soda felsite (keratophyre) or a sedimentary rock altered by contact metamorphosis, such as the Adinole of the Hartz, was a question on which petrologists were not as yet in absolute agreement. The evidence from sedimentary rocks in contact with greenstone on Cataclens and Round-hole Points indicated a sedimentary origin, as did General McMahon's notes on the sections he had examined. Crinoidal remains had been found in black shales of the Ordovician district of Veryan, interbedded with radiolarian cherts, but these shales had as yet yielded no typical zonal fauna. He (Mr. Fox) had sent some sections of the carboniferous cherts of East Cornwall

to Dr. Hinde, who found those from Carzantic Quarry, near Launceston, full of radiolarian casts, with one instance of structure. Further investigations were being made in this direction by Mr. Ussher and himself. In conclusion, he drew attention to the unwise practice of taking away shingle from beaches faster than it was being reproduced by nature.

IN connection with the controversy over preformation and epigenesis which at present agitates the biological world, we may draw the attention of our readers to a series of articles contributed by Wilhelm Haacke to the *Naturwissenschaftliche Wochenschrift* (Bd. ix. Nos. 32–38, Aug. and Sept. 1894), under the title "Schöpfung und Wesen der Organismenform." The writer passes under review the various theories of the origin and development of organisms which are associated with the names of Albrecht von Haller, Wolff, Blumenbach, Goethe, Lamarck, St. Hilaire, Darwin, Weismann, Roux and other biologists, and criticises them from a standpoint not far removed from that of Oscar Hertwig. The synthetic views of the author do not give one the impression of finality, but, as a historical *résumé* of the oscillations and tendencies of thought upon some fundamental problems in biology, Dr. Haacke's essay is distinctly interesting.

THE importance, both from economic and from scientific points of view, of a thorough knowledge of the floating fauna and flora round our coasts is so generally recognised, that our readers will be interested in a recent article which, in concise form, furnishes a number of valuable data upon this subject, and must considerably facilitate the further prosecution of similar researches. The article forms part of a report contributed by Mr. W. Garstang to the current number of the *Journal of the Marine Biological Association*, in which the author gives a record of his observations upon the fauna during 1893–94, and upon the breeding seasons of marine animals at Plymouth, and also submits an attempt to construct a calendar of the changes observable in the floating fauna from month to month in the same locality. *Der Anfang ist das Schwer*, and marine biologists familiar with the seeming fickleness of marine phenomena know well the powers of discrimination and the experience necessary for the production of accurately generalised information under this head. It is most satisfactory, therefore, that the valuable work upon our north-eastern fauna, which Prof. M'Intosh has conducted for many years past at St. Andrews, should be now supplemented by the observations of another competent naturalist on our south-western shores. If, as we hope, arrangements can before long be made for carrying on continuous observations at the young, but promising, station at Port Erin, and on the west coasts of Ireland and Scotland, we shall in good time be equipped with data of the most valuable kind for determining many problems connected with the natural history of our migratory and other fishes.

THE second of the *Tufts College Studies* embodies the results of an investigation of the development of the lungs of Spiders (*Agelena nævia* and *Theridium tepidariorum*) by Orville L. Simmons. The author's interpretations differ entirely from those of Jaworowski, already noticed in our columns (October 25, p. 621). He finds that the lungs arise as infoldings of the posterior surface of the appendages of the second abdominal somite, the lung cavity being essentially a pit in the body-wall at the base of, and behind, the appendages in question. The development of the lamellæ agrees strikingly with Kingsley's observations on the origin of the gills of *Limulus*, and lends considerable support to Prof. Lankester's well-known theory. The tracheæ develop behind the next pair of limbs at the apex of a similar depression of the body-wall. In their earlier stages these appendages show on their posterior surfaces certain feeble undulations, which the author regards as aborted lung- or gill-lamellæ. The tracheal twigs arise as simple ingrowths comparable, in the author's opinion, with the infoldings which produce the lamellæ. Mr. Simmons concludes that the lung-book condition is primitive, the tracheæ of Arachnids being derived from it. How far he is right in this conclusion, and how far (if at all) Jaworowski has gone wrong, are questions that we hope will not long remain undecided.

A REDETERMINATION of the temperature of greatest density of water has recently been carried out by M. de Coppet, who gives an account of his results in the *Annales de Chimie et de Physique*. On account of the very slow change of density about that temperature it is difficult to determine it within a hundredth of a degree Centigrade. The method adopted was a modification of that of Despretz. A number of thermometers were mounted in the lid of a cylindrical water vessel with their bulbs at various distances from the bottom, and symmetrically disposed about the axis. On immersing the vessel in a cold water bath, a current was set up, passing down along the sides and ascending in the centre. After a while the current stopped, and then was reversed. The course of the current could be followed by the readings of the thermometers. The water having the greatest density would sink to the bottom, and the temperature of the lowest bulb would be approximately that of greatest density. But the temperature at which the lowest thermometer stopped for a time was higher on cooling than on heating. The curves exhibiting the two series of changes are, however, symmetrical, and give the temperature of maximum density as 3°·982 by the hydrogen thermometer under a pressure of one atmosphere.

A SIMPLE method of obtaining light of different wave-lengths for use in polarimetric work is described by Landolt in the *Sitzungsberichte* of the Berlin Academy, No. 38. White light from an Auer's glow-lamp is passed through different absorption cells containing coloured solutions which can be readily procured. Details are given of the preparation of five such cells, by means of which red, yellow, green, light blue, and dark blue light may be obtained. Examined spectroscopically, the light is in each case found to consist of a band, and is not by any means monochromatic; if, however, the rotation be less than 20°, or, with one or two of the cells, even if it be considerably greater, the field of the polarimeter remains apparently uniform in tint. The wave-lengths with which the bands may be taken to correspond, were determined by using the cells in a set of observations on the rotation of quartz, and comparing the results with those obtained for the rotation of quartz by Broch's method. The wave-lengths were thus ascertained to be not far removed from those of the Fraunhofer lines C, D, E, F, G. The instrument employed was a Laurent half-shadow polarimeter fitted with a Lippich's polariser. A simple method of this kind has long been required for the speedy investigation of rotatory dispersion. It is also of importance to have a ready means of obtaining light of short wave-length, which is of especial service when determining the rotatory power of feebly active substances.

IN a paper communicated to *L'Electricien* (Paris), M. G. Darriens gives an account of some recent experiments he has made on the chemical reactions which take place in the ordinary lead accumulator. To get an idea of the chemical state of the negative plate of an accumulator, the author treated a given weight of the negative plate of a fully-charged accumulator with hydrochloric acid, and measured the volume of hydrogen evolved. He then measured the volume of hydrogen evolved when an equal weight of ordinary sheet-lead was dissolved in hydrochloric acid, and obtained practically the same number as before. This experiment seemed to indicate that the negative plate of a charged accumulator consists of metallic

lead, in a very finely-divided state, and that a charged accumulator simply represents an ordinary voltaic cell in which lead is the negative element. In order to test this point, the author has examined the behaviour of several forms of primary battery in which finely-divided lead is used as the negative metal. In the case of a Daniell cell consisting of a copper plate in a saturated solution of copper sulphate and a plate of spongy lead in dilute sulphuric acid, the liquids being separated by an ordinary porous pot, the mean of several experiments gave the value 0·64 volt as the electromotive force. A calculation of the electromotive force of this cell, based on the heats of formation of the different substances, gives 0·3 volt, so that it would appear as if lead in this very finely-divided state evolved more heat when it entered into combination than under ordinary conditions. If this supposition is true, it is necessary to add 0·34 to the figures calculated for ordinary sheet-lead, to allow for this "allotropic" modification of the metal. If we apply this correction to the observed electromotive force (1·6 volts) of an element consisting of PbO_2 and pure lead, we get the quantity 1·94 volts, which represents the electromotive force of the element PbO_2 and spongy lead. The above values can be utilised to calculate the quantity of heat necessary to convert ordinary lead into spongy lead, the value obtained being 7·4 calories. With a Daniell cell, as described above, in which the spongy lead had a surface of one square decimetre, and weighed 440 grms., the mean electromotive force was 0·57 volts and the capacity 13·75 ampere-hours, the internal resistance being about 0·12 ohms. This form of cell is subject to the same objection as the ordinary form of Daniell, namely, that after a time the copper-sulphate solution diffuses through the porous pot, and the copper is deposited on the negative metal.

THE filtration of water on a large as well as on a small scale has acquired quite a different significance since the bacteriology of water has sprung into existence; and it is as a useful, because impartial contribution to this subject, that we welcome Surgeon-Major Johnston's short treatise on "the relative efficiency of certain filters for removing micro-organisms from water." The investigations here recorded were made as qualifying work for the degree of D.Sc. at Edinburgh University, and the experiments were carried out in the Public Health Laboratory of the University. The filters examined were those known as the Atkins patent water filter, Maignen's table "Filtre Rapide," the Nordmeyer-Berkefeld filter, and the Pasteur-Chamberland filter. The first two filters are described as useless for sterilising water, both of them not only allowing "micro-organisms to pass through the pores," but affording "a suitable nidus for the growth and multiplication of micro-organisms, which are found in much greater numbers in the filtered water than in the unfiltered." The "Berkefeld" and "Chamberland" filters were more elaborately examined. The "Chamberland" cylinder selected was one intended for slow filtration, and in comparing the results obtained with it and the "Berkefeld" cylinder respectively, it must be borne in mind that the rate of filtration through the latter was 5⅓ times greater than through the former, although after twenty-four hours' continuous filtration, the rate was only 1¼ times greater. Major Johnston's opinion, based on his examination of these particular cylinders, is that "the Pasteur-Chamberland filter is the best and only one on which reliance can be placed for permanently sterilising water." An important point, and one which has been overlooked by the author, is the temperature of the room in which the filters were kept whilst under examination. Freudenreich found that a higher or lower temperature had a marked effect on the efficiency of the Chamberland filter. It is to be regretted that in a thesis of this kind, purporting to have a bibliography, the author should have entirely neglected to mention or refer to, in any way, a large number of important investigations on these particular filters published during the last few years in various foreign journals.

MR. G. J. SYMONS has contributed to part ii. of the Report of the Chicago Meteorological Congress, an interesting summary of early English meteorological literature, embracing the years 1337–1699. He only deals with some fifty books and pamphlets contained in his own library, but his special knowledge of meteorological bibliography enables him to give some useful particulars about these old works. We can only briefly refer to a few of them here. In the Bodleian Library at Oxford there is (as far as is known) the earliest continuous weather record in the world, containing observations by the Rev. W. Merle from January 1337 to January 1344. A few copies of a translation of this work were printed in 1891. These observations show that the weather at that time was very similar to what it is now. In 1670, "The Shepheard's Legacy" was printed. This work is excessively scarce, and is the earliest edition of what has since been reprinted many times as "The Shepherd of Banbury's Rules for judging the weather." In 1671 appeared "A discourse concerning the Origine and Properties of Wind," &c. This treatise is noteworthy as being probably the first in which the theories of the winds are compared with details of the trade winds, monsoons, &c. In 1696 a work entitled "New Observations on the Natural History of the World of Matter," &c., by the Rev. T. Robinson, was published. It gives the earliest description yet known of the strong local wind known in Cumberland as the *helm wind*. The subject of this wind has been brought before the Royal Meteorological Society on several recent occasions, and that Society appointed a committee to collect information upon it.

THE November number of the *Journal* of the Chemical Society has been published. It is almost entirely taken up with abstracts of papers published in other journals.

MESSRS. R. FRIEDLÄNDER AND SON have sent us their *Naturæ Novitates*, Nos. 14–19, 1894, and No. xxx. of the quarterly list of their new publications. The lists are invaluable to those who wish to keep in touch with recent scientific literature.

THE *Quarterly Journal* (No. 201) of the Geological Society contains several papers on the geology of Africa. Dr. J. W. Gregory describes the glacial geology of Mount Kenya; Captain H. G. Lyons, the stratigraphy and physiography of the Libyan Desert; and Mr. H. Draper, the principal physical and geological features of South-eastern Africa, and the occurrence of dolomite in South Africa. There are seven other papers in the *Journal*, and sixteen plates.

WE have received parts iv. to vii i. of the third volume of the *Transactions* of the Leicester Literary and Philosophical Society, extending from July 1893 to July 1894. The Society holds general meetings, at which lectures of a more or less popular character are given, and sectional meetings for the reading and discussion of technical papers. Its object is to cultivate literature, science and art, and, judging from the reports, good work is being done in each of these directions.

IT is well known that Dr. A. Bernthsen's "Text-book of Organic Chemistry" is an excellent elementary account of the principles of organic chemistry. Dr. George McGowan's translation of the work, published by Messrs. Blackie and Son, was reviewed in these columns in December 1889 (vol. xli. p. 172). A second English edition, revised and extended by the author and the translator, has now appeared. It is virtually a translation of the fourth German edition, published last year, and therefore various chapters have been recast in order to include new developments of their subjects.

MESSRS. R. AND J. BECK have just issued an illustrated catalogue of microscopes, object-glasses, and other apparatus for which they are famed. In it we find descriptions of microscopes, from the large binoculars (which some investigators declare to be almost indispensable for certain researches) to the smaller instruments suitable for bacteriological and clinical work, and the useful petrological microscopes. The microscope, like the telescope of the present day, bristles with innumerable accessories, and Messrs. Beck's catalogue appears to contain most of these adjuncts. A copy of the catalogue will be sent, post free, on application.

THE Report of the Weather Bureau of the United States for the year 1893, which has just reached this country, shows that a general reorganisation has been effected, and that the work has been carried on successfully. A very important publication of the results of observations during 1891 and 1892, from upwards of 2000 stations, has been recently issued. Every means is taken to popularise the science; the daily weather map is now issued at seventy-two stations of the Weather Bureau outside of Washington, the number distributed annually being over two and a half millions. The circulation of the weekly weather crop bulletins of the State services has also greatly increased; and continues to be the most valuable feature of State weather service work. A large number of railway companies co-operate with the Bureau in distributing the daily weather forecasts by telegraph over their lines, and whistle-signals are used to a considerable extent in some States. The subject of seasonal forecasts is receiving the careful attention of the Bureau, since the meteorological service of India has indicated a path by which useful results can perhaps be reached. The report also states that Prof. Bigelow continues his studies of magnetism with sufficient prospect of success to justify the time and labour expended. The library of the Bureau now consists of nearly 20,000 books and pamphlets, and the bibliography of meteorology comprises more than 65,000 titles.

CULTIVATORS and admirers of roses will be interested in "Rhodologia"—a discourse on roses and the odour of rose—by Mr. J. C. Sawer, published by W. J. Smith, North Street, Brighton. Too much attention is generally given to the development of colour, form, and size of the flower, little heed being paid to the great variety of perfumes generated in the beautiful petals. Mr. Sawer says that there are experienced gardeners who can discriminate many varieties of roses in the dark, recognising them by their perfumes. The pure odour of rose is best represented by *Rosa Damascena*, Miller, and *R. centifolia*, Lin. The art of distilling roses appears to have originated in Persia, and dates from about 1612. In 1684 it is certain that otto of rose was manufactured on a large scale at Shiraz. Otto of rose was known in Europe, however, about forty years sooner than in the East, where its manufacture was first practised. We learn that at the present day the odorous products of the rose are extracted in Bulgaria, France, Germany, and to some extent in India, Persia, Tunis, Algeria, Morocco, and Egypt. The rose cultivated in Bulgaria for the otto is a variety of *R. Damascena*—the red damask rose. *R. centifolia*, which in English gardens is grown as the cabbage rose or Provence rose, is cultivated commercially in the south of France. Mr. Sawer brings together in his pamphlet a mass of details of interest to students, as well as to manufacturing chemists and buyers of rose-products. Rose growers (both amateur and professional) should certainly read "Rhodologia."

TWO remarkable substances, carbazide or carbonyl nitride, CON_6, the nitrogen analogue of phosgene gas $COCl_2$, and di-urea, $CO(NH \cdot NH)_2CO$, the carbonyl derivative of di-hydrazine, are described by Prof. Curtius and Herr Heidenreich in the current *Berichte*. The former compound, which is constitutionally formulated $CO(N_3)_2$, is found to be readily produced when the recently described hydrochloride of carbohydrazide, $CO(NH \cdot NH_2HCl)_2$, is treated with a cold aqueous solution of sodium nitrite. The reaction is a relatively simple one, proceeding according to the equation:—

$$CO(NH \cdot NH_2HCl)_2 + 2NaNO_2 = CO(N_3)_2 + 2NaCl + 2H_2O.$$

Carbazide as thus produced is a colourless oil of most explosive character. It explodes with great violence when merely touched. When the oil is dissolved in ether, and the solution is allowed to evaporate over calcium chloride, the pure substance CON_6 is left in long brittle crystals, which usually explode spontaneously in a bright light, but may occasionally be preserved for some little time before disruption. The substance is extremely volatile, and the vapour possesses a most penetrating and stupefying odour, reminding one simultaneously of phosgene gas and azoimide, N_3H. Its composition is readily proved by saponification with alkalies, which convert it into salts of azoimide, which can be precipitated by silver nitrite. It also reacts with aniline in alcoholic solution to produce carbanilide and free azoimide. The second compound described in the communication, di-urea, $CO\langle{}^{NH \cdot NH}_{NH \cdot NH}\rangle CO$, is produced when the compound $\begin{matrix} NH \cdot COOC_2H_5 \\ | \\ NH \cdot COOC_2H_5 \end{matrix}$, also recently described by Prof. Curtius, is heated to 100° in a tube with hydrazine hydrate. Di-urea crystallises readily from water in monoclinic prisms melting at 270°. It behaves as a strong monobasic acid which is capable of expelling carbonic acid from carbonates. The ammonium salt, $C_2H_3N_4O_2 \cdot NH_4 + H_2O$; barium salt, $(C_2H_3N_4O_2)_2Ba + 3H_2O$; silver salt, $C_2H_3N_4O_2Ag$; and diammonium (hydrazine) salt, $C_2H_3N_4O_2 \cdot N_2H_5$, have been prepared and analysed. It is a very stable substance, quite different in this respect from the explosive carbazide above described. When heated, however, with concentrated hydrochloric acid in a sealed tube to 150° it is decomposed into carbonic acid and hydrazine.

$$CO(NH \cdot NH)_2CO + 2H_2O = 2CO_2 + 2N_2H_4.$$

The hydrazine remains combined with the hydrochloric acid in the form of a chloride, presumably diammonium chloride N_2H_5Cl.

THE additions to the Zoological Society's Gardens during the past week include a Brown Capuchin (*Cebus fatuellus*) from Guiana, presented by Mr. Graham S. Pownall; two Common Marmosets (*Hapale jacchus*) from South-east Brazil, presented by Mr. D. B. Macdougall; two Black-backed Jackals (*Canis mesomelas*) from South Africa, presented by Mr. Claude Southey; three Crossbills (*Loxia curvirostra*), two Parrot Crossbills (*Loxia pityopsittacus*), an European White-winged Crossbill (*Loxia bifasciatus*), a Yellow Bunting (*Emberiza aureola*), two Northern Marsh Tits (*Parus borealis*) from Russia, presented by Captain A. Newnham; a Double-ringed Dove (*Turtur bitorquatus*) from Java, presented by the Hon. Rose Hubbard; a Black Salamander (*Salamandra atra*), European, presented by Mr. Maurice Suckling; a Bonnet Monkey (*Macacus sinicus*) from India, two Lions (*Felis leo*, ♂ ♂) from Africa, deposited; a Golden Plover (*Charadrius pluvialis*), three Dunlins (*Tringa alpina*), European, purchased; a Spotted Pigeon (*Columba maculosa*), a Triangular-spotted Pigeon (*Columba guinea*), two Vinaceous Turtle Doves (*Turtur vinaceus*), bred in the Gardens.

OUR ASTRONOMICAL COLUMN.

A COMET ON THE ECLIPSE PHOTOGRAPHS OF 1893.—A year ago Prof. Schaeberle announced that the eclipse photographs taken by him at Chile in April 1893, showed a comet-like structure in the corona near the sun's south pole. The photographs taken by the British observers in Brazil and Africa were examined in order to see if they showed the cometary object, but nothing could then be made out. It is well known, however, that faint objects can be easily found when the observer knows what can be seen, and where to look for it. Prof. Schaeberle and Prof. Holden were confident that a comet was photographed upon the corona of the 1893 eclipse, and, with the idea of obtaining confirmation of the discovery, the latter sent Mr. W. H. Wesley copies from negatives obtained at Chile and Brazil, having marks upon them showing the exact position of the object in question. These guides have fulfilled their purpose, for Mr. Wesley says, in the *Observatory*, that they clearly point out a cometary structure in the corona. The object is extremely faint, and, unless particular attention is drawn to it, appears like a forked coronal ray. Evidently the only way to prove that the object was really a comet was to measure its angular distance from the moon's limb on the photographs taken at the different eclipse stations. Mr. Wesley has done this, and he finds that the distances are: Chile, 29′; Brazil, 36′; Africa, ± 47′. Therefore, it is concluded "the evidence of motion relatively to the sun, given by the comparison of the plates taken at the three stations, seems to place the nature of Prof. Schaeberle's interesting discovery beyond a doubt."

THE TRANSIT OF MERCURY.—The transit of Mercury across the sun on Saturday, November 10, is a matter of more interest to American than to European astronomers. The planet will enter upon the sun's disc at 98° from the North point, counting towards the East, and will leave at a point 50° from the North, counting towards the West. It will reach the sun's limb at five minutes to four in the afternoon; but as the sun sets at Greenwich about twenty minutes later, there will not be much opportunity for observation in London. In America, however, if the weather is favourable, the planet will be observed during the whole of the five hours it will take in transiting. The following are the Greenwich Mean Times of the phases of the transit:—

		h.	m.	s.
Ingress, exterior contact	Nov. 10	3	55	31·2
Ingress, interior contact	,,	3	57	15·4
Least distances of centres (4′ 26″·8) ...	,,	6	33	48·5
Egress, interior contact	,,	9	10	26·4
Egress, exterior contact	,,	9	12	10·4

MIRA CETI.—Mr. Fowler writes from South Kensington to draw attention to the fact that this remarkable variable will be suitably placed for observations during its progress to the next maximum. According to the *Companion to the Observatory*, the date of minimum was September 24, and the maximum may be expected about February next. It will be of great interest to obtain a spectroscopic record during the rise to maximum, with special reference to the time of appearance of the bright lines of hydrogen, which have been seen near the time of maximum.

Mr. Fowler observed the spectrum on October 24, with the three-foot reflector, and it did not then differ from the spectrum of such a star as α Herculis, in which the hydrogen lines are not known to appear bright. The bright part of the spectrum which is coincident with the carbon band near λ 5165 was relatively less bright, however, than when it was observed near the last maximum.

RETURN OF ENCKE'S COMET.—It is reported that Encke's comet was observed at Rome by Prof. Cerulli, near the predicted place, on November 1. According to a search ephemeris given in the *Astronomische Nachrichten*, No. 3260, for Berlin midnight, the comet's place for November 8 is R.A. 22h. 59m. 30s. Decl. + 12° 32′ 18″. The comet passes perihelion next February.

TWO VARIABLE STARS.—In a *Wolsingham Observatory Circular*, No. 40, dated October 30, the Rev. T. E. Espin says: "The variability of two red stars, R.A. oh. 49·0m. Decl. + 58° 1′ and R.A. 1h. 49·8m. Decl. + 58° 46′ has been definitely ascertained."

OBSERVATIONS OF MARS.

A LARGE proportion of the October number of *Astronomy and Astro-Physics* is devoted to articles on Mars, illustrated by several coloured plates. Schiaparelli's map of Mars forms the frontispiece; Prof. Schaeberle contributes nine drawings of the planet; and there are three plates containing drawings made at the Lowell Observatory, Flagstaff, Arizona, by Mr. Percival Lowell, Prof. W. H. Pickering, and Mr. A. E. Douglass. The following statement, from an article by Prof. Pickering, is a chronological summary of the more important facts and discoveries relating to Mars. It is chiefly compiled from Flammarion's monograph on Mars, and should be of special interest at the present time:—

272 B.C. The first known observation of Mars is recorded in Ptolemy's Almagest.

1610. The phases of Mars were discovered by Galileo.

1659. The first sketch showing surface detail was made by Huyghens. He also suggested a rotation in 24 hours.

1666. Cassini determined the rotation of Mars to take place in 24 hours 40 minutes. He also observed the polar caps, and "he distinguished on the disc of Mars, near the terminator, a white spot advancing into the dark portion, and representing without doubt, like those of the moon, a roughness or irregularity of the surface." This latter statement is curious, but the effect was undoubtedly due to irradiation, since his telescope was entirely inadequate to enable him to observe such a delicate phenomenon.

1777. With the exception of Huyghens, Hooke, and possibly Maraldi, no one succeeded in making recognisable sketches of the surface detail upon Mars for over a century, until Sir William Herschel took the matter up in this year.

1783. Sir William Herschel detected the variation of the size of the polar snow caps with the seasons, measured the polar compression, and determined the inclination of the axis of the planet to its orbit.

1785–1802. Schrœter made an extended study of the planet. His drawings are upon the whole rather better than those of Herschel. He discovered among other things the very dark spots to which Prof. Pickering has referred in his publications as the Northern and Equatorial Seas. He, however, supposed them to be clouds.

1840. Beer and Maedler published the first map of the planet, assigning latitudes and longitudes to the various markings. On this map are indicated the first canals, and the first of the small lakes, so many of which have been discovered during the last few years. The canals are Nectar and Agathodaemon and portions of Hades and Tartarus. The lake is Lacus Phoenicis. Their map is the first satisfactory representation of the entire surface of the planet. The only region which previous observers had clearly distinguished was that in the vicinity of the Syrtis Major.

1858. Secchi made a careful study of the colours exhibited by the planet.

1862. Lockyer made the first series of really good sketches of the planet, showing all the characteristic forms with which we are now so familiar. His drawings, and also those of some of the other observers, give the first indications of the appearance of the central branch in the Y, so called by Secchi.

1864. Dawes detected eight or ten of the canals.

1867. Huggins detected lines due to the presence of water vapour in the spectrum of Mars.

1867. Proctor determined the period of rotation of Mars within 0·1 second.

1877. Hall discovered the two satellites of Mars.

1877. Green made a very excellent series of drawings of the planet, superior to anything which had preceded them.

1877. Schiaparelli made the first extensive triangulation of the surface of the planet, and added very largely to the number of known canals.

1879. Schiaparelli detected the gemination of Nilus, the first known double canal.

1882. Schiaparelli discovered numerous double canals, and announced that the appearance formed one of the characteristic phenomena of the planet.

Mr. Percival Lowell reports the observations of Mars made at the Lowell Observatory, in continuation of those recorded in our issue of September 13. The subjoined abstract of the paper raises some interesting points. The suitability of the site of the observatory may be judged from the fact that the planet has

been observed at Flagstaff every night, with but few exceptions, since the beginning of June. British astronomers would like to be blessed with similar favourable opportunities.

A noteworthy feature of Mr. Lowell's previous paper was the large area occupied by the dark regions on Mars, while those singular, tilted peninsulas that are so generally represented connecting the continents with the islands to the south were conspicuous by their absence. At that time one continuous belt of bluish-green stretched unbroken from the Hour-glass Sea to the columns of Hercules, or rather to where this pass should have been, for it was not visible. Now (September 10) the continuity is cut. Hesperia has reappeared, and it has done this in just the way we should expect it to show were it land drying off by a sinking of the general water level. Simultaneously, the region formerly occupied by the polar sea and the region to the north of it from having been blue, has now become for the most part reddish yellow. This reappearance of Hesperia and change of colour of the regions farther south is not due to increasing distinctness of vision consequent upon the nearer approach of the two planets. Had Hesperia been then of anything like the brightness it is now it could not have been invisible. Furthermore, Eridania is at present one of the brightest parts of the disc, not only as it comes round into view, but in mid-career across. Last, and not least in significance, the polar sea has shrunk to a thin line in keeping with the diminished size of the polar cap itself. All this water has gone somewhere.

What may be the condition of these seemingly amphibious lands, whether they be marsh chiefly water at one time and dry land at another; or whether their dark colour be due to vegetation which sprouted under the action of the water, and then died when it withdrew, is a moot point. Mr. Lowell's opinion is that it is half and half; that the transference of the water is chiefly a surface one, and that the layer of water is almost everywhere so shallow as to be soon drained off. His reasons for believing the aqueous circulation to be a surface one are many. In the first place, with the exception of certain peculiar appearances near the south pole, there is no evidence of anything like clouds or mist observable upon the planet, nor has there been since the observations began. On the contrary, all parts of the surface seem to be revealed unveiled. For an aerial circulation the only supposition at all feasible is thought to be that of a heavy, nightly dew, advanced by Prof. Pickering. There are strong reasons in the probable constitution of the Martian atmosphere for believing this possible. But in view of certain facts connected with the canals, and referred to later, the dew theory seems to be improbable.

As to how much of the dark areas are water, and how much vegetation, there is as yet no evidence to decide. Prof. Pickering has made some ingenious polariscopic observations to this end, but the difficulties inherent in the process are such as to preclude definite answer as yet. At first the polar sea seemed to show evidence of polarisation, confirming what we knew before of its watery character. Later the lakes, polar sea, and dark areas alike revealed no trace of it. Inasmuch, then, as there is every reason to suspect the polar sea, at least, to be water, we are left in doubt as to the adequacy of the instrumental means to detect at present such minute phenomena.

Since Mr. Lowell's last paper, irregularities have been detected at Flagstaff in the Martian terminator. These fall for the most part under two heads, of which one is practically new. It consists of certain polygonal flattenings first observed on June 30 by Mr. Douglass. Since then these irregularities have become so conspicuous that it is now difficult not to see one of them in the course of an hour's observation. Sometimes they show as simple slices shaved off the terminator, a paring of the planet's surface; sometimes they appear bordered by enclosing projections. They range from twenty to forty degrees wide. But the suggestive thing about them is that they show almost invariably upon that part of the terminator where the darker of the dark regions is then passing out of sight.

At first sight it might seem as if the observed appearance were directly due to the darker areas lying at a lower level than the rest of the surface. But the connection is not so simply direct. For Mr. Lowell points out that were it due to a zone of low-level lying between zones of higher altitude, it could be observed only as a limb effect in this case still further diminished by the cosine of the phase angle, a quantity far too small to be observable.

Nor will variations in slope explain the phenomenon. For to have an area show as a depression on account of its slope, either the areas on both sides of it must be rising in altitude, or the area itself must be falling in height, and this state of affairs could not go on for ever unless the surface were an impossible spiral. So that the persistency of this flattening is thus unaccounted for.

Prof. Story has suggested that these dark areas have smooth surfaces such as water would have. In this case, remarks Mr. Lowell, the reflection from them, by which alone they would be perceptible, would diminish much more rapidly from the centre to the side than would be the case with regions having rough surfaces, such as deserts. It may be added that though a rough surface, properly constructed, might obliterate itself by its own shadows, this could not happen to either a desert or a forest or a grass-grown plain.

The second kind of irregularities are projections, or small notches, such as are visible upon the lunar terminator; only that the Martian ones are much less pronounced. They are probably due to mountains which seem to be of no great height. The first of these was observed by Mr. Douglass on June 30. An especially prominent one he noted on August 19. It consisted of a projection flanked by a long shadow cutting into the planet obliquely. He measured the shadow's length at 35″. Taking the obliquity into account, this seems to imply a range the length of whose projection would be about 2″. It is difficult to say how much of this is due to irradiation; especially as each observer differs. The best tests Mr. Lowell has been able to make give a probable average of about five-sevenths of a tenth of a second of arc with the power then applied, about 640. Calling the terminal projection of this range therefore ·13″, its height appears to be about 3700 feet. But the smallness of the quantity measured and the uncertainty of the factor of irradiation renders the result largely indefinite.

A consequence of the slope on the effect of these mountains is interesting. For an elevation need not appear as such. What would show as a projection on the nether side of the terminator would appear as a depression on the hither one.

Interesting plateaus were observed on two occasions by Prof. Pickering. One of these lies in Phætontis not far from the columns of Hercules, which thus seem to have been most appositely named. Both plateaus rise abruptly, are surprisingly level on top, and stand at about the same height, a height which from the reduced measurements does not probably exceed 2600 feet.

On Mars the second kind of irregularity is less common than the first, and the elevations indicated are apparently never what we should call high. We may therefore conclude that the Martian surface is, as compared with our terrestrial one, relatively flat.

Certain whitish patches have been observed on the planet, first by Prof. Pickering on August 16, and subsequently several times by both Prof. Pickering, Mr. Douglass, and Mr. Lowell. Prof. Pickering calls them clouds. To Mr. Lowell, appearances thus designated are of two kinds. The one, certain whitish, flocular patches not far from the pole, may possibly be cloud; for they present a peculiar aspect, not like snow, nor yet like *terra firma*. No motion, however, has been seen in them. The others are merely certain bright spots on the general surface of the planet. These are not whitish, but yellowish, and will probably do very well for the more arid, dried-up tops of the land. They likewise do not move, and, furthermore, show always the same appearance day after day as regularly as their regions come round. Many of them were equally conspicuous at previous oppositions, and have been chronicled by various observers. Their contours are neither shifty nor indistinct, but as sharp-cut as those of any other region.

Most suggestive of all Martian phenomena are the canals. Were they more generally observable, the world would have been spared much scepticism and more theory. They may, of course, not be artificial, but observations made at the Lowell Observatory indicate that they are. For it is one thing to see two or three canals, and quite another to have the planet's surface mapped with them upon a most elaborate system of triangulation.

In the first place, they were, at the season of writing, bluish-green, of the same colour as the seas into which the longer ones all eventually debouch. In the next place, they are almost without exception geodetically straight, supernaturally so, and this in spite of their leading in every possible direction. Then

they are of apparently nearly uniform width throughout their length. What they are is another matter. Mr. Lowell thinks, however, that the mere aspect is enough to cause all theories about glaciation fissures or surface cracks to die an instant and natural death.

But it is their singular arrangement that is most suggestively impressive. They have every appearance of having been laid out on a definite and highly economic plan. They cut up the surface of the planet into a network of triangles instantly suggestive of design. What is more, at each of the junctions there is apparently a dark spot. This feature seems to be invariable, as, on closer approach, junction after junction turns out to have one. The larger of these appear on Schiaparelli's chart as lakes. But there would seem to be a small infinity of smaller ones. A short half-hundred of them were seen at Arequipa in 1892, and others have recently been detected at Flagstaff. For example, an important new canal, which runs from the western end of the sea of the Sirens to Ceraunius, and which in view of its point of departure Mr. Lowell is induced to call the Ulysses, passes through three of these small dark spots on the way, one at each junction. One of these was seen at Arequipa and elsewhere in 1892; the other two are new discoveries. The region of the Lake of the Sun is especially fertile in canals. In one of the drawings which accompanies the paper here summarised, thirty-one canals are to be seen, counting each line between junctions as a separate canal. Of these seventeen are among those in Schiaparelli's chart, while fourteen are not. Of the twelve lakes in the figure, five are not down on his chart. This is thought not, in general, to be the result of change, though changes there apparently have been after proper discount has been made for difference of observations and of drawing. First and foremost, the Golden Chersonese has vanished; the land of Ophir now forms the continental coast-line. Secondly, Icaria has entirely altered in contour, resembling now an open fan about the Phœnix lake for pivot. Phætontis has shrunk to one-third of its former width—as represented in Schiaparelli's chart. Eosphoros no longer enters Phœnix lake at the point opposite Pyriphlegethon, but farther to the west. But the strangest transformation of all is that of the Phasis, which has apparently obligingly become two (not geminated in the technical sense) to suit both the old and the new state of things. There is now a canal running in the same direction as the old Phasis, but not to the southern end of Phætontis; and there is another one running to the southern end of Phætontis, but not in the same direction as heretofore. This attempt to carry out two apparently important ends by self-multiplication is not a common characteristic of inanimate nature—a point which Mr. Lowell holds is worth consideration.

Mr. A. Stanley Williams contributes to the November *Observatory* an account of his observations of Mars up to October 20. With regard to the canals Mr. Williams says:—"By taking advantage of every favourable opportunity, fifty-one canals have been observed up to the present time [October 20]. These include most of those shown in Prof. Schiaparelli's latest map that could be properly observed at present, and in addition three others not marked in the map. Generally speaking there is no difficulty in certainly identifying the canals, with the exception of a few which are situated far north, and consequently are too close to the limb to be distinctly observed. The general accuracy of the map is very striking, and I have often been strongly impressed by the very thorough manner in which Prof. Schiaparelli's work has been done. It is most rare to come across the trace of a canal not marked in his map, and the positions of objects are usually very reliable."

In the October number of our contemporary, Mr. Williams stated that Phison was probably double. Later observations, however, have shown it to be only single, the apparent gemination being probably caused by the existence of a feeble, unrecorded canal running parallel to it, and about midway between it and the coast bordering the Kaiser Sea. Agathodæmon and Araxes were seen intensely double on three or four nights in September. Chrysorrhoas was also seen double, but this canal appeared as an inconspicuous object compared with Agathodæmon and Araxes. In September Mr. Williams saw Amenthes as a narrow inconspicuous and apparently single canal. At the beginning of October, however, the object appeared as a very broad, dusky, double canal. Ganges is another broad, conspicuous double canal, the duplicity of which, according to Mr. Williams, is so obvious as to be apparent on almost any night on which observations are possible.

Referring to the small dark spots designated lakes, Mr. Williams says:—"Several more of these curious dark spots have been seen. Lacus Phoenicis on a good night appears as a small, nearly round, almost black spot, resembling the shadow of a satellite of Jupiter when in transit. On one night a feebler companion spot was seen just preceding it. Lacus Tithonius is a similar definite and nearly black spot, with a feebler companion following it. In a fine drawing of Mars, dated September 5, Mr. Cammell shows Lacus Moeris as a minute dark spot, with Nepenthes as a narrow definite line, and so I have seen them on several nights lately. Lacus Tritonis is a similar spot. At the junction of the canals Amenthes (following component), Thoth, and Astapus, there is also a little dark spot. The dark spot at the north end of the Ganges, known as Lacus Lunæ, has been rather perplexing. On several nights there was an evident appearance of duplicity about it, though it was impossible to say with certainty in which direction it was double. At length, however, the mystery was cleared up, the lake having been seen distinctly double on September 29 at right angles to the direction of the Hydraotes. The streak or bridge dividing the lake into two was bright yellow."

The varying appearances presented during October by the Mare Cimmerium, and the extensive region lying to the north of it, leads Mr. Williams to think that a great development of cloud or mist has lately taken place on Mars. His observations suggest "that cloud and mist formations are much more extensive and common on Mars than is generally considered to be the case."

THE ELECTRIC CONDUCTIVITY OF PURE WATER.

THE difficulties besetting the preparation of water free from the last traces of dissolved impurity cannot be better illustrated than by the attempts which have been made to ascertain the electric conductivity of the pure liquid. At the outset it has to be remembered that the conductivity of water is exceedingly small. As the result of the most recent observations it has been found that one millimetre of water has at 0° almost the same resistance as 40,000,000 kilometres of copper of the same cross-section; consequently a copper wire having the same resistance and sectional area as one millimetre of water would be long enough to encircle the earth one thousand times. From the difficulty of preventing the introduction of small quantities of dissolved material into the water, and from the large diminution which such impurities exercise upon the resistance, there is probably no physical constant for which such widely varying values have been given as for the electric conductivity of water.

If the conductivity of mercury be taken as 10^{10}, prior to 1875, the following values had been ascribed to water by the observers named:—80, Pouillet; 70, Becquerel; 15, Oberbeck; 4·5, Rosetti; 2·16, Quincke; and 1·33, Magnus. In 1875, Kohlrausch succeeded in reducing the observed conductivity to 0·71, or a value only 1/120th of that given by Pouillet. The large diminution thus brought about was no doubt due, for the most part, to the improved methods employed in obtaining purer samples of water. In Kohlrausch's experiments pains were taken not only to remove organic matter and any volatile alkaline or acid impurities from the water, but also to ensure that in its subsequent treatment contact with glass was avoided, the purified water being distilled through a platinum condenser into a platinum resistance-cell. The next important modification in the treatment of the water was again introduced by Kohlrausch in 1884. The whole of the above measurements had been made upon water distilled under ordinary conditions, and thus in presence of air; he therefore proceeded to ascertain what alteration in conductivity took place when the water was rendered air-free. For this end he employed a glass apparatus resembling in construction the so-called "water-hammer." A glass bulb of some 150 c.c. capacity, which served as a retort, was connected by a glass tube with a small glass receiver fitted with platinum electrodes. In this receiver the resistance of the water was measured by the use of a galvanometer and a continuous current, as the latter was so feeble that no appreciable effect was produced by polarisation. The glass connecting-tube was provided with a vertical branch, through which water, or liquids to clean the apparatus, could be introduced. Having admitted a quantity of purified water into the bulb, the vertical tube was then connected with a mercury air-pump, the pump

set in action, and the water repeatedly shaken. A flask of cooled sulphuric acid was also put into communication with the evacuated enclosure to absorb water vapour, and thus promote partial distillation of the water. When dissolved gases had been removed, the vertical tube was sealed, and water was then distilled from the bulb into the receiver, the former being immersed in a bath at a temperature of 30° to 40°, and the latter in a cooling mixture at from 0° to −8°, the temperature being kept as low as possible in order to diminish the solvent action of water on the glass. The value obtained in this way for the conductivity at 18° was 0·25, or a number which is practically only one-third of that given by water distilled in air.

Small as this number was, it was not supposed to represent the actual conductivity of water, because experiment showed that the conductivity altered rapidly with the time, owing to the dissolution by the water of material from the glass receiver, and from the electrodes. The correctness of this supposition is strikingly verified in a communication recently made by Kohlrausch and Heydweiller to the Berlin Academy of Sciences (*Sitzungsberichte*, March 1894). One of the pieces of apparatus used in 1884, and described above, had been allowed to stand filled with water for some ten years, and, apparently from long contact with the water, the glass has become much less soluble than it is under ordinary circumstances. Indeed, during the time necessary for an observation the conductivity does not alter appreciably, and only rises by 0·01 in a day. The method of experiment employed is similar to that just described, the main modifications consisting in additional precautions to obtain the water air-free, and in freezing the purified water prior to its introduction into the apparatus. This method of freezing, suggested first by Nernst, is of value in eliminating volatile impurities which might distil over with the steam. The smallest value now found for the conductivity is ·0404 at 18°, or a number which is only 1/2000th of the original value given by Pouillet, and only one-sixth of that obtained in the same apparatus in 1884.

Since with each improvement the value for the conductivity has been largely reduced, the question which naturally arises in connection with this last result is, how closely can it be supposed to approximate to the truth? Indeed, seeing that the conductivity is so very small, it might fairly be suspected that absolutely pure water is itself a non-conductor, and that the observed conductivity is merely due to the presence of a slight trace of impurity. As it seems almost impossible to answer this question by purely experimental methods, theoretical aids have to be employed, and by means of the hypotheses involved in the new theory of solutions, Kohlrausch and Heydweiller proceed to show that pure water is actually a conductor, and that its conductivity can be ascertained from their observations. The method they employ is briefly as follows:—According to Arrhenius, if water is a conductor, the reason for this is that certain of its molecules exist dissociated into the ions H and OH. Moreover, the magnitude of the conductivity depends upon two factors: firstly, on the number of dissociated molecules; and secondly, on the velocities with which the ions travel. The conductivity varies with the temperature because the number of dissociated molecules, as well as the ionic velocities, increases with the temperature. From these theoretical views, although it is not possible to estimate the actual value of the conductivity, yet the rate at which it should vary with the temperature may be ascertained. For, in the first place, according to van't Hoff, the extent of the dissociation should vary with the temperature just as it does in a dissociating gaseous system; and in the second place, the velocities of the ions H and OH may readily be obtained at different temperatures from measurements on dilute aqueous solutions, such as those of KOH, HCl, and KCl.

Now, Kohlrausch and Heydweiller measured at 18° the temperature-rate of change for a series of samples of water of different degrees of purity, and also the conductivity of two samples of very pure water at temperatures between −2° and 50°. They then assumed that the observed conductivity was really a sum, being composed of the conductivities of pure water and a dissolved impurity. They were thus enabled to show how it is possible, by making use of the rate of change as deduced by theory for the single temperature of 18°, to obtain from their observations the conductivity of pure water at different temperatures.

The first result arrived at, is that the temperature-function of the conductivity over the entire range from −2° to 50° agrees within the limits of the experimental errors with the function predicted by theory. This, as the authors remark, is one of the most remarkable confirmations yet adduced of the validity of the hypothesis of the new theory of solutions. The second and the most important conclusion for the question under discussion is, that at 18° the conductivity of pure water has in all probability the value 0·0361. The smallest value actually observed, it will be remembered, was 0·0404. The impurity present in the sample affected the conductivity, therefore, by 0·0043, or by some 10 per cent. If this impurity were of the nature of a salt, as in all likelihood it is, the amount which would exert this effect would not require to be more than a few thousandths of a milligram per litre. We have here, therefore, the remarkable result that an impurity of this nature, if present to the extent of only a few parts per thousand million, is capable of influencing the conductivity by as much as 10 per cent. of its value. This, together with what has already been said, leaves little question that of all the physical constants of water, there is none which is so sensitive to small traces of dissolved impurity as its electric conductivity.

J. W. RODGER.

NEO-VITALISM.[1]

A QUARTER of a century ago, du Bois-Reymond headed the revolt of Mechanicalist Biology against the Vitalism of Johannes Müller. From Bichât to Magendie, from Johannes Müller to Schwann, the pendulum swung backwards and forwards; but it was reserved for du Bois-Reymond, in his now famous Berlin addresses, together with Ludwig and Helmholtz, to expose the fallacies of vitalism, and establish physiology on a mechanical basis.

In the present address he takes up arms against the "new vitalism," which since the discoveries of Heidenhain *re* activity of cell in secretion, *versus* mere mechanical diffusion, has made a new departure, based on a partial misconception of these secretory activities. The position of the debate as it now stands will be best shown by an abstract of Prof. du Bois-Reymond's recent manifesto.

From Descartes and Leibnitz, until they encountered their first opponent in Magendie, vitalistic theories were paramount. During this period "vital force" was conceived as the attribute of the soul in distinction to the body, or confused with the so-called "nervous principle," with animal heat or electricity.

Johannes Müller and Schwann again fought out the question; even the discovery by Schwann of independent cell-life in the organism failing to convince Müller that his views were erroneous. The overthrow of vitalism was reserved for Ludwig, whose autographic methods strengthened the physical side of experimental physiology. He came forward as the champion of anti-vitalism, and the same position was taken up by many of Müller's immediate pupils. The fundamental difference between this and all previous criticism lay in the physico-mathematical training of the antagonists, which enabled them to detect the *πρῶτον ψεῦδος* of vitalism. This prime error is the misconception of "force." Force is not an entity existing apart from matter; it is ultimately a mathematical concept, standing for the physical changes which alone can be known to us. The atoms are not a truck to which the forces can be harnessed; their attributes are eternal, integral, inalienable. Helmholtz said that without a rational conception of nature, scientific research would have no meaning; vital force, however, is unthinkable.

The fundamental distinction between organic and inorganic bodies has not been adequately recognised. In crystals, and dead bodies generally, matter is in static equilibrium, stable, indifferent, or labile; in living organisms, the equilibrium is dynamic. As in heat, and electrical diffusion, the rise and fall of current is balanced; there is constant metabolism. And metabolism, as well as the conservation of energy, present insuperable difficulties to the vitalist. Heat and muscular work, ciliary and amœboid movements, not least electricity, cannot be generated in animals otherwise than by conversion of potential into kinetic energy, by oxidation of carbon and hydrogen. For this nutritive matters—air, warmth, moisture, and for plants light (the "integrating stimuli" of J. Müller) are indispensable

[1] "Ueber Neo-Vitalismus." Von du Bois-Reymond. Sitzungs Berichte der Akademie der Wissenschaften zu Berlin. Oeffentliche Sitzung zur Feier des Leibnizischen Jahrestages vom 28 Juni, 1894.

conditions. And we must further compare the speed of organic processes with those of the crystal—quiescent to all eternity, unless disturbed by external forces. One of the finest conceptions of modern science is that the dynamic equipoise in the life of the individual corresponds to the cycle of living matter in all nature.

Labile equipoise is, however, preponderant in the organism. And here is the simplest explanation of the reaction which Müller held peculiar to living beings—excitability. The specific energies yielded up by living things in response to stimulus, amount to nothing more than the mechanical reaction of stored-up energy which we find, *e.g.*, in a chronometer. A repeating clock, in its specific reaction to stress or strain, heat or cold, moisture or dryness, electrical or chemical influences, presents a close analogy to the living muscle.

A final blow, it seemed, was dealt to vitalism by Darwin's "Origin of Species," which, through natural selection and the survival of the fittest, accounted rationally for existing variations. Thus the controversy was to all appearance ended. Of late, however, on anatomical rather than on physiological grounds, a new school of vitalism has arisen. By a somewhat strained conclusion from the labours of Schwann and Heidenhain, it is asserted that the processes deriving from elemental organisms are too vast in relation to the latter to be accounted for on mechanical principles. A more satisfactory *rationale* for heredity is also demanded.

Prof. du Bois-Reymond dismisses in a few words the arguments of Driesch and Rindfleisch (1888–93). In regard to Bunge ("Lehrbuch der physiol. Chemie," 1887), he points out that the "activity behind which lies the mystery of life" is only static equilibrium of the organism, dependent on integrating stimuli, and reducible to a physical equation. In fact, it is metabolism, maintained by chemical processes, which convert potential into kinetic energy. We have here the πρῶτον ψεῦδος of the older vitalism, for it matters little whether we deal with the comparatively simple problem of fifty years back, or, with Driesch and Bunge, search into the cell and its atoms, or their yet unknown final particles. Impassable, indeed, are the limits of our knowledge, but let us confine our *ignorabimus* to its proper frontier.

To the first contention of Neo-vitalism, du Bois-Reymond opposes the molecular theory with its infinitesimal particles of matter; for the last, he refers us to the current controversy between Weismann and Herbert Spencer. There is, doubtless, room for criticism of the Darwinian theory. For instance, natural selection fails to account for the appearance of organs such as the poison-fangs of snakes or the electric organs of fishes, which are useless in the struggle for existence until fully developed. But if Darwinism were fore-doomed, and exposed, in the words of Herr Driesch, as "a cheap and specious deception," it is improbable that Neo-Vitalism would reap any benefit. There may be still another solution to the problem.

Now, as before, we stand in face of the unsolved riddle, Origin of Being, with all the wondrous chain and intricacies of development. Yet as an alternative to supernaturalism, we can conceive one primordial act of creation whereby the germ of life inherent in matter could develop by its intrinsic laws into the brain of a Newton. Thus, with no day of creation the whole order of nature would evolve mechanically, without intervention of Old or New Vitalism.

And so we return upon the ideas of Leibnitz, save that Materialism replaces Supernaturalism, inasmuch as we may conceive that infinite matter, with its qualities as we know them, has been circling in infinite space from all eternity.

FRANCES A. WELBY.

SCIENCE IN THE MAGAZINES.

PROF. A. W. RÜCKER contributes to the *Fortnightly* a brief sketch of the work of von Helmholtz. Our readers are familiar with the investigations carried out by this eminent physicist; nevertheless, the two concluding paragraphs of Prof. Rücker's article sums up the chief of them so admirably as to be worth quoting here.

"He was one of the first to grasp the principle of the Conservation of Energy. He struck independently, and at a critical moment, a powerful blow in its defence. He penetrated further than any before him into the mystery of the mechanism which connects us with external nature through the eye and the ear. He discovered the fundamental properties of vortex motion in a perfect liquid, which have since not only been applied in the explanation of all sorts of physical phenomena, of ripple marks in the sand, and of cirrus clouds in the air, but have been the bases of some of the most advanced and pregnant speculations as to the constitution of matter and of the luminiferous ether itself.

"These scientific achievements are not, perhaps, of the type which most easily commands general attention. They have not been utilised in theological warfare; they have not revolutionised the daily business of the world. It will, however, be universally admitted that such tests do not supply a real measure of the greatness of a student of nature. That must finally be appraised by his power of detecting beneath the complication of things as they seem, something of the order which rules things as they are. Judged by this standard, few names will take a higher place than that of Hermann von Helmholtz."

In the same magazine Sir Robert Ball discusses the possibility of life in other worlds—a subject that has a curious fascination for the unscientific, but upon which the author throws the light of modern scientific knowledge. "No reasonable person will," he thinks, "doubt that the tendency of modern research has been in favour of the supposition that there may be life on some of the other globes. But the character of each organism has to be fitted so exactly to its environment that it seems in the highest degree unlikely that any organism we know here could live on any other globe elsewhere. We cannot conjecture what the organism must be which would be adapted for residence in Venus or Mars, nor does any line of research at present known to us hold out the hope of more definite knowledge." The verdict thus appears to be "possible, but not probable," and the subject therefore stands where it did.

Mr. R. S. Gundry contributes to the same magazine an article on Corea, China, and Japan; and Mr. A. H. Savage-Landor one on Japanese people and customs; while Mr. G. Lindsay describes his rambles in Norsk Finmarken.

Prof. N. S. Shaler contributes to *Scribner* an interesting paper on "The Horse," the text being illustrated with pictures by Delort. He does not speak very highly of the animal's intelligence. In his words: "The mental peculiarities of the horse are much less characteristic than its physical. It is, indeed, the common opinion, among those who do not know the animal well, that it is endowed with much sagacity, but no experienced and careful observer is likely to maintain this opinion. All such students find the intelligence of the horse to be very limited. Although some part of this mental defect in the horse, causing its actions to be widely contrasted with those of the dog, may be due to a lack of deliberate training and to breeding with reference to intellectual accomplishment, we see by comparing the creature with the elephant, which practically has never been bred in captivity, that the equine mind is, from the point of view of rationality, very feeble." It is worth remark, however, that a good deal of misapprehension exists as to the intelligence of the elephant. According to the best authorities, though elephants are docile and obedient, their intellectual capacity is below that of most other Ungulates. Colonel H. G. Prout contributes his second article on "English Railroad Methods," giving a number of interesting facts respecting passenger and freight traffic, cost of construction, &c., in England and America.

Colonel A. G. Durand shows, in a paper in the *Contemporary*, that the southern region of the Eastern Hindu Kush is one full of interest. In the *Humanitarian*, St. George Mivart writes on "Heredity." A portrait of the author forms the frontispiece of the number. Mr. Grant Allen continues his moorland idylls in the *English Illustrated*, his subject this month being house-martins.

Chambers's Journal contains its usual complement of chatty articles, among which may be mentioned "Feathered Architects," "The Infinity of Space," and "The Vanishing Eland." *Longman's Magazine* reprints an address, "How to Make the Most of Life," delivered by Sir B. W. Richardson before the Literary and Scientific Section of the Grindelwald Conference this year. The Rev. B. G. Johns writes on "The Injuries and Benefits of Insects" in the *Sunday Magazine*, and the Rev. T. R. R. Stebbing contributes an instructive article on certain crustacea to *Good Words*. The latter magazine also contains an article on tea, by Mrs. A. H. Green, and a well-written explanation of the laws of motion, by Emma Marie Caillard.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The examiners for the Burdett-Coutts Scholarship have reported that no candidate of sufficient merit has presented himself for examination. The Scholarship, therefore, has not been awarded this year.

There will be an election to a Geographical Studentship of the value of £100 at the end of Hilary Term, 1895. Candidates should send in their names to the Reader in Geography, 1 Bradmore Road, Oxford, before Wednesday, February 27, 1895.

The Savilian Professor of Astronomy, Prof. H. H. Turner, will lecture in the Schools on Thursday, November 8, on the subject of the Transit of Mercury on Saturday, November 10.

In a Convocation held on Tuesday, November 6, the degree of Master of Arts, by decree of the House, was conferred on Robert Warington, F.R.S., Sibthorpian Professor of Rural Economy.

CAMBRIDGE.—The Cavendish Laboratory Syndicate have presented a report on the pressing needs of the department of experimental physics. It appears that a large laboratory for elementary classes and an additional lecture room, together with certain accessory rooms, are urgently required. To erect and furnish these on a suitable scale would require some £10,000. As the University is unable to meet any such expense at present, it is proposed to put up part of the building at an expense of £4000, of which half can be provided from the accumulated fees of students working in the laboratory. The Financial Board think that £2000 more can be obtained from the Common University Fund. Mr. Fawcett, the architect, has prepared plans for the work, which are to be seen at the Cavendish Laboratory.

The Sedgwick Memorial Museum Syndicate state that the tenders for the building designed by Mr. T. G. Jackson, A.R.A., have been some £4500 in excess of the estimate based on the architect's calculations. They are reluctantly forced to the conclusion that the University cannot afford to supplement the Memorial Fund to the required extent, and they accordingly ask powers to reconsider the plan, or to substitute a new one for it.

At the annual election to Fellowships at St. John's College, on November 5, Mr. H. C. Pocklington was one of the successful candidates. He was bracketed Fourth Wrangler 1892, was placed in the first division of the first class with Mr. Cowell, the Senior Wrangler, in Part II. of the Tripos of 1893, and this year gained one of the Smith's Prizes, the other falling to Mr. Hough, also a scholar of St. John's. Mr. Pocklington presented a dissertation on the periods of the vibrations of a vortex-ring constituted by fluid circulating round a hollow core, in which the periods of the unsymmetrical vibrations are for the first time determined. The analysis also included a determination of the effect which an electric charge would produce on the vibrations and the stability of a vortex atom in a rotational æther. In a minor investigation, which will appear in the next number of the *Proceedings* of the Cambridge Philosophical Society, the forms assumed by two parallel cylindrical hollow vortices moving steadily through fluid, and the character of the surrounding motion, are investigated in detail.

Mr. S. Sandars has bequeathed to the University £2000 for the endowment of a Reader in "Bibliography, palæography, typography, bookbinding, book-illustration, and the science of books and manuscripts."

As the result of the prolonged discussion on post-graduate study in the University, the Council of the Senate have sanctioned a grace for the appointment of a syndicate to consider (1) the best means of giving further help and encouragement to persons who desire to pursue courses of advanced study or research within the University; (2) what classes of students should be admitted to such courses; and (3) what academic recognition, whether by degrees or otherwise, should be given to such students, and on what conditions.

Mr. Herman, of Trinity College, has been appointed Chairman of Examiners for the Mathematical Tripos, Part I.

Dr. Forsyth, F.R.S., Sir R. S. Ball, F.R.S., R. T. Glazebrook, F.R.S., and Prof. G. B. Mathews, have been appointed Examiners for Part. II. of the Mathematical Tripos.

Prof. Ewing, F.R.S., Prof. Osborne Reynolds, F.R.S., and W. N. Shaw, F.R.S., have been appointed Examiners for the Mechanical Sciences Tripos.

DUBLIN.—The medals in Natural Science, given at Moderatorship, have been awarded as follows:—Gold medals to R. A. Rossiter and T. B. Jobson; silver medal to C. W. Orpen. The Professor of Botany's prizes for practical work on the Gymnosperms, to be accompanied by sections and drawings, have been given to T. B. Jobson, for work on the anatomy of the young stem of *Ginkgo biloba* and on the reproductive organs of *Taxus baccata;* and to R. A. Rossiter, for work on the floral development of *Thuja plicata* and *Larix Europea.*

Lectures on the Experimental and Natural Sciences for Michaelmas Term commenced on November 2. Prof. Reynolds lectures on Inorganic Chemistry, Prof. Fitzgerald on Heat, Prof. Sollas on Mineralogy and Physical Geology. Prof. Mackintosh lectures on Zoology, and gives demonstrations on Comparative Anatomy. Prof. Wright lectures on Algæ and Fungi, and gives a series of demonstrations on the Vascular Cryptogams. The assistant to the Professor of Botany, Mr. H. Dixon, gives a course of Laboratory instruction on vegetable cells and tissues.

The special courses in Natural Science for 1895 are in Geology, the Cambrian Period; in Zoology, the Invertebrate Heart; in Botany, the Natural Orders, Cruciferæ and Papilionaceæ.

The Anthropological Laboratory has reopened for the session 1894–95. Dr. C. R. Browne will, under the direction of Prof. D. Cunningham, give, on three days in each week during Term, demonstrations on Anthropological Methods. These will be open to all students.

Assisted by a grant from the Royal Irish Academy, Dr. C. R. Browne visited, during the long vacation, the district of North Erris, in the county of Mayo, believed to be one of the most primitive regions in Ireland. The anthropological results of this visit will in due course be laid before the Irish Academy.

The Dublin University Experimental Science Association held its first meeting for its eighteenth session on the 6th inst. Prof. Sollas delivered the opening address, in which he treated of "Geological Time."

FROM a Return made to the Department of Science and Art, and published last week, it appears that the total amount spent on technical education during the year 1892–93, in England, Wales, and Scotland, was £529,718, and that the estimated total amount allocated to technical education for the year 1893–94 was £696,328. Forty-one out of the forty-nine county councils in England are applying the whole of the residue received under the Local Taxation (Customs and Excise) Act to technical education, and eight a part of it to the same purpose. Of the councils of the sixty-one county boroughs, fifty-three are devoting the whole of the residue to technical education, and seven a part of it. The thirteen county councils and the three county boroughs in Wales and Monmouth are not only devoting the whole of the residue to intermediate and technical education, but six of them are also levying a rate, or making grants out of the rates, for the same purpose. In the case of Scotland, twenty-three out of the thirty-three county councils are applying the available funds to technical education, and seven a part. Of the 194 burghs and police burghs, however, 122 are applying the whole to the relief of rates.

THE Technical School Committee of the Birmingham Corporation have appointed Dr. W. E. Sumpner, of the Battersea Polytechnic School, from among seventy-five candidates, as Principal of the new local Technical School. The salary is £500 per annum.

THE extensive buildings that have been lately erected as an addition to the medical school at the Owens College, Manchester, were formally opened by the Duke of Devonshire, the President of the institution, on Tuesday.

SCIENTIFIC SERIALS

American Meteorological Journal, October.—The meteorological services of South America, by A. L. Rotch. In the Argentine Republic there are now five stations of the first order, forty of the second order, and one hundred rain stations. The first of the *Annales* was published in 1878, and dealt with the climate of Buenos Ayres from observations since 1801. In Uruguay there is one observatory of the first order, at Villa Colon, near Montevideo, and in 1890 a Meteorological Society was established, and publishes a

monthly review. In Brazil, observations were made at Rio de Janeiro, since 1825, but no record of them is to be found until 1844; from this time summaries have been regularly published. A Central Meteorological Department was established in 1888 in connection with the bureau of the Navy, but the climatological service has not yet been organised.—The forecasting of ocean storms, &c., by W. Allingham. This paper was prepared for the International Meteorological Congress held at Chicago in August last. It deals more particularly with the storms of the North Atlantic, and the author shows that at present any attempt to forecast them from America is not very successful. Nevertheless, the Meteorological Office of Paris continues to receive and publish daily reports from the United States and Canada, as well as from steamers arriving at American ports from the Atlantic.—Sun-spots and Auroras, by Prof. H. A. Hazen. The author has laid down curves of all the sun-spots measured on the Greenwich and India photographs from 1881 to 1888, and also the auroral numbers recorded in the United States, and shows that auroras and sun-spots are not concomitant or coincident phenomena. For the purpose of inquiring into the annual range, the auroras and sun-spots for twenty-three years have been summed for months. There is a remarkable correspondence in these results; both phenomena show a maximum in April, and the second maximum occurs in September for auroras, and in October for sun-spots. Prof. Hazen considers that the investigation of sun-spots and auroras is the most promising line that can be taken in a study of the possible effects from some cosmical force upon our atmosphere.

Bulletin of the American Mathematical Society, second series, vol. i. No. 1 (October 1894).—This is a continuation of the *Bulletin* of the New York Society. The title of the Society having been changed, as previously announced, of necessity the title of the *Bulletin* is also changed. An article on the "Summer meeting of the American Mathematical Society" gives an account of the doings, and abstracts of the papers read, at the August meeting in Brooklyn, N.Y., of the American Association for the Advancement of Science. The co-operation of the two Associations resulted in a successful gathering for the younger body.—Other articles in this number are on the connection between binary quartics and elliptic functions, by Prof. E. Study. This is an abstract of a paper which will appear in the *American Journal of Mathematics*. It shows how a certain group of rational and irrational co-variants of a binary quartic can be expressed as one-valued functions of one or two parameters, thus filling up a number of lacunæ contained in former presentations of the subject.—Reduction of the resultant of a binary quadric and n-ic by virtue of its semi-combinant property, by Prof. H. S. White. The author discusses the partial problem solved by Clebsch, viz. to write in symbolic form the resultant of a binary quadric and a binary quantic of arbitrary order n. The method employed is novel, and illustrates the utility of the theory of conjugate forms.—Next a list of astronomical papers read at the American Association meeting (see *supra*), is given, and short abstracts supplied. Notes and new publications complete this number.

American Journal of Mathematics, vol. xvi. No. 4 (Baltimore, October 1894).—"Sur la transformation des courbes algébriques," by E. Goursat (pp. 291–298), discusses two generalisations of a theorem demonstrated by Lüroth (*Math. Annal.* ix. p. 163). The rest of the number (pp. 299–396) is taken up by a masterly memoir on isotropic elastic solids of nearly spherical form, by C. Chree. It is preceded by a full table of contents, and has 320 equations. The author remarks that the investigation of a solution of the elastic solid equations for the equilibrium or motion of homogeneous isotropic material enclosed by the simplest of all surfaces, the spherical, presents no small difficulty. For even a slight departure from the spherical form the increase of difficulty is so considerable that, so far as I know, the only problem of the class successfully treated hitherto is that of a nearly spherical solid exposed to gravitational force, but free of all surface force. In the case considered by Mr. Chree, surface forces appear as well as bodily forces, so that the problem is much more general than that previously treated. His method is novel, and the memoir closes with some speculations as to the action of the sun on the earth.

Bulletin de la l'Académie Royale de Belgique, No. 8.—Note on the subject of a recent communication from M. Ch. Lagrange, by M. F. Folie. The author claims to have been the first to announce that the theoretical period of initial nutation would be found too short owing to the internal fluidity of the globe, and that the best method for observing this nutation would be that of observations at intervals of twelve hours. He also stated that the variations of latitude would be equal and of opposite sign on two opposite meridians in the same hemisphere, which was borne out by observations in Europe and Honolulu. His hypothesis explaining the annual variations is capable of explaining and estimating the systematic differences between the catalogues of Greenwich and the Cape, given by Downing, and by the diurnal nutation, the differences between Paris, Pulkowa, and Washington, and between Melbourne and the Cape.—On the origin of the dicrotism and the undulations of the systolic plateau of arterial pulsation, by Victor Willem. This work was undertaken in order to decide whether any of the pulsations shown by the sphygmograph and the recorders of arterial pressure have a peripheral origin, or whether they all start from the heart and its neighbourhood. Experiments upon the carotid and crural arteries of dogs show that the latter alternative is true. The author further studied the influence of various injections upon the pulsation.

SOCIETIES AND ACADEMIES.

LONDON.

Entomological Society, October 17.—Henry John Elwes, President, in the chair.—Dr. H. G. Breyer, of Prætoria, Transvaal, South Africa, was elected a Fellow of the Society. Mr. G. C. Champion read a letter, dated August 15 last, from Mr. J. Y. Johnson, of Funchal, Madeira, on the subject of a recent visitation of locusts to the island, and exhibited specimens. Mr. Johnson mentioned that Darwin, in his "Origin of Species," recorded that in November 1844, dense swarms of locusts visited Madeira. He said that since then, until August last, these insects had not visited the island. Mr. Champion remarked that the species was *Decticus albifrons*, Fabr., not a true migatory locust. Mr. Champion also exhibited specimens of *Anthaxia nitidula*, *Velleius dilatatus* and *Athous rhombeus*, taken by himself in the New Forest during the past summer.—Mr. H. Goss read a letter received from Captain Montgomery, J.P., of Mid-Ilovo, Natal, reporting vast flights of locusts there, extending over three miles in length, on August 31 last, and exhibited a specimen of the locust, a species of *Acridium*. Captain Montgomery stated that, as a rule, his district, like most of Natal, was free from the pest, but that an exceptional invasion had occurred in 1850.—Mr. J. W. Tutt exhibited four typical specimens of *Emydia cribrum* from the New Forest, and, for comparison, four specimens of the variety, *candida*, of the same species, taken at an elevation of 4000 feet, near Courmayeur, on the Italian side of Mont Blanc. He stated that he had also met with this form in the Cogne Valley, at an elevation of from 6000 to 8000 feet.—Mr. R. Adkin exhibited a specimen of *Erebia æthiops*, in which the left fore wing was much bleached, taken in August last, near Carnforth. Mr. Adkin also exhibited a series of *Acronycta rumicis* from Co. Cork, Ireland, including light and black forms, with examples from the Scilly Isles, Isle of Man, and North of Scotland for comparison.—Mr. Elwes exhibited a series of *Chionobas alberta* ♂ ♀, *Chionobas uhleri*, var. *varuna*, and *Erebia discoidalis*, from Calgary, Alberta, N.W. Canada, which had been collected in May last, by Mr. Woolley-Dod. He said that the validity of *C. alberta*, which had been questioned by Mr. W. H. Edwards, was fully established by these specimens.—Prof. E. B. Poulton, F.R.S., gave an account of the changes which he had recently made at Oxford in the arrangement of the Hope Collections in the Department of Zoology, and as to the rooms now available for students working at these collections.—Mr. G. T. Bethune-Baker communicated a paper, entitled "Descriptions of the Pyralidæ, Crambidæ, and Phycidæ, collected by the late T. Vernon-Wollaston in Madeira."

PARIS.

Academy of Sciences, October 29.—M. Lœwy in the chair.—Experimental verifications of the theory of weirs, with either adherent or partly submerged water-sheet, with regard to the pressures, by M. J. Boussinesq.—On the existence in plants of principles capable of condensation with production of carbonic acid, by MM. Berthelot and G. André. Plant-leaves were

dried at 110°, reduced to powder, and then heated on an oil-bath, at 120°–130°, with 12 per cent. hydrochloric acid. The work was carried out in an atmosphere of hydrogen. It resulted in a slow evolution of carbon dioxide. This may be accounted for on the hypothesis that the contained carbohydrates have a ketonic constitution. Experiments on the simple carbohydrates are in progress.—On the movements which certain animals make in order to fall on their feet, when precipitated from a height, by M. Marey. Successive instantaneous photographs, taken in two planes, are given of a cat in the act of falling. The necessary movements are accomplished by the animal rotating the forepart of its body when drawn in, so that its moment of inertia is small as compared with that of the extended hind-quarters, and by this movement being repeated by the latter when drawn in and the fore-part extended.—A note concerning the above communication, by M. Guyon. It is shown that the rotation of the animal is not contrary to received laws.—Observations on the principle of areas, by M. Maurice Lévy.—Reduction of the equation of continuity in hydraulics to the form $\frac{d\rho}{dt}+v_1\frac{d\rho}{ds_1}+\rho\frac{dv_1}{ds}-2\rho v_1\frac{b'\alpha}{ds''}=0$. An abstract of a memoir by M. P. E. Touche.—The first volume of a work by M. G. Hinrichs, "On the Mechanics of Atoms," gives a discussion of atomic weights and methods used in their determination, and treats of the question of the unity of matter.—On the problems of dynamics of which the differential equations admit a continuous group, by M. P. Staeckel.—On the differentiation of trigonometric series, by M. Matyas Lerch.—On the constitution of the electric arc, by M. L. Thomas. The arc between two carbons containing metallic salts consists of a nucleus surrounded by an envelope; in the former are found the substances giving band spectra, hydrocarbons or carbon vapour and cyanogen, in the envelope metallic vapours from the dissociated salts pass from the positive to the negative pole, and there burn in the oxygen of the air, producing the metallic line spectra characteristic of this region.—Relation between the maximum vapour pressures of water, ice, and a saline solution at the freezing-point of this solution, by M. A. Ponsot.—On the gaseous products given off by wood charcoal when heated to a high temperature out of contact of air, by M. Dosmond.—On the transformation temperatures of irons and steels, by M. Georges Charpy.—Kermésite, by M. H. Baubigny.—On the superposition of optical effects of several asymmetric carbon atoms in the same active molecule, by MM. Ph. A. Guye and M. Gautier. In a molecule containing several asymmetric carbon atoms, each of them acts as if all the remainder of the molecule were inactive. The optical effects of several asymmetric carbon atoms in the same molecule are algebraically added to give the optical activity of the molecule.—On the saturated hydrocarbons with active amyl radicals, by Mdlle. Ida Welt.—On the estimation of alcohol in essential oils, by MM. Charles Fabre, Garrigou, and Surre.—On the existence of *cellules en paniers* in the *acinus* and excretory conduits of the mammary gland, by M. E. Lacroix.—Observations on a note by MM. Prillieux and Delacroix.—On the *gommose bacillaire* of vines, by M. L. Daille.—Culture of a fungus (*Collybia velutipes*) growing on wood, by MM, Costantin and Matruchot.—On the disease "Rouge" in the Paris nurseries and plantations, by M. Louis Mangin.—On the relations of the basalt and phonolite of the Suc d'Araules (Haute-Loire), by M. Ferdinand Gonnard.—On the geology of French Congo, by M. Maurice Barrat.—On several quaternary grottos of the Dordogne, and on some megalithic monuments of Orne and La Manche, by M. Émile Rivière.

NEW SOUTH WALES.

Royal Society, June 6.—C. Moore in the chair.—The following papers were read:—Notes on some minerals and mineral localities in the northern districts of New South Wales, by D. A. Porter.—On the magnetic susceptibilities of specimens of Australian basalts, by Prof. A. W. Rücker, F.R.S.—On boleite, nantokite, kerargyrite, and cuprite, from Broken Hill, by Prof. Liversidge, F.R.S.—From number to quaternion, by C. Fleuri.—New orbit of the double star β 416 = Scorpii 185, by Prof. S. Glasenapp.—On the value of gravity at the Sydney Observatory, by E. F. J. Love.—Preliminary notes on the pharmacology of *carissa ovata*, var. *stolonifera*, Bail, by Dr. T. L. Bancroft.—On the almandine garnets from the Hawkesbury sandstone at Sydney, by H. G. Smith.—On a natural mineral spring at Bungonia, by Rev. J. Milne Curran.

July 4.—Prof. Threlfall, President, in the chair.—The following papers were read:—On a transparent star-chart: a convenience for observers, by H. C. Russell, F.R.S.—Aboriginal Bora held at Gundabloui in 1894, by R. H. Mathews.—Observations and orbit elements of comet Gale 1894, by John Tebbutt.—On the structure and composition of some Australian basalts, by Rev. J. Milne Curran.

August 1.—Prof. Threlfall, President, in the chair.—The following papers were read:—On garbage destructors, by Prof. Warren and Dr. Ashburton Thompson.—The geology of lime-kilns, Bathurst district, by W. J. C. Ross.—The territorial divisions of New South Wales into counties, by W. D. Campbell.—On the timbers of New South Wales, by J. V. De Coque.—On the Aboriginal rock carvings and paintings in New South Wales, by R. H. Mathews.—The Society's bronze medal and money prize of £25 were presented to each of the two last-named gentlemen for their papers.

September 5.—Prof. Threlfall, President in the chair.—The following papers were read:—Some stone implements used by the Aborigines of New South Wales, by R. H. Mathews.—Recent researches in the testing of cement, by W. S. de Lisle Roberts.—A comparison of the languages of Ponape and Hawaii, by the late Rev. E. T. Doane, with additional notes and illustrations by Sidney H. Ray.—Preliminary note on the structure of gold nuggets, by Prof. Liversidge, F.R.S. Gold nuggets on being cut through or sliced and polished, and then etched by chlorine water, were found to exhibit well-marked crystalline structure closely resembling the Widmanstatt figures shown by most metallic meteorites, except that in the nuggets the crystals are more or less square in section and show faces which evidently belong to the octahedron and cube. On heating the nuggets in a bunsen burner, blebs or blisters form, on both the polished and unpolished surfaces, and on still more strongly heating, these, in some cases, burst with sharp reports, and pieces of gold are projected with considerable violence. As no explosions have been observed on dissolving or eating away the crusts of these blisters by chlorine water, it would appear that the blebs are probably due to the vaporisation of some liquid or solid substance. As soon as a fresh supply of nuggets is obtained, experiments will be proceeded with to ascertain definitely whether gold nuggets contain occluded gases, or liquids or solids which are vaporisable. In slicing some nuggets, scattered granules of quartz were met with inside, although quite invisible outside, and at first it was thought that the explosions might be due to the quartz; but the gas, in some cases, continued to issue from the burst bleb (where the aperture formed was small) and forced the bunsen flame out into lateral jets, just as if urged by a blow-pipe.

Linnean Society, September 26.—Prof. David, President, in the chair.—On the correct habitat of *Patella kermadecenis*, Pilsbry (=*P. Pilsbryi*, Braz.), by John Brazier. The author expressed the opinion that this is the species referred to in Mr. Percy Smith's pamphlet, "The Kermadec Islands: their Capabilities and Extent" (Wellington, 1887), which states that on Macauley Island there occur "large limpets (as big as small saucers, and good eating)."—On a *Trochus* from Port Jackson, and new varieties of *Bulimus miltocheilus*, Reeve, from the Solomon Islands, by John Brazier. Under the name of *Trochus Adamsi*, n.sp., was re-described a Port Jackson mollusc, the original specific name of which (*T. comptus*, A. Ad.) is preoccupied for a species named by Phillipi. Dr. Fischer also confounded *T. comptus*, A. Ad., with the New Caledonian *T. Poupineli*, Montr., which is a distinct species. Three new varieties of *Bulimus miltocheilus*, Reeve, were also described.—Observations on *Dendrolagus bennettianus*, De Vis, by Edgar R. Waite. The author described the species from material recently obtained from the Bloomfield River, Queensland. He was of opinion that in respect of both external and anatomical characters it is a well-marked species.

AMSTERDAM.

Royal Academy of Sciences, September 29.—Prof. Van de Sande Bakhuyzen in the chair.—Mr. Beyerinck discussed the reduction of sulphates by a specific sulphide ferment. This subject bears on two questions of general bacteriology, *i.e.* (1) the production of sulphuretted hydrogen, and (2) the power of reduction. Bacteria may produce H_2S in four different ways: Firstly, from sulphur, this being dissolved, by the excretion of ammonia, amines or alkaloids forming sulphides, which are decomposed by carbonic acid; secondly, from proteids containing sulphur, well known in cases of putrefaction; thirdly,

from sulphites and thiosulphates (the latter of these substances being decomposed into sulphites and sulphur, and the sulphites acted on as in the first case); fourthly, by the reduction of sulphates. From the common reducing bacteria which turn nitrates into nitrites, and these into ammonia salts, which produce from litmus, indigo-blue, methylen-blue, &c., the corresponding leucoids, none has the power to attack sulphates. This is done by a specific ferment, a very small *spirillum*, which is perfectly anærobic, and which is common in the black mud of polluted waters, as also in these waters themselves. It grows with very small quantities of organic nutriment, as malates, peptone, sugar, and phosphates added to common water, rendered alkaline by sodium carbonate. Temperatures from 25° to 30° are the best for reduction, For the determination of the H_2S the iodometric method can be used. Common water with the addition of $\frac{1}{10}$ per cent. sodium malate, $\frac{1}{10}$ per cent. asparagin, $\frac{1}{10}$ per cent. potassium phosphate, and $\frac{1}{2}$ per cent. sodium carbonate, infected with mud containing the ferment, and secluded from the air, and with forty-five milligrammes SO_3 per litre, was in three days quite free from this substance, containing nearly 10·2 milligr. H_2S, the cause of the deficit (twenty-one milligr. SO_3, not transformed into H_2S) being not yet quite clear. Mohr's salt (ferrous ammonium sulphate) is very well adapted for reduction experiments, the smallest trace of reduction being indicated by the formation of black FeS. The spirillum has been named *Spirillum desulfuricans*. It seems to be of geological importance, inasmuch as the deep ground water of the province of South Holland is quite free from sulphuric acid, which, being abundant on the surface, is apparently reduced by the sulphide ferment, and rendered insoluble as FeS and FeS_2.—On Kerr's magneto-optic phenomenon, by C. H. Wind. The author supposes that, in a metal placed in a magnetic field, both the conduction and the displacement current give rise to a *Hall*-effect, the intensity coefficient being different in the two cases. In this way the discrepancy, which exists between the experimental results, and the theory of Lorentz and Van Loghem, may be removed.—Prof. Kamerlingh Onnes read a memoir, in which Dr. Kuenen gave a graphical representation of the condensation of a mixture of two substances with π and ι taken as co-ordinates. His conclusions are contradictory to those of Duhem, but in accordance with the theory of Van der Waals and his own experiments. All mixtures of two substances must show retrograde condensation.—Prof. Onnes also communicated the results of an investigation, by Dr. Borgesius, on the molecular refraction and dispersion of some salts in solution, made with an interferential refractometer especially constructed for this purpose, and giving the small differences of refraction of two fluids by a single reading of verniers and counting of striæ.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Lehrbuch der Experimental Physik: A. Wüllner, Erster Band (Leipzig, Teubner).—Elements of Metallurgy: W. J. Harrison and W. J. Harrison, Jun. (Blackie).—A Text-Book of Organic Chemistry: Dr. A. Bernthsen, translated by Dr. G. M'Gowan, 2nd English edition (Blackie).—The Rise and Development of Organic Chemistry: Dr. C. Schorlemmer, edited by Prof. A. Smithells (Macmillan).—Geometrical Conics: C. Smith (Macmillan).—Amphioxus and the Ancestry of the Vertebrates: A. Willey (Macmillan).—The Life and Correspondence of Wm. Buckland, D.D., F.R.S.: Mrs. Gordon (Murray).—Die Maschinellen Hilfsmittel der Chemischen Technik: A. Parnicke (Frankfurt a/M., Bechhold).—Arithmetic for Schools: C. Smith, 2 pts. (Cambridge University Press).—Practical Physiology of Plants: F. Darwin and E. H. Acton (Cambridge University Press).—A History of Epidemics in Britain: Dr. C. Creighton, Vol. 2 (Cambridge University Press).—An Elementary Introduction to Mineralogy: R. H. Solly (Cambridge University Press).—Report of the Commissioner of Education for the Year 1890–91, Vol. 1 (Washington).—Index Kewensis: J. D. Hooker and R. D. Jackson, Part 3 (Oxford, Clarendon Press).—An Introduction to Comparative Psychology: Prof. C. Lloyd Morgan (Scott).—Théorie de l'Ondulation Universelle: B. Conta (Paris, Alcan).—Smithsonian Institution Report to July 1892 (Washington).—Mineral Resources of the United States, 1892–93: D. T. Day (Washington).—U.S. Geological Survey Monographs:—The Penokee Iron-Bearing Series of Michigan and Wisconsin: K. D. Irving and C. R. van Hise (Washington).—Tertiary Rhynchophorous Coleoptera of the U.S.: S. H. Scudder (Washington).—A Manual of Topographic Methods: H. Gannett (Washington).—Tenth Annual Report of the Bureau of Ethnology, 1888–89: J. W. Powell (Washington).—Involution and Evolution according to the Philosophy of Cycles: Kalpa, 1st part: The Universe (Eyre and Spottiswoode).—A Monograph of the Land and Freshwater Mollusca of the British Isles; J. W. Taylor, Part 1 (Leeds, Taylor).—The Life and Inventions of Thomas Alva Edison: W. K. L. Dickson and A. Dickson (Chatto).—Physiology for Beginners: Drs. M. Foster and L. E. Shore (Macmillan).—Les Chronomètres de Marine: E. Caspari (Paris, Gauthier-Villars).—Die Lebensweise der Meeresthiere, Zweiter Theil einer Einleitung in die Geologie als Historische Wissenschaft: Prof. J. Walther (Jena, Fischer).—The Construction of the Modern Locomotive: G. Hughes (Spon).—Commercial Geography: Prof Gonner (Macmillan).—Horse-Breeding for Farmers: A. E. Pease (Macmillan).—A Treatise on Hygiene and Public Health, Vol 3 (Churchill).—The Deserts of Southern France, 2 Vols.: S. Baring-Gould (Methuen).—Sir Victor Brooke, Sportsman and Naturalist: O. Leslie Stephen (Murray).—The Mountains of California: J. Muir (Unwin).—Illustrated Catalogue of Microscopes, &c., manufactured by R. and J. Beck., Ltd. (68, Cornhill).—A Text-Book of Mechanical Engineering: W. J. Lineham (Chapman and Hall).—Royal Natural History, Vol. 2 (Warne).—Geotektonische Probleme: A. Rothpletz (Stuttgart, Koch).—Morphologie der Erdoberfläche, 2 Vols.: Dr. A. Penck (Stuttgart, Engelhorn).—Twelfth Annual Report of the Fishery Board for Scotland, 1893, Part 3: Scientific Investigations (Edinburgh).—Lectures on the Darwinian Theory: Prof. A. Milnes Marshall (Nutt).—Album von Papúa-Typen: A. B. Meyer and R. Parkinson (Dresden, Stengel).

PAMPHLETS.—National Health: C. Scott (Belfast, Mullan).—Report on Experiments on the Manuring of Hay, Oats, and Turnips (Glasgow).—The Pamunkey Indians of Virginia: J. G. Pollard (Washington).—Bibliography of the Wakashan Languages: J. C. Pilling (Washington).

SERIALS.—Physical Society of London. Proceedings, Vol. xiii. Part 1 (Taylor and Francis).—Journal of Anatomy and Physiology, October (Griffin).—Journal of the Royal Microscopical Society, October (Williams). Longman's Magazine, November (Longmans).—English Illustrated Magazine, November (198 Strand).—Mineralogical Magazine, September (Simpkin).—Sunday Magazine, November, Isbister).—Good Words, November (Isbister).—American Journal of Mathematics, Vol. xvi. No. 4 (Baltimore).—Bulletin of the American Mathematical Society, October (New York, Macmillan).—L'Anthropologie, tome v. No. 5 (Paris, Masson). Beiträge zur Biologie der Pflanzen, vii. Band, 1 Heft (Breslau, Max Müller).—Morphologisches Jahrbuch, 21 Band, 4 Heft (Leipzig, Engelmann).—Bulletin of the U.S. Geological Survey, Nos. 97-117 (Washington).—Transactions of the Leicester Literary and Philosophical Society, Vol. 3, Parts 4 to 8 (Leicester; Gibbons).—Zeitschrift für Wissenschaft Zoologie, lviii. Band, 3 Heft (Leipzig, Engelmann).—Contemporary Review, November (Isbister).—Natural Science, November (Macmillan).—Humanitarian, November (Hutchinson).—Quarterly Journal of the Geological Society, Vol. l. Part 4, No. 200 (Longmans).—Geological Magazine, November (Stanford).—Journal of the Chemical Society, November (Gurney and Jackson).—Geological Magazine, November (Paul).—Scribner's Magazine, November (Low).—Natural History of Plants: Kerner and Oliver, Part 7 (Blackie).—Fortnightly Review, November (Chapman and Hall).

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