THURSDAY, MARCH 30, 1899.

METEOROLOGY IN FRANCE.

Traité élémentaire de Météorologie. Par Alfred Angot, Météorologeste titulaire au bureau central météorologique. Pp. vi + 412. (Paris : Gauthier-Villars, 1899)

IN the opinion of the author, meteorology, or more generally the physics of the earth, does not receive in France that study and attention which the subject deserves, both from its inherent interest and its possible usefulness. He traces this indifference to the absence of regular teaching in the schools devoted to higher education, to the want of an enlarged professoriate, and, though the statement is not made directly in words, to a deficiency of text-books written with the special object of instruction. He contrasts the devotion that is paid to the study of meteorology in the United States with the apparent carelessness that he perceives in his own country, and offers this book, which is the *résumé* of a course of lectures he has given in his professorial capacity, to attract more general attention to the subject, and to fill a gap in the scientific literature which his experience teaches him exists. Without the same means of judging of its necessity as M. Angot possesses, we cannot say how far this hope will be realised, but one can have no hesitation in saying that he has offered to his countrymen an admirable treatise, well calculated to serve the ends he has in view. It is well arranged, clearly written, not overloaded with details, either numerical or instrumental, presenting all the facts that are fairly well established, and indicating as far as necessary the lines of future investigation.

M. Angot divides his treatise into five books, each of which is fairly complete in itself. These books are entitled "Temperature," "Atmospheric pressure," "Aqueous vapour," "Disturbances of the atmosphere," and "Weather forecasts." In other words, we have the results of observation followed by theoretical deduction and practical application. The general plan followed in each of the three first books is to discuss the results of observation as derived directly from instruments. These observations disclose the variations that are noticeable throughout the day and throughout the year, each of which comes under examination in turn. The explanation of the several variations follows, both as to amount and time of displacement ; that is to say, both amplitude and phase. This explanation is traced to the general effect of the sun as modified by the action of local circumstances. The plan is very generally adhered to throughout and is satisfactory. It brings clearly before the reader the amount of disturbance that is to be explained, and the efficiency of the causes to explain the results of observation. Of course diagrams and graphical illustration are frequently used, and where it has been necessary to exaggerate effects in order to make them easily and saliently visible, the scale on which the enlargement has been made is stated. It would be well if this practice were more frequently followed in elementary works ; very erroneous notions are sometimes carried away by students, who remember the diagrams more perfectly than the letter-press they are intended to illustrate.

In the determination of temperature, which is the first climatic element considered, the observations, whether of the atmosphere, the soil, or of rivers, are readily made, and the explanation easily traced on general principles. The author writes for those who have only elementary notions of physics and mathematics, so that he sometimes states a law and gives its experimental proof without entering into a complete mathematical demonstration. This is noticeable in the matter of underground temperatures, an interesting subject treated here more fully than in most elementary works, but there is no specia reference to the theory of conductivity of heat. In this course the author is amply justified. In treating of the physics of the earth's crust, it is permissible to assume the results of laboratory and theoretical inquiries into the subject of heat and its diffusion.

The division entitled atmospheric pressure necessarily includes some general notion of air movements, of barometric gradients and of cyclonic disturbances, though the more interesting results arising from the discussion of the behaviour of the atmosphere over areas of high and low pressure are reserved for the penultimate section on the perturbations of the atmosphere. We have in the discussion of the vexed question of diurnal variation of pressure, an instance of the manner in which the author treats subjects that are still more or less uncertain and require further examination. M. Angot prefers to leave the many unsatisfactory hypotheses that have been suggested to explain the cause of this phenomenon severely alone. He is content to say that a complete explanation is still wanting. In his discussion of the observed fact, he follows the explanation originally due to Carlini, and developed by Lamont, of the superposition of two distinct oscillations—the diurnal and the semi-diurnal wave. The latter he leaves where he found it. Into the former, as due to diurnal variation in temperature, the author enters very thoroughly, tracing the modifications which are produced by latitude and elevation above the earth's surface. He quotes the observations obtained from barometric readings on the Santis and on Mont Blanc, but makes no reference to Prof. Pickering's measures carried out at elevated stations on the Andes.

The section on aqueous vapour and of the various forms it subsequently assumes, will be found very interesting, embracing all the facts which have been clearly established. We think a little more consideration might have been given to the subject of the action of dust in the atmosphere, both in connection with precipitation and, subsequently, when treating of the optical phenomena of the atmosphere. We should gather that M. Angot is doubtful of the value of much of Mr. Aitken's work, for example. In the sub-section on clouds, some very good illustrations are given. The importance of accurate observation is here and elsewhere insisted on, and we think necessarily ; for notwithstanding recent efforts to inculcate a better knowledge of cloud forms and motions, it will generally be admitted that, except among cloud specialists, uniformity of description and exactness of nomenclature are still wanting. The publication of the "International Cloud Atlas," a work on which consider-

able attention and ability have been expended, and from which a noticeable advance was anticipated, has, so far as one can observe in this country, remained a dead letter. It may be that the Meteorological Office has sent out instructions to the numerous army of observers who contribute to the mass of records accumulated at the office, but so far they do not seem to have been followed with a practical result. On this ground we welcome the effort that any less official source may make to instruct a public who cannot but be benefited by more accurate and scientific observation.

Perhaps the most interesting portion of the book will be found in the last two divisions, wherein we meet with the deductions and conclusions drawn from observation rather than the mere statement of facts. In the eyes of many, the forecasting of weather, including as it does the possibility of safe-guarding against the action of severe storms, whether inland or on our coasts, is regarded as the final outcome of meteorological observation. No office dares to issue forecasts for any particular place. Local circumstances exercise an influence which cannot be adequately taken into account. M. Angot tells us that it has not yet been found possible to divide France into more than eight divisions, and to attempt to give the probable variations in temperature and weather that will generally prevail in each district. Evidently the mechanism employed and the success that attends its use are both about the same as in England. Ninety per cent. of the forecasts are found to possess a satisfactory degree of accuracy. But it is a question whether forecasting, carrying with it an idea of prophecy, is quite the right term. Long ago Le Verrier wrote :

"The ultimate result of the organisation which we are establishing should be to announce a storm as soon as it appears at any point in Europe, to follow it on its course by means of the telegraph, and to give timely notice of it to the coasts which it may reach."

We believe that this view indicates the present position of the various meteorological bureaux. A clear evidence of the approach of a storm or of a change of weather must exist before any announcement can be made. Then it becomes a question of telegraphic communication outrunning the speed of the storm. There is no prophecy from first to last. The preparation of synoptic charts permits and assists the recognition of these signs of changes to be made earlier than would be the case, but experience seems to be often the only guide that will give the direction in which the storm will move. M. Angot regrets the position of Western Europe and the unfavourable conditions under which it is placed for gaining information from stations on the West. Telegraphic communication with Iceland would, he thinks, furnish much valuable information ; but the provision of a telegraphic cable with that remote island cannot be looked upon as likely to be made. On the possibility of predicting weather for longer periods than twenty-four hours M. Angot speaks hopefully, and seems to approve of the suggestion of Dr. Van Bebber, though we have not seen any direct reference to this meteorologist. There is no necessity to enter into this question here, since we have recently given some account of the long-continuing types of weather and the use that is made of them (NATURE, vol. lviii. p. 28). We feel that in these few remarks very scant justice has been done to a very excellent book, on the appearance of which we congratulate the author, and venture to express the hope that his intention of awakening greater interest in the subject of meteorology in France will be realised.

RIVER DEVELOPMENT.

River Development as illustrated by the Rivers of North America. By Prof. I. C. Russell. Pp. xv + 327. (London : J. Murray. New York : G. P. Putnam's Sons, 1898.)

THIS book is one of a Progressive Science Series now being published in the United States and here. The American edition was issued under the title of "The Rivers of North America." The object of the book, as set out in the introduction, is to assist the reader "in questioning the streams and in understanding their answers, and at the same time creating a desire for more light on other and related chapters of the earth's history," and in satisfying an insatiable desire which the reader is told "exists for more knowledge concerning the work of the streams to which so many of the changes that have been made on the earth's surface are due."

The book consists of nine chapters, dealing with the disintegration and decay of rocks ; the laws governing the streams ; the influence of inequalities in the hardness of rocks ; on river-side scenery ; material carried by streams in suspension and in solution ; stream deposits ; stream terraces ; stream development ; some of the characteristics of American rivers ; the life-history of a river. Of these nine chapters only one is given to the description of the rivers of America, and, with the exception of short allusions to other rivers, this only includes a very brief account of the Mississippi, the Colorado, the Columbia and the Saint Lawrence.

The book may be read with interest by readers who wish to obtain general information as to the formation and physical condition of rivers. The material is, however, not of that definite character which a reader might expect to find in a book written for a scientific series. It does not contain any information that would not be already in the possession of a student who has paid attention to the physics of rivers. The author does not appear to have made a special study of the physics of rivers, or to have carried out any independent observations or experimental research. The facts and data given have been collected from the writings of physical geographists and the reports of the United States Geological Survey. In fact the author only claims to be "a guide who points out the routes others have traversed."

In the description of the agencies which operate in the formation of water-courses, of the effects produced by running streams, and the characteristics of different rivers, the author has not confined himself to that severe simplicity of style that is generally adopted in a scientific treatise, nor has he been economical of words. In fact, those generally in use not being sufficient, he has considered it necessary to add to them. Thus the reader is told that

"When a stream has lowered its channel nearly to base-level downward *corrasion* is retarded, but lateral *corrasion* continues. Low-grade streams are the ones

most inclined to meander, and to broaden their valleys. If this process is continued for a sufficient time in any region, it will lead to the removal of all land within reach of the stream down to their own level. Base-level of *corrasion* thus becomes practically the base-level of erosion. The ultimate result of erosion is to reduce a land area to a plain at sea-level. Such perfect plains, however, are exceedingly rare; but approximations to the ultimate result are common, and plains in this penultimate stage have been named *peneplains*." . . . "The action of a stream in *corrading* its channel in one portion of its course, and *aggrading* it in another portion, is carried on at the same time and is a highly complex process."

And again,

"What charming pictures of placid rivers flowing between wooded and flower-bedecked banks, softened and partially obscured, perhaps, by moaning mists, enrich the memories of those who have travelled in the Carolinas, Georgia and Alabama! Whence the fascination of these sleepy streams, flowing through flat-bottomed valleys bordered by wildly roughened, plateau-like uplands? What has subdued the broader features of the landscape in a region where every river bank reveals folded and contorted rocks similar to those in the neighbouring mountains?"

After describing the development of rivers from observed facts, the author in the last chapter gives his imagination full play, and "pictures in his mind the leading events in the life of a majestic river whose murmurs we may be pardoned for fancying make audible the memoir of a million years." "Looking across the shimmering sea of fancy, we see the new-born consequent streams appearing like shining threads of silver when the skies are clear," &c. Instead of this imaginative description a reader interested in the history of rivers would naturally regret that the space thus occupied had not been devoted to dealing more fully with the characteristics of the few rivers of which a description is given. Thus in describing that remarkable river the Colorado, and stating that there is nothing of the same class in the whole world, and telling how that it has carved its course through solid rock, and flows in a canyon from 4000 to 6000 feet deep, with a valley more than fifteen miles across, no explanation is given, or suggestion made, as to what special characteristic the water of this river—which, as its sources flow through an arid plain, must be limited in quantity—possesses that has enabled it to perform this incredible amount of wearing away by the action of water alone. The author states that the remnants of the great plateau, across which the Colorado flowed in its infancy, was once 4000 feet lower than now; at which level it remained for tens of thousands of years while the river cut down its channel to base-level, and by lateral *corrasion* broadened its valley; during which time the climate was arid, and being subsequently slowly elevated the river once again had to begin the task of *corrading* its bed to base-level. Although the theory of the author as to the depression of the bed of this river being due to the wearing of water and not to any opening of the ground caused by earthquakes or alterations in the surface-level caused by uprisings, is that generally accepted by geologists, yet in a scientific treatise on rivers it would have been more satisfactory if some cause had been assigned why the water of this particular river should have produced such remarkable results as compared with those effected by the Niagara, the St. Lawrence, the Mississippi, or other great rivers having larger volumes of water and of equal age. In the case of the Niagara the flowing water has made such slight impression on the limestone rocks over which it flows, that little more than a surface skin has been eroded, and the striated marks due to glacial action may still be traced almost to the water's edge; and the wearing action of its flowing water has only cut back the rock over which it falls to a distance of seven miles with a fall of little over 300 feet, as compared with the 300 miles in length and over a mile in depth of the Colorado.

Although the river systems of America are of a magnificent and comprehensive character, this book would have been more instructive as a scientific treatise on river development if the author had taken a wider survey of river action, and given some information as to the characteristics and development of some of the other large river systems of the rest of the world.

PYRAMID AND PLANISPHERE.

The Book of the Master; or, the Egyptian Doctrine of the Light born of the Virgin Mother. By W. Marsham Adams. Pp. xxii + 204. (London: John Murray, 1898.)

IN a book published some three years ago Mr. Adams proclaimed what he considered to be "a clue to the creed of early Egypt." He is doubtless an enthusiast, and of the importance of his work he does not entertain the smallest misgiving. So startling, indeed, to him was the originality of his idea that he was convinced of its truth from this fact alone; to have invented it, he wrote

"were an intellectual masterpiece which surely demands nothing less than a creative genius of the very loftiest order. So majestic is the outline of the conception as it rises solemnly on the view that I cannot for a moment believe it to be the offspring of my own imagination."

Mr. Adams therefore, according to his own account, was in the enviable position of being either "a creative genius of the very loftiest order," or the discoverer of a fact that "with overwhelming splendour" illuminates "mystery after mystery of the invisible world."

The discovery which Mr. Adams heralded in this very enthusiastic manner was a mystical connection between the Egyptian "Book of the Dead" and the Great Pyramid at Gîzeh. About both these wonders of ancient Egypt many wild theories have in their time been aired, but perhaps one of the wildest is that which Mr. Adams proclaimed. For three years he published nothing further on the subject, but he has now produced another book in which he repeats and elaborates his ideas. In fact "The Book of the Master" incorporates whole passages from his former work with the change of a word or two here and there, for, as Mr. Adams rathe characteristically remarks in his preface,

"I have not thought it advisable to rewrite that which I saw no probability of improving by revision."

Mr. Adams is not content with the common-sense view of regarding the pyramids as the tombs of Egyptian kings. He suggests a "spiritual and most far-sighted

purpose" for their construction, seeing in them a mysterious type or symbol of the religious beliefs and aspirations of their builders, and he sets to work to prove his theory by tracing a correspondence between their internal arrangements and the various chapters of the Book of the Dead. With regard to his theory it will suffice to point out the fact that Mr. Adams employs the Turin Papyrus of the "Book of the Dead," which dates from a period not earlier than the twenty-sixth dynasty, to explain the arrangements of a structure erected at least 3000 years earlier. This connection between the Great Pyramid and the Turin Papyrus is not the only "revelation" Mr. Adams has given us, for he is convinced that the Deluge was merely a phenomenal inundation of the Nile valley, that Eden was situated in Central Africa, and Paradise itself in the eastern basin of the Congo. He holds views of his own, also, in comparative philology, in accordance with which he derives the response "Amen" of the Book of Common Prayer, not from the Hebrew *âmên*, "verily," but from the name of the Egyptian god Âmen-Rā. So, too, the British cheer, "Hip, hip, hurrah!" is, according to Mr. Adams, merely hieroglyphic for "On, on, to plunder!"

The form of problem, however, which appears to have most attraction for Mr. Adams is to take a building and some object with which it is apparently unconnected, and to trace wonderful and mystical connections between the two. As he formerly connected up the Great Pyramid and the Turin Papyrus, so now in his new book he traces connections between the temple of Hathor and the famous planisphere at Denderah. "To effect a comparison between the chambers of the building and the different parts of the planisphere," he writes, "and through them with the constellations of the heavens, is not a difficult task." And for Mr. Adams it certainly is not, for he proceeds to do it with the greatest ease and fluency. In fact we are convinced that Mr. Adams would find little difficulty in tracing any number of mystical relations between, let us say, the "Ingoldsby Legends" and St. Paul's Cathedral. We make a present of this suggestion to Mr. Adams, and hope that he may find time to develop it, even though he should be compelled to cease for a time from his revelations of Egyptian mysteries.

OUR BOOK SHELF.

A Laboratory Manual in Astronomy. By Mary E. Byrd, A.B. Pp. 273 + ix. (Boston: Ginn and Co., 1899.)

OWING to uncertainty of weather and the variety of times required for observations, the teaching of practical astronomy presents peculiar difficulties, and we therefore welcome a book which gives us the benefit of a teacher's extended experience. The course includes both indoor and outdoor studies, but excludes the use of instruments with the exception of a small telescope and other simple pieces of home-made apparatus.

The first four chapters consist chiefly of indoor exercises on the use of almanacs, maps and globes, and the solution of problems relating to time. These prepare the way for the outdoor observations, with which the remainder of the book is chiefly concerned. Each of the later chapters commences with a series of questions to be answered either by direct observation or from the data obtained by observation, and following these are explanations elucidating the more important points, as well as numerous examples giving results actually obtained by the students of Smith College Observatory. As examples of the class of observations to be made, we may mention meridian altitudes, and amplitudes at rising or setting, of sun, moon, and stars, the determination of time, longitude, and latitude, the identification of planets, and the observation of variable stars. Simple computations, furnishing checks on the observations, are introduced whenever possible, and throughout the whole course the student learns to enter his results methodically. One cannot help but marvel at the accuracy frequently obtained by the rough means employed.

Generally speaking, the explanatory matter is clear and complete, but we may note that no instructions are given as to placing the sun's equator in Fig. 34, and that some of the problems in Chapter iv. would be more intelligible to readers on this side of the Atlantic if a description of the apparatus called the "heliotellus" were included. For the benefit of those who live in an unfavourable climate, the use of artificial stars, as in the course at South Kensington, might be introduced with advantage. These are easily adapted to the transit instrument, wire micrometer, &c., and are always available. A useful piece of additional apparatus also would be a model sextant, such as that described in "Demonstrations and Practical Work in Astronomical Physics at the Royal College of Science, London."

The book has many novel features, and will be very helpful to teachers and students alike; while it will not relieve either from the trouble of adapting exercises to the occasion, it will greatly facilitate the preparation of working programmes.

Two classes of students may especially profit by following the course of instruction laid down, namely, those who study spherical astronomy as a branch of applied mathematics, and star-gazers who make their observations with little or no regard for mathematical considerations.

The Tutorial Algebra. Part ii. Advanced Course. ("The University Tutorial Series.") By William Briggs and G. H. Bryan, F.R.S. Pp. viii + 596. (London: W. B. Clive, 1898.)

IN these 596 pages we have a treatise based on the "Algebra" of Prof. Radhakrishnan. The reason for this is that the latter book is known to be the result of a careful study of the best English authorities; while, as we read in the preface, "recent writers have shirked the task of educing what is intelligible to the average student from the work of the greatest masters of the subject. . . ." The authors have, nevertheless, taken great pains to present the student with an excellent advanced course, a more elementary course in a separate volume being promised at an early date.

It is natural that certain modifications and additions to the treatise mentioned above should find a place in the volume intended for English readers, and those included here, are, among others, logarithms, interest, convergency and limiting values.

Chapter xxvi., on the graphic representation of functions, by Mr. J. H. Grace, gives the reader a good insight into the method of discussing equations graphically; and this should serve as a useful introduction to other branches of mathematics, such as conic sections.

Throughout the book the exposition is clear, and numerous examples are inserted in the text. As a school treatise it should serve its purpose well, and those who are reading the subject by themselves will need little, if any, outside aid.

An Elementary Text-book of Botany. By Sydney H. Vines, M.A., D.Sc., F.R.S. With 397 illustrations. Pp. 611. (London: Swan Sonnenschein and Co., Ltd., 1898.)

PROF. VINES'S "Students' Text-book of Botany," or at least the first half of it, was reviewed in NATURE for October 25, 1894. This book is now widely known, and, as a well-ordered repertory of facts for the advanced student, is probably unrivalled.

The present work, as we are told in the preface, was "undertaken to meet a demand which appeared to exist for a less bulky and expensive volume." While the reduction in cost is considerable, the diminution in bulk is not so very great; the number of pages is about 600, as compared with about 800 in the larger work. The new text-book has also been somewhat simplified, by the omission of "certain difficult and still debatable topics, such as, for instance, the details of nuclear division, or the alternation of generations in the Thallophyta."

The book, however, subject to these omissions and abridgments, is the same, and for the most part verbally the same, as the original work. It is obvious that an elementary text-book, in the sense of a first introduction to the science, cannot be prepared on this principle. Such an introduction requires to be thought out as a whole, from the point of view of the beginner's needs. Prof. Vines's new publication is only to be called elementary relatively to its predecessor. It remains essentially what it was before its abridgment—a book for consultation and reference on the part of those who have already gained some considerable knowledge of the subject. For this purpose we have no doubt that the book, in its new form, will prove of great value to readers who require sound information on all parts of the science, but who do not need quite so much detail as the larger text-book contains.

It should be added that the present work has been brought "up to date," and takes account of the chief advances in the science which have been made since the publication of the "Students' Text-book."

The Principles of Agriculture: a Text-book for Schools and Rural Societies. Edited by L. H. Bailey. Pp. xv + 300. (New York: the Macmillan Company. London: Macmillan and Co., Ltd., 1898.)

THIS is a work written by eight of the professors and teachers of Cornell University. It attempts within the limits of a small volume to give an elementary popular account of the principles of agriculture. The task is made the more difficult as the subject is not limited to the discussion of the conditions necessary for the growth of field crops, but includes fruit culture, and a long section on animal physiology and nutrition. It follows, consequently, that a great deal is left out that we should have expected to find. An attempt is made to reduce the necessary deficiencies of the book by frequently referring the reader to other books treating the subject more fully.

In the earlier part of the volume there is much excellent teaching in vigorous language as to the primary necessity of a good physical condition of the soil. "The farmer should give attention to the texture of his soil before he worries about its richness. The conditions must first be made fit or comfortable for the growing of plants; then the stimulus of special or high feeding may be applied." . . . "By superior tillage you can expand one acre into eight, or by neglectful management eight acres can be reduced to one." . . . "Success in modern agriculture depends more on the size of the farmer than on the size of the farm."

The book includes not a few misstatements, the result, probably, of hasty writing for uncritical readers.

R. W.

LETTERS TO THE EDITOR.

The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*]

Experiment to Illustrate the Zeeman Effect.

AN interesting dynamical illustration of the Zeeman effect may be made by fixing a gyroscope so that its axis of rotation is the line of suspension of a pendulum bar so suspended as to be capable of vibrating in any plane. When the gyroscope is rotating the plane of vibration of the pendulum rotates with a precessional motion, and when the pendulum is caused to vibrate in a circular path its rate of description of its orbit depends on its direction of rotation round its orbit. The analogy to the Zeeman effect would make the rotation of the gyroscope correspond to the imposed magnetic force and the motion of the pendulum to that of the electrons. The explanation of the motion by the properties of a gyroscope is pretty obvious. It may be a matter for further consideration whether there are analogies between the length of the pendulum and its precession when describing elliptic orbits and the Zeeman effects: the ordinary elliptic precession corresponding to such a phenomenon as the double sodium line.

GEO. FRAS. FITZGERALD.

Trinity College, Dublin, March 24.

The Colour of Sea Water.

AS Mr. Threlfall, in his letter to NATURE of March 16, seems to have fallen into an error regarding the explanation of the colour of sea water, given by me in the paper referred to in his letter, perhaps I may be allowed to make a few remarks on the subject. He says my explanation is based on the principle that sea water is a blue liquid, and that the green tint often seen in sea water is due to the presence of yellow particles. Now, while it is pointed out in the paper referred to that yellow particles will make a blue water appear greenish, yet it is nowhere stated that yellow particles are the exclusive cause of greenness in sea waters. What may have caused Mr. Threlfall to make this overlook, may be the fact that only an abstract of the paper was published, and the different points, therefore, not fully explained. Still, I think there is enough in the abstract to show that greenness in sea water was recognised to be due in some cases to other causes than the one referred to in Mr. Threlfall's letter.

At the beginning of the paper referred to, experiments are described showing that the water of the Mediterranean is a blue transparent medium full of solid floating particles, and that it is "these solid particles that determine the brilliancy, and the selective absorption of the water determines its colour." It is then shown that the colour of the particles will have an influence on the appearance of the water; that if the particles be yellow the blue water will appear green, as any one can observe on looking at the Mediterranean water where it overlies a yellow sand bed. After describing experiments made on the waters in the Italian and Swiss lakes, the paper goes on to the consideration of the experiments made on sea water on the west coast of Scotland, from which I quote the following:—"The water was here found to be much greener than any previously examined. A large quantity of the water was filtered, when it was found that most of the suspended particles were fine grains of sand. From this it is concluded that the greenness of our northern seas is *in part* due to the reflecting particles being yellow, and the reflected light, therefore, deficient in the more refrangible rays. These yellow sand particles not only explain *part of* the greenness of our northern seas, but they also explain their comparative darkness and deadness, the yellow sand particles reflecting so little light. The importance, however, of even these bad reflectors was very evident during the time the observations were being made. It was noticed that the water was much more brilliantly green during and immediately after an inshore wind, and when the filter showed the water to have a good deal of sand in suspension, than after a calm, when many of the particles had settled out. *Some water collected about a mile seaward from Ballantrae was examined in a glass tube 7½ m. long, and was found to be of a blue-green colour.*"

If attention be given to the parts printed above in italics, I think it will be admitted that the writer did not consider the yellowness of the reflecting particles as the exclusive cause of the greenness in sea water, and in the last sentence quoted it is stated that the water on the west coast of Scotland, when examined in a long tube, transmitted a blue-green light, therefore greener than the water of the Mediterranean.

The paper concludes with some tests made in Loch Lomond and with pure water, and a number of well waters; these were found to vary from blue to yellowish brown. As the waters of most of our rivers and lakes are yellowish brown, it is probable that it is the addition of this yellowish water to sea water that makes the seas surrounding our islands of a greenish colour.

JOHN AITKEN.

Ardenlea, Falkirk, March 20.

The Wehnelt Current Interrupter.

THE form of contact breaker recently introduced by Wehnelt is attracting so much notice, that it may be worth while to draw attention to an essentially identical arrangement described by Spottiswoode for use with an induction coil, more than twenty years ago (*Proc. Roy. Soc.*, vol. xxv. p. 549). He says: "Another form of contact breaker was also occasionally used. The principle upon which it was based was the sudden disruption of a thin film of conducting liquid by a discharge between the electrodes of a circuit. The mode of effecting this was to make one electrode terminate in a platinum plate fixed in a horizontal position, and supplied with a uniform film of dilute sulphuric acid; the other in a platinum point, the distance of which from the plate is capable of delicate adjustment by means of a screw. Electro-motive force required for this break is not less than that of five cells of Grove. As soon as the current passes, the fluid between the plate and point will be decomposed, and electrical continuity broken. This done, the fluid flows back again, and continuity is restored. By a proper adjustment of the supply of fluid and of the distance between the electrodes (the latter varying from ·05 to ·001 of an inch), the number of disruptions may be made to attain 1000 per second. The currents delivered by this form of break are exceedingly uniform, and the effects produced are quite equal in delicacy to those produced by the electro-magnetic or by the wheel break."

R. J. STRUTT.

IN reference to the Wehnelt current interrupter—in 1874 I used a similar interrupter on a coil with fifty Groves' cells. The idea was not even then new, for although my experiment was due to accidental short-circuiting of electrodes during electrolytic experiments, which led to my final application of the so-called interrupter as a resistance to current, and then as a rapid make-and-break, I found that some of the old masters of electrics had evidently used it before. Since November 1896, I have always endeavoured in using a Jackson tube to condition the tube by heating, when connected with coil, so that the make-and-break of coil shows infinitesimal sparking and works with such rapid vibrations that a musical note is produced, the pitch varying as the position of the flame heating the tube is altered. Shadowgraphs can then be obtained of the human trunk from thirty-five seconds upwards, and the results on English fluorescent screens are almost perfect. This has all been mentioned in my lectures at the Royal Artillery Institute, &c., the first being at the end of October 1896.

WILLIAM WEBSTER.

The Laboratory, Art Club, Blackheath.

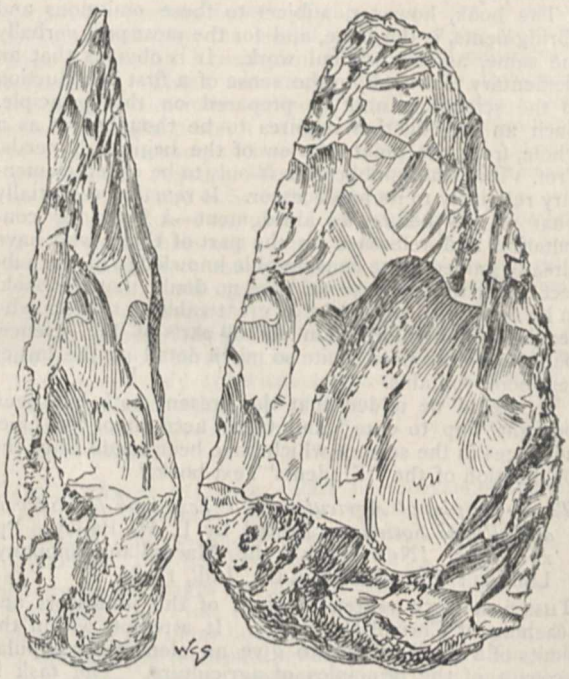
Palæolithic Implements from the Valley of the Ver.

THE river Ver rises at Markyate Street, near Dunstable, at the junction of Hertfordshire with Bedfordshire, and runs to St. Albans, whose ancient name Verulamium is derived from the river. Leaving St. Albans, the river becomes the Colne and joins the Thames at Staines. Many Palæolithic implements have been found by myself and others in the valley of the Colne, but up to now none have been recorded from the valley of the Ver.

It is true that for many years I have found Palæolithic implements in contorted drift (or where contorted drift has been) on the highest hill-tops north of the source of the Ver, but none of these positions have been in the river's valley. They have belonged to large ponds and swamps of Palæolithic age on the hill-tops.

For the last three or four years small excavations for clay have been made in a brick-yard east of Markyate Cell, but until this last winter I have never seen any human work amongst the excavated material. The implements occur in relaid contorted drift, which has been washed in patches from higher ground. The implementiferous material only occurs here and there in the brick-field; it is a brown clay full of large stones, and rests upon a brick-earth of much greater age, probably glacial, which in turn rests on Lower Chalk. The implementiferous clay is on the surface, and is never more than two feet deep. The pit is 108 feet above the Ver, and 547 feet above the Ordnance datum. On the hills to the north, and removed from the water-shed of the Ver, implements occur at 595 feet.

I have lately found six Palæolithic implements in the valley of the Ver at Markyate Street, all above the average in size and weight; they are faintly ochreous and slightly abraded. The example illustrated to one-half the actual size—1673 in my collection—weighs 1 lb. 6¾ ozs., two others weigh 1 lb. 1 oz. each, others 1 lb. 4 ozs. and 1 lb. 4¼ ozs. With these implements were numerous large cores and large blocks of flint, from which a flake or two had been struck. These were abandoned by me as too heavy for convenient carriage. Only one flake has come to hand; in fact, no stones as small as ordinary flakes are in the material. I have found a few Palæolithic flakes one and a half miles nearer St. Albans, in the same river valley, north of Friar's Wash.



Palæolithic implement from the valley of the Ver. One-half actual size

Twenty-one years have now passed since I first directed attention to the Palæolithic implements found on the hill-tops of North Herts (*Jour. Anth. Institute*, vol. viii., 1878). Since that time I have greatly extended my observations on these hills, but no evidence whatever has been seen by me indicative of a greater antiquity than post-glacial. The high-level implements at North Herts and South Beds are never in glacial material. The implementiferous brick-earth is always on the top of the glacial clay, where the latter is present, and to this rule I have seen no exception. The glacial gravels and clays and the boulder clay are here positively barren of human work.

Dunstable. WORTHINGTON G. SMITH.

THE NATIVE TRIBES OF CENTRAL AUSTRALIA.[1]

THE sincere efforts of some of the Australian governments to protect the native tribes have met with eminently satisfactory ethnographical results. It is only a few months ago that a highly meritorious work on the Queensland natives by Walter E. Roth was published by the Queensland Government, and we have now before us a very thorough work dealing with the native tribes of Central Australia—the joint production of a professor of biology and a protector of aborigines. These gentlemen have spent many years in the study of their black friends, and have become initiated into those mysteries into which Grey, Gason, Fison and Howitt were the first to make headway. The book thus contains a considerable amount of information quite new to us, as well as other matter largely confirmatory of the investigations of their predecessors, rendered all the more valuable by the conscientious pains that have been taken to thoroughly investigate everything in connection with native customs with which they have had to deal. In referring to the common statement that the Australian native is incapable of gratitude, the authors explain the position taken up by the aboriginal as regards this virtue, and point out that, although he is exceedingly liberal himself, he does not think it necessary to express his gratitude when he receives a gift from one of his own tribe, and that we should, in order to understand the sentiments of the native, put ourselves into his mental attitude, and then the question is capable of being more or less explained or understood. It is no doubt by their adoption of this attitude that they have been peculiarly successful in their studies. With the advent of the white man the secret ceremonies fall into disuse, for the young men get attracted away to the stations, and naturally feel less disposed to obey their elders; and these, in turn, consider the growing youth unworthy of initiation; hence the ceremonies get neglected and die out. It is of consequence therefore that every scrap of information regarding them be properly recorded, and in doing this Messrs. Spencer and Gillen have collected a mass of detail which, while it may at first sight appear somewhat superfluous, will be invaluable for future reference as further investigations are carried on.

Valuable portions of the book consist in the comparisons made between the results of studies on the Australian tribes under review, and those of studies made by anthropological students elsewhere, and it is significant of the importance of field work that the theories of McLennan and Westermarck on group marriage are not borne out by the present investigations. For instance, marriage by capture, notwithstanding what has been written on the subject, is an exception rather than the rule with the Australians, so that a good deal that Westermarck bases on this custom falls to the ground. In group marriage the authors distinguish (p. 108) three grades of development, and from their studies of these conclude that the customs indicate a temporary recognition of certain general rights which existed in times previous to that of the clearly defined system of group marriage. The authors are careful to add that the indications do not afford any direct evidence of the former existence of actual promiscuity, but only that evidence is afforded in such direction. The tendency of the evidence of prehistoric promiscuity is, however, so strong that we cannot doubt its former existence; and if the authors had elucidated no other point than this, they would have done good work. The totemism of the tribes shows some curious departures from the customs commonly associated with the idea of totemism as met with amongst other Australian tribes, as well as with primitive people elsewhere. Each individual considers himself the direct reincarnation of an ancestor, whose spirit having become humanised, has entered a woman, and so the individual is born in human form; the totemic animal or plant is not regarded exactly as a close relative, and an individual may help to kill or destroy his totem; members of the same totem are not bound to assist one another, nor does totemism rule in marriage, so that two individuals of the same totem may be lawfully man and wife. The authors are unable to explain satisfactorily these anomalies, nevertheless their inquiries on the subject of totemism are quite amongst the most fascinating of the book. The Arunta tribe, the description of whose customs occupy the greater portion of the monograph, reckon descent through the male instead of, as do most of the surrounding tribes, through the female; but, as is pointed out (p. 36), it is doubtful whether in all cases the counting of descent in the female

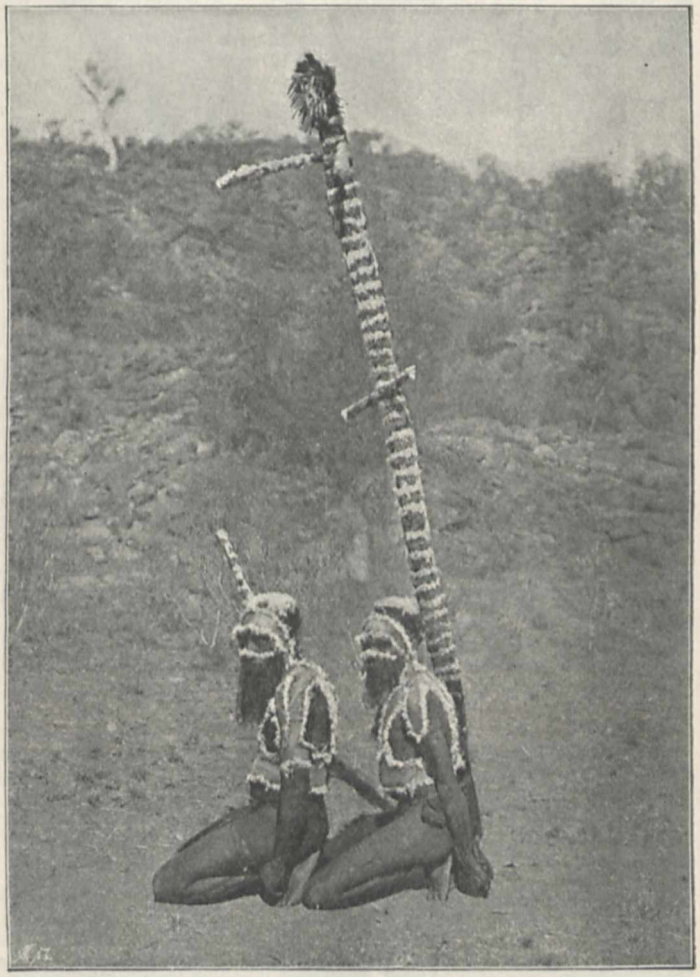


FIG. 1.—Iruntarinia ceremony of the Unjiamba Totem to illustrate one form of Nurtunja; the small cross pieces represent pointing sticks.

[1] "The Native Tribes of Central Australia." By Prof. B. Spencer and F. G. Gillen. Pp. xx + 671. (London: Macmillan and Co., Ltd., 1899.)

line has preceded the counting of it in the male line, and we are also shown good reason for excepting the statement that descent in the female line is necessarily a sign of primitiveness. Perhaps the divergences in the customs recorded of some of these Central Australian tribes may have a connection with the traditional wanderings of their Achilpa ancestors, concerning which we are provided with detailed accounts and maps of the routes followed. The fact, that the ancestors came from the south-west and south-east, and found themselves among already located peoples, looks as if the northern immigration having crossed Australia and reached the extreme confines of the continent had rolled back on its tracks. Every group of natives appears to have its local head man; this position he attains on account of his skill in hunting or fighting, or his knowledge of the ancient traditions of the tribe; such a man will consult the elders of his tribe, but the final disposition of all points rests in his hands: no stranger will enter the camp without his permission; should he have no son to succeed him he appears to have the power to nominate the individual he desires to be his successor—in other words he is in a primitive fashion chief of his group. On the other hand, the natives do not appear to have arrived at that state where a chief of a tribe becomes a necessity. We are glad to see the authors take a stand against the common assertion that the Australian aboriginal is degenerate; no assertion can be wider the mark, for we have no evidence to show that the Australian was ever in a higher state of civilisation than that in which he is now found.

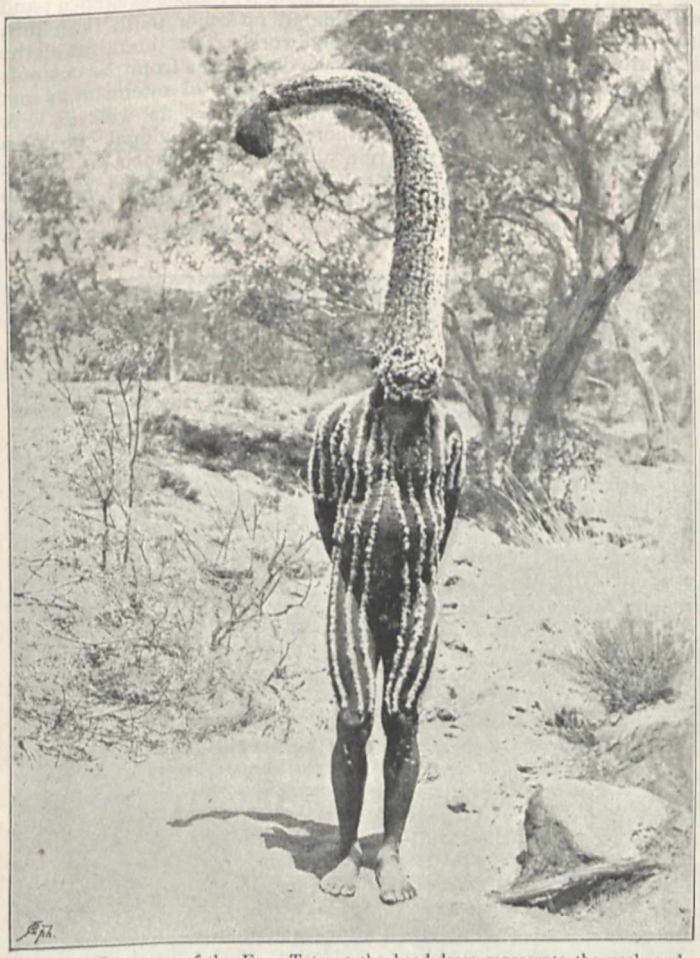


FIG. 2.—Ceremony of the Emu Totem; the head-dress represents the neck and head of an emu.

FIG. 3.—Kurdaitcha creeping up to his enemy. Between his teeth he holds a small stone Churinga; the shoes are seen on his feet, and in his left hand he holds a shield and two or three wooden Churinga.

The book, suitably dedicated to the founders of Australian anthropology, is a solid piece of work of altogether exceptional merit. In the above remarks we have only been able to point out a few of its more salient features; but there is a mass of information we have not touched upon, and which will gladden the heart of the anthropological student. The excellent illustrations of the ceremonies, evidently obtained with much care, patience and difficulty, are of considerable assistance to the text; the glossary fulfils its purpose, and the index is good.

HY. LING ROTH.

SIR DOUGLAS GALTON, K.C.B., F.R.S.

SIR DOUGLAS GALTON, whose death we regret to have to record, was for many years one of the best-known men not only in scientific circles but also in many walks of life. He was born in 1822, educated at Rugby, and entered the Royal Military Academy at the age of fifteen; here he had a most distinguished career, and obtained his commission in the Royal Engineers in 1840, taking a first prize in every subject of the examination.

He entered public life in 1847 as secretary to the Commission that investigated the application of iron to railway structures, and soon afterwards became an inspector of railways and secretary of the railway department of the Board of Trade. This position he resigned in 1860, but his knowledge of railway matters led to his still carrying out a good deal of important work in connection with railways. Perhaps the most important of these was a series of experiments for testing automatic brakes, carried out in 1878 and 1879. The results of these experiments were brought by him before the Institution of Mechanical Engineers in a series of papers, which have ever since ranked among the standard works of reference for engineers.

He also rendered most important services to submarine telegraphy, acting as chairman of a Committee appointed by the Government to investigate the reasons for the failure of the Atlantic cable of 1858, and the Red Sea and Indian cable; the report of this Committee, issued in 1861, is recognised as the "most valuable collection of facts, warnings and evidence ever compiled concerning submarine cables."

In 1860 he was appointed Assistant-Inspector-General of Fortifications, and two years later he became Assistant-Under-Secretary of State for War. After his retirement from this post he became Director of Works and Public Buildings in Her Majesty's Office of Works, an appointment which he held until 1875.

He was for twenty-five years General Secretary of the British Association, and this fact alone should win for him the gratitude of scientific men; and he only resigned that post to be appointed President in 1895. But sanitary matters especially attracted his attention. As Captain Galton he invented the grate which still goes by his name, and which introduced a new idea. He never patented this invention, so it was to no one's interest to push it; had it not been for this state of things, there is no doubt that it would long ago have come into general use, and would probably have brought a large fortune to its inventor.

He was connected with all the great sanitary undertakings of the last forty years or more. Whether it was the main drainage of the metropolis, or the improvement of the health of the army, or the training of sanitary inspectors, Sir Douglas Galton was always to the fore; in fact, no scheme connected with sanitary improvement has for many years past been considered complete without his co-operation. He strongly opposed the scheme of the Metropolitan Board of Works by which the sewage of London was discharged into the river at Barking and Crossness, urging that a nuisance would be created by it, and that it should be taken down as far as Sea Reach in order to be diluted with a much larger volume of water. The result amply justified his anticipations, and showed the correctness of his judgment.

He was one of the early supporters of the Parkes Museum, and also the leading spirit of the Sanitary Institute, of the Council of which he was chairman for the second time at his death; but to enumerate the positions he filled, and filled with distinction, would take up too much space.

He was elected an Honorary Member of the Institution of Civil Engineers in 1850, and a Fellow of the Royal Society in 1859, and received the honorary degrees of D.C.L. from the University of Oxford, and LL.D. from Durham and from Montreal. He was made a C.B. in 1865, and a K.C.B. in 1887.

Personally he was a kindly and genial man who made many friends, and few, if any, enemies, and his "amiable personality," a phrase happily applied to him by one of the foreign delegates of the International Congress of Hygiene and Demography in 1891, of the executive committee of which he was chairman, will be much missed.

W. H. C.

PROFESSOR OTHNIEL CHARLES MARSH.

JUST within a period of two years the United States has lost two of its most distinguished palæontologists, Cope having passed away on April 12, 1897, while the death of Marsh is announced to have taken place on the 18th of March of the present year. The two names have been associated (not always, unfortunately, in the most amicable manner) in connection with the marvellous discoveries of strange and gigantic creatures which have rendered the last five-and-twenty years unique in the history of palæontology; and it may be regarded as certain that none of their successors, however able they may be, will ever attain the world-wide celebrity accorded to these distinguished workers. For as Owen and Huxley are the two English biologists whose names have become household words, so Marsh and Cope are the popular representatives of Trans-Atlantic palæontological investigation.

Marsh, who was considerably the elder of the two, was the more familiarly known in England, from his custom of making periodical visits to Europe at comparatively short intervals. His last visit was to the Zoological Congress held at Cambridge during the past summer; and all those who then saw him could scarcely fail to notice that the hand of death had already made its grip on the once stalwart frame.

According to the information at present available to us, it appears that Marsh was sixty-eight years of age at the time of his decease. Born in the States, he received a large portion of his education at Yale; but he also studied geology and palæontology at various continental seats of learning, such as Berlin, Breslau, and Heidelberg, thus acquiring a wide basis of knowledge which stood him in good stead in after years. He was appointed to the chair of Palæontology in the University of Yale in the year 1866; and this important post he held till his death. For many years he was also palæontologist in charge to the U.S. Geological Survey, at first under Clarence King and then J. W. Powell; but of his subsequent relations to that department we are not fully aware. Marsh possessed the University degrees of Ph.D., LL.D., and M.A.; and his great attainments were recognised by his affiliation to many European scientific bodies. In this country, he was a Fellow of the Geological Society, having been elected as far back as 1863, and in 1877 having received the first award of the then newly-founded Bigsby Medal. In 1881 he was elected a Corresponding Member of the Zoological Society of London; and he was likewise on the roll of the British Association, whose meetings he on several occasions attended. A nephew, we believe, of the late George Peabody, Marsh was a man of considerable, if not large fortune; and to this circumstance is partly owing the vast extent of the collections he succeeded in accumulating.

Prout's discovery in 1846 in the Miocene strata of Western America of remains belonging to the animals now known as *Titanotherium* was the commencement of the investigations which made celebrated the names of Leidy, Cope, and Marsh. But it was not till 1869 that the older beds on the western flanks of the Rocky Mountains were explored, and the Eocene mammals of America thus brought to light. It was in this year that the explorations in the neighbourhood of Fort Bridger at the base of the Uinta Mountains were commenced; and it was from this district that the Uinta, Bridger, Wasatch, and Wind River beds received their names. The first worker in this field of research was Leidy, whose labours were mainly confined to the fauna of the higher Tertiary beds of the "Mauvaises Terres" to the east of the Rocky Mountains. By 1862, in which year appeared his paper on *Eosaurus* from the Carboniferous of Nova Scotia, Marsh was, however, well to the fore as a working palæontologist, and shortly after the opening-up of the Fort Bridger district as a fossiliferous locality he was almost at the zenith of his fame; the year 1872 being notable as the one in which the now well-known names *Ichthyornis* and *Hesperornis* were applied to the toothed birds of the Kansas Cretaceous. Some idea of the rapidity with which specimens were collected and described may be gathered from the fact that between the years 1862 and 1879 Marsh proposed no less than 134 new generic terms for the fossils he accumulated and described. That many of these names subsequently turned out to be synonyms, in no way detracts from the energetic character of his labours. For it must be remembered that between 1869

and 1879 he was making known not only the Uintatheres (his so-called Dinocerata) of the Eocene of the Western States, but likewise the huge Jurassic Dinosaurs like *Brontosaurus* and *Atlantosaurus*, as well as the Toothed Cretaceous birds of Kansas. It was during this period, too, that the world was excited by his discovery of the pedigree of the horse, which fortunately came just when an actual example was urgently needed to solidify the foundations of the evolutionary hypothesis.

On this side of the Atlantic we are, perhaps, too apt to regard Marsh in the light of what used to be called a closet naturalist. But he was in reality a courageous and intrepid explorer, who between the years 1869 and 1888 is stated to have crossed the Rocky Mountains no less than twenty-one times. And in the early days of his explorations, before the opening-up of the country by railways, such expeditions contained no slight elements of danger. Not only were there difficulties of the road and inclemencies of climate with which to contend, but hostile Indians were often on his track; and we have heard from the explorer's own lips accounts of some of the perils to which he has been exposed on trips of this description.

We have said that it was between 1869 and 1879 that the great bulk of the early descriptive palæontological work of Marsh took place; and by the latter date he had leisure to undertake more elaborate and detailed memoirs. Accordingly, we find the quarto monograph on "Odontornithes" making its appearance in 1880, and that on "Dinocerata" four years later. We believe that similar monographs on the Titanotheres and Dinosaurs were in contemplation, and the plates for them prepared; but for some reason, into which we need not inquire, these were never issued. A smaller memoir on the last-named group was, however, published in 1896. Whatever may be the final judgment as to the value of the literary matter in the two quarto memoirs, the beauty and exactness of their exquisite illustrations will render them of permanent value.

Twenty years after the discovery of the Bridger and Uinta beds—that is to say, in 1889—Marsh was able to announce the discovery of numerous remains of Cretaceous Mammals in the Laramie formation of Dakota and Montana. And although he was not absolutely the first to make the discovery, the number of specimens he obtained first put the occurrence of mammals in these beds on a firm footing. About this time he was also engaged in making known the gigantic Horned Dinosaurs of the Laramie, whose huge bulk and uncouth forms made them even more marvellous than their predecessors of the Jurassic.

And here it may be mentioned that Marsh by no means confined his investigations to palæontology, frequently entering upon questions of the age of strata. A remarkable instance of this is a paper urging that the British Wealden strata should be regarded as of Upper Jurassic rather than of Lower Cretaceous age; a communication which, we think, has scarcely received all the attention that it deserves at the hands of European workers.

What will be the final verdict in regard to Marsh's life-work, it is too early to attempt to forecast. As a collector and explorer he had great and unrivalled opportunities; and in this part of his task, at least, he rose fully to the occasion. He saw his opportunity of making a great name, and he took it. And yet, perhaps, this is scarcely a fair way of putting it, for there is little doubt that Marsh had a strong and innate love for his work, which would have led him to be a palæontologist under any circumstances.

Being a man of great determination and strength of will, he, like many others of the same turn of mind, could ill brook contradiction; and he was accordingly somewhat too apt to insist on his own views and hypotheses long after they had been proved incorrect or untenable. And it was probably this impatience of contradiction and correction that at times led him to mistake reiterated and dogmatic assertion of refuted statements for logical argument. That Marsh is entitled to claim a place in the very front rank of scientific workers is not likely to be urged; and there are, in truth, no grand and enduring generalisations associated with his name. At the same time, to paraphrase the words of the donors of the Bigsby and Lyell medals, he is undoubtedly one who has been of the most eminent service to palæontology, and has, therefore, deserved well of the science.

Allusion has already been made incidentally to certain acrimonious feelings connected with his work on the other side of the Atlantic. May we venture to hope that in the future his co-labourers and successors in America will endeavour to dwell on his merits rather than on his failings, and to remember that the time-honoured motto, "*De mortuis nil nisi bonum*," has not yet been superseded. R. L.

WIRELESS TELEGRAPHY BETWEEN FRANCE AND ENGLAND.

MR. MARCONI is to be cordially congratulated upon the success which has attended his latest experiments in telegraphy without intervening wires. For several months he has been actively engaged in establishing communication by means of his apparatus between stations several miles apart. He has gradually increased the distance between the stations, and has now succeeded in exchanging messages across the Channel. The *Times* of yesterday prints the following message transmitted by wireless telegraphy from France, and the communication possesses particular interest on account of the fact that it is the first press message sent across the Channel by the wireless telegraph system.

"*Wimreux*, March 28.

"Communication between England and the Continent was set up yesterday morning by the Marconi system of wireless telegraphy. The points between which the experiments are being conducted are South Foreland and Wimreux, a village on the French coast, two miles north of Boulogne, where a vertical standard wire, 150 feet high, has been set up. The distance is thirty-two miles. The experiments are being carried on in the Morse code. Signor Marconi is here conducting the trials, and is very well satisfied with the results obtained.

"This message has been transmitted by the Marconi system from Wimreux to the Foreland."

The Dover correspondent of the *Times* states that this and other messages were received and read at the South Foreland station with as much distinctness as though the termini had been connected with wires. This is a very remarkable achievement, and one that will to some extent compensate Mr. Marconi for the trouble he has taken to bring his apparatus to that state of perfection which has led to such gratifying success. The practical value of a system of telegraphy which enables messages to be exchanged across the Channel without the use of connecting wires cannot be overestimated.

The experiments were conducted by Mr. Marconi in the presence of Colonel du Pontavice, French military attaché, and Commandant Fiéron, naval attaché in London; Captain Ferrier, representing the French Government, and M. Voisenat, of the French telegraph service. The results obtained have placed the efficiency of Mr. Marconi's instruments beyond doubt, and we may hope soon to see the establishment of a regular system of communication with the continent by means of telegraphy without connecting wires.

NOTES.

THE meeting of the International Geological Congress, which is to be held in Paris in 1900 (August 16 to 28), promises to be one of exceptional interest and success. It takes place at a time when a grand universal exhibition will attract many men of science from all countries. It represents a science of progressive character, which deals not only with the history of the earth and of the life which has existed, but furnishes the basis for geographical study, lends aid in art and manufactures, and is of essential importance in mining, agriculture, and hydrology. Subjects such as these draw men together irrespective of their nationality, and form bonds of union which political differences cannot rend asunder. The Committee of Organisation is constituted as follows: President, M. Albert Gaudry, Professor in the Museum of Natural History; Vice-Presidents, MM. Michel Lévy and Marcel Bertrand; General Secretary, M. Charles Barrois. The excursions which have been planned to follow the ordinary meeting number no less than nineteen, and they are so arranged that every important district in France and along its borders, and all formations of particular geological interest will be visited. Among the districts are the Paris Basin, the Boulonnais, Normandy, the Ardennes, Picardy, Brittany, Touraine, Dordogne, the Alps and Mount Blanc, Bordeaux, and the Pyrenees.

WE regret to see the announcement of the death of Prof. Gustav Wiedemann, professor of physics in the University of Vienna, at seventy-three years of age.

THE death is announced of M. Naudin, member of the section of botany of the Paris Academy of Sciences, at eighty-three years of age; and of Dr. Franz Ritter von Hauer, the distinguished geologist, at Vienna, at seventy-seven years of age.

AT a meeting on Monday of the Royal College of Physicians of London, Dr. William Selby Church, senior physician to St. Bartholomew's Hospital, was elected the president of the college.

SCIENTIFIC visitors to Paris at Easter will be interested to know that the Société Français de Physique will hold its annual exhibition of new apparatus and experiments on Friday and Saturday, April 7 and 8. The exhibition will be held in the rooms of the Society, 44 rue de Rennes.

THE French Minister of Public Instruction will preside at the closing meeting of the thirty-seventh Congrès de Sociétés savantes on April 8. The Congress opens at Toulouse, on April 4. The Toulouse Geographical Society has organised in connection with the Congress an exhibition of apparatus for the decimal measurement of time and angles.

A REPORT by Prof. T. E. Thorpe, F.R.S., Principal of the Government Laboratory, and Prof. Thomas Oliver, physician to the Royal Infirmary, Newcastle-upon-Tyne, concerning the employment of components of lead in the manufacture of pottery, and their influence upon the health of the workpeople engaged in that industry, has been issued as a Blue Book.

AT the last meeting of the Institution of Mechanical Engineers Mr. Arthur T. Walker, a member of the Council of the Iron and Steel Institute, was elected a vice-president in succession to the late Sir Douglas Galton.

THE *British Medical Journal* announces that Dr. T. Grigor Brodie, at present lecturer on physiology at St. Thomas's Hospital Medical School, has been nominated by the laboratories committee of the Royal Colleges of Physicians and Surgeons to be director of the research laboratories on the Thames Embankment.

AT Monday's meeting of the Royal Geographical Society the President made the gratifying announcement that Mr. L. W. Longstaff, a Fellow of the Society, had subscribed the sum of 25,000*l.* to the fund for the scientific exploration of the Antarctic regions. A vote of thanks to Mr. Longstaff for his munificent gift, proposed by Sir Clements Markham, was seconded by Lord Lister, and enthusiastically carried. This generous donation brings the fund at the disposal of the Joint Antarctic Committee up to 40,000*l.*, which is sufficient to ensure our co-operation with Germany in 1900, but is not enough to enable the expedition to be carried out on a scale worthy of our country. It is to be hoped that the example set by Mr. Longstaff will be followed by others who think that England should take the first place in Antarctic exploration, and are in a position to enable her to do so.

IT is announced that the Russian expedition for taking meridian measurements in Spitsbergen will leave St. Petersburg on May 1. Two steamers have been placed at the disposal of the expedition by the Russian Ministries of Marine and Ways and Communications, and the Minister of Finance has granted 50,000 roubles for two years. M. Bjalinizki, the zoologist, and Dr. Bunge, the Polar explorer, will accompany the expedition, which will be under the leadership of Staff-Captain Sergievski.

THE fortieth meeting of the Institution of Naval Architects was held in London on Wednesday, Thursday and Friday of last week, the Earl of Hopetoun, president of the Institution, presiding. The annual report, read at Wednesday's meeting, states that the Council have had for some time under consideration the rules for the election of members and associates. Following the example of the Institution of Civil Engineers and of the Mechanical Engineers, they proposed that a new class should be introduced, to be called associate members, who would consist mainly of young men fully trained, but not yet holding positions of importance. The candidates must have served a four years' apprenticeship to a naval architect and shipbuilder, or must have had four years' training in a recognised naval college. This change in the rules was adopted by the meeting. The new rules will not come into force until Friday, March 24, 1900. A gold medal was presented to Prof. Captain Kriloff, for his papers on "The general theory of the oscillations of a ship on waves" and "On stresses experienced by a ship in a seaway"; and also one to Prof. Hele-Shaw, for his two papers describing his "Investigation of the nature of surface resistance of water and of streamline motion under certain experimental conditions." The annual dinner of the Institution was held at the Hotel Cecil on Wednesday evening, March 22.

REFERENCE has already been made to the new scheme for the Physic Garden at Chelsea. It is now definitely announced that the garden has been handed over to the Trustees of the London Parochial Charities, who have agreed to dedicate a sum of 800*l.* yearly to its maintenance. Under the new scheme the garden is to be administered exclusively for the promotion of the study of botany with especial reference to the requirements of general education, scientific instruction, and research in botany, including vegetable physiology, and instruction in technical pharmacology as far as the culture of medical plants is concerned. The practical management of the garden will be vested in a committee formed of representatives nominated by the Trustees of the London Parochial Charities, the Treasury, the Lord President of the Council, the Technical Education Board, the Royal Society, the Royal College of Physicians, the Society of Apothecaries, the Pharmaceutical Society, the London County Council, and the Senate of the University of London. Earl Cadogan and his successors, as representing Sir Hans Sloane, who conveyed the garden in 1722 to the Apothecaries'

Company in trust for the encouragement of botany, is also a member of the committee.

THE following are the lecture arrangements after Easter at the Royal Institution :—Prof. J. Cossar Ewart, three lectures on zebras and zebra hybrids; Prof. Silvanus P. Thompson, two lectures on electric eddy-currents (the Tyndall Lectures); Prof. W. J. Sollas, three lectures on geology; Prof. Dewar, three lectures on the atmosphere; Mr. Lewis F. Day, three lectures on embroidery; Prof. L. C. Miall, two lectures on water weeds; Mr. Louis Dyer, three lectures on Machiavelli; Mr. W. L. Brown, two lectures on to Iceland in search of health; Mr. Edgar F. Jacques, three lectures on the music of India and the East, and its influence on the music of Europe (with musical illustrations). The Friday evening meetings will be resumed on April 14, when a discourse will be delivered by Prof. A. W. Rücker on earth currents and electric traction. Succeeding discourses will probably be given by Dr. F. W. Mott, Prof. C. A. Carus Wilson, Dr. W. J. Russell, Prof. T. Preston, the Right Rev. the Lord Bishop of Bristol, Sir William Martin Conway, Mr. H. G. Wells, and others.

WE are glad to be able to announce that with March 1 the Administration of Telegraphs of Mexico have commenced the publication of daily weather charts, showing for 8h. a.m., Washington time, the state of the barometer, thermometer, and weather over that extensive country. Stations have been established in thirty-five localities, and these are augmented by a few voluntary observers. The service is organised on the principle of that of the Weather Bureau of Washington, and the system has been established primarily to meet the requirements of the Telegraph Administration, and, in the second place, to supply the Mexican Meteorological Observatory with trustworthy information. Weather forecasts are not yet issued, but no doubt the meteorological authorities will be glad to make good use of the opportunities offered. The charts are published in a new paper entitled *Boletin Telegráfico*.

IN the current number of the *Revue Générale des Sciences*, there is an interesting note on ceramic novelties, recording results of experiments promoted by the Society for the Encouragement of National Industry towards the solution of certain problems of pressing importance in the pottery industry. Under the title of "Atelier de Glatigny, Études et Notes No 1, Imprimeries Cerf à Versailles," M. Glatigny, a practical potter of repute, sets forth the lines of scientific and artistic thought that have found expression in his work. There is no attempt made to deduce general rules applicable to every branch of the trade, but a faithful record of actual experiments definitely and rigorously carried out. In a word, it is the record of an attempt to replace empiricism by careful scientific work, and as such it ought to be of especial service in this country, where rule-of-thumb still holds absolute sway. The chief points treated are: the influence of the atmosphere of the kiln on the colours produced by well-known colouring oxides; the influence of different ingredients on the dilatibility of body and glaze—a matter of the utmost importance to English potters, as one of the chief faults of their wares, the crazing of the glaze, is profoundly influenced by these factors; and, finally, the production of certain new pastes of the porcelain and stoneware type by the addition of substances such as powdered glass, oxide of zinc, magnesia, &c., to the substances commonly used for pottery pastes. One longs for the time when English potters shall publish the results of their labours in this way.

A DEPUTATION of representatives from the Decimal Association, chambers of commerce, educational institutions, and trade unions, waited upon Mr. Ritchie on Wednesday, March 22, at the House of Commons to urge upon the Government the compulsory adoption of the metric system of weights and measures on January 1, 1901. Several of the delegates described the advantages which metric system possesses, reference being made to the great waste of time involved in teaching our complicated system of arithmetic, and the loss of trade resulting from the use of a system not understood by other nations. In reply, Mr. Ritchie expressed himself in agreement with the arguments in favour of the metric system, but stated that his own view, and that of his colleagues, was that chaos and confusion would be created by the compulsory adoption of the metric system in this country, and it would be practically impossible to carry out a compulsory law on the subject. They had not only passed a law two years ago to make the metric system legal, but they had also added to their Board of Trade standards the standards for the metric system, and only seventeen of the whole of the local authorities in the country had come to verify their standards. It would be much better, if the chambers of commerce desired this system to be compulsory, that they should endeavour to popularise the system by putting it in practice. Certainly it would be an immense advantage to our export trade, and now that our merchants and manufacturers were alive to the disadvantages of the non-adoption of the new system they should do something in the way of adopting it. He had been in communication with other Government departments with the view of having it adopted compulsorily, and it was now under consideration.

DR. MARTIN FICKER, in a paper communicated to the *Zeitschrift für Hygiène*, describes an elaborate series of investigations he has made on some of the conditions affecting the vitality of certain pathogenic bacteria, especially those of cholera in artificial surroundings. To the student this paper is of importance, inasmuch as it at once indicates the spirit in which bacteriological research should be approached, and the pitfalls which beset the path of the unwary at every turn. The sense of dissatisfaction which surrounds a good deal of the work done with bacteria is due to the discrepancy which occurs in the results chronicled by different authors, and sometimes by one and the same author in the same subject. These discrepancies Dr. Ficker has sought to diminish in the future by pointing out some at least of the sources of error in such work, by calling attention to the importance of factors which are only too frequently overlooked. The memoir covers over seventy pages, and it is impossible to deal here with the numerous minute details which have been investigated by the author. Perhaps the most novel and interesting of the questions discussed is the influence exercised on bacteria by glass of different kinds in the vessels employed for their observation, a subject already dealt with in other connections by various investigators. As regards the degree of alkalinity imparted to water by glass of different origin, very wide divergence has been observed; and inasmuch as some bacteria, and notably those of cholera, are favourably affected by the alkalinity of their surroundings, this factor would certainly appear to be of importance. Various samples of glass were investigated in this connection, and marked differences were noted in the behaviour of cholera germs suspended in water in vessels of so-called Jena and other glass. Dr. Ficker's paper serves to emphasise once more how what superficially may appear to be inconsiderable trifles in detail, may be of supreme importance in determining the successful or otherwise management of bacteria.

THE stability of motion of a bicycle is a problem of the greatest interest, both practical and mathematical, which has too long remained unattacked. We are glad to see that Mr. F. J. W. Whipple, of Trinity College, Cambridge, has at last investigated this problem, and has been successful in obtaining

conclusions of a practical kind. One of the most interesting points which had to be worked out was the condition that a machine could be ridden without holding the handles. Mr. Whipple finds that there are four critical velocities connected with the stability of the motion, which he calls V_1, V_2, V_3, and V_4. For velocities greater than V_1 the motion is unstable, but may be rendered stable by a rider who turns the first wheel towards the side on which he is falling, or moves his body away from that side. The force he has to exert in the former operation is comparatively great, whereas the distance he has to move his body in the latter case is small. For velocities between V_1 and V_2 the motion is stable, even when the rider does not move his body and makes no use of the handles. For velocities less than V_2 the motion without hands is unstable, but between V_2 and V_3 it is stable for a rider who moves his body through a very small distance in the same direction as the fall is carrying him. This distance is about 1/20 of the distance he is moved by the swaying of the machine. For velocities between V_2 and V_4 the motion is stable for a rider who keeps the motion of the handles as small as possible. For velocities below V_4 a rider who combines the two methods, using both his weight and his hands, may be successful. The balance for such low velocities is not automatic, but is a feat which requires conscious attention. Mr. Whipple, considering a typical machine, obtains the following values in miles per hour: $V_1 = 12{\cdot}2$, $V_2 = 10{\cdot}4$, $V_3 = 8{\cdot}5$, $V_4 = 7{\cdot}4$. He considers that practically V_2 is the most important factor in determining the ease of riding, but unfortunately its calculation for any given machine is not easy. In connection with the effects of spinning friction, it is pointed out that a well-inflated tyre is conducive to stability. Mr. Whipple's paper appears in the *Quarterly Journal* of Pure and Applied Mathematics for March.

A NEW method of photographing in natural colours is reported by *Science* to have been discovered by Prof. R. W. Wood, of the University of Wisconsin. The colours are said to be obtained by diffraction; and, though at present the production of the first finished picture is somewhat tedious, duplicates can be printed as easily as ordinary photographs are made. The pictures are on glass, and are not only colourless, but almost invisible when viewed in ordinary lights; but when placed in a viewing apparatus, consisting of a convex lens on a light frame, show the colours of nature with great brilliancy. The principle is that the picture and the lens form spectra which overlap, and the eye placed in the overlapping portion sees the different portions of the picture in colour depending on the distance between the grating lines at that place. Prof. Wood says the finished picture is a transparent film of gelatine with very fine lines on it, about 2000 to the inch on the average. The colours depend solely on the spacing between the lines, and are pure spectrum colours, or mixtures of such, the necessity of coloured screens or pigments, used in all other processes except that of Lippmann, having been overcome. The pictures can be projected on a screen by employing a suitable lantern, or can be viewed individually with a very simple piece of apparatus consisting of a lens and perforated screen mounted on a frame. It is difficult to form an opinion upon the method or results from the information so far available, and we hope that further details will soon be published.

IT is well known that aneroids are not to be depended upon for the determination of altitudes. When an aneroid and a mercurial barometer are subjected to a diminishing pressure, brought about either by increase of altitude or experimentally by means of an air-pump, it is found to indicate a lower reading than that shown by the mercurial barometer. The lower the pressure, and the greater the length of time the diminution of pressure is experienced, the greater is the loss in any individual aneroid. As the extent of the loss of an aneroid subjected to diminished pressure depends upon the length of time during which the instrument is exposed to this pressure, evidently a way to remedy the defect is to obtain an instrument which can be put in action when required to make a determination of pressure, and put out of gear or thrown out of action when not wanted for use. An aneroid which fulfils these conditions has been invented by Colonel H. Watkin, C.B., and is manufactured by Mr. James J. Hicks. The instrument has precisely the same appearance as an ordinary aneroid, and the only addition is a fly-nut at the back, by means of which the vacuum-box can be put in action when a reading is required. This aneroid has been reported upon favourably by Mr. Whymper and other travellers, and it is certainly an advance upon the ordinary instrument. When the instrument is in action a line on the ring, to which the fly-nut is fastened, coincides with an arrow upon the case. This, we think, admits of improvement, for the coincidence cannot be very accurately determined. In taking readings before and after putting the instrument out of action, we found a slight difference on each occasion, which may perhaps be due to the difficulty in bringing the ring back to the same point.

FROM the *Journal* of the Franklin Institute we learn that the Elliott Cresson gold medal has been awarded to Mr. Clemens Herschel, and John Scott legacy premiums and medals to Messrs. Frederick N. Connet and Walter W. Jackson for their joint invention of the Venturi meter, an apparatus designed for measuring the flow of liquids in pipes of any desired dimensions up to 60 inches or more in diameter. The Venturi proper, invented by Mr. Herschel, consists essentially of a tube containing a constriction through which the water has to flow, and by measuring the difference of pressure between the wider and narrower parts, the rate of flow of the liquid can be calculated by well-known formulæ. The two last-named inventors have devised the elaborate registering apparatus driven by clockwork, whereby the indications of the piezometer are made to give a record of the total quantity of water flowing through the pipe by a species of mechanical integration or "quadrature."

THE fifth edition of the *Naturalist's Directory* for 1899, published by Mr. L. Upcott Gill, is to hand. It contains the names, addresses, and specialities of several thousand field naturalists, as well as curators of museums and professors and lecturers on natural science. The zoologists alone occupy seventy-two pages, and a rough statistical tabulation of a few pages, selected at random, shows that ornithology and lepidoptera head the list, the numbers of specialists in each of these being more than double of that in any other department; ornithology and oology when added together have the majority. Mollusca, malacology and conchology, when combined, come next in point of numbers, entomology (in general) next, and coleoptera next again. Although the other orders of insects and the other branches of zoology are mostly represented, their devotees fall greatly behind those of the afore-mentioned subjects. Microscopy occupies twelve pages, and shows a large preponderance of specialists in pond life and vegetable physiology. Diatoms and foraminifera come next, but a long way behind, in popularity; and after these, bacteria, marine zoology, biology, photo-micrography, and micro-entomology divide the favours about equally. In botany, which occupies fifteen pages, phanerogams, as might be expected, have an overwhelming majority; while among cryptogams, mosses and hepaticæ appear to be most popular. Geology and palæontology extend over thirteen pages. In addition the volume contains a trade directory, a list of societies, field clubs and museums, from the Royal Society and British Museum downwards, and a list of books of the year

on natural science. The long list of names in the *Naturalist's Directory* reassures us that field natural history of the good old sort still holds its own in the matter of popularity, despite the conflicting claims of laboratory science on the one hand, and photography and bicycling on the other.

Cosmos for February 25 contains an illustrated article on Volta's discovery of the cell which bears his name, and on the exhibition to be held at Como in commemoration of the centenary of the discovery.

THE *Revue scientifique* for February 25 contains an account of a paper read before the French Association for the Advancement of Science by M. Armand Viré, on the peculiar cœcal fauna of the caves of the Jura and the Pyrenees. From it we learn that a subterranean laboratory for studying the modifications in the tactile and other organs of animals produced by darkness has been opened in the catacombs of the Jardin des Plantes at Paris, under the direction of Prof. Alphonse Milne-Edwards, and interesting results have already been obtained.

A NEW American botanical journal was started with the commencement of the current year, under the title of *Rhodora*. It is edited by Dr. B. L. Robinson, of the Gray Herbarium, Harvard University, and is brought out under the auspices of the New England Botanical Club.

SOME attention has been recently directed to the qualities of rhea or ramie-fibre (*Boehmeria nivea*) as a material for textile fabrics. In the *Agricultural Gazette* of New South Wales for November 1898, Mr. H. N. Jackson advocates its growth for commercial purposes in that Colony.

WE have received *Bulletins* Nos. 12–14 of the Geological and Geographical Commission of São Paulo, Brazil, entirely devoted to the botany of the district, and comprising monographs of the orders Compositæ, Solanaceæ, Scrophulariaceæ, Campanulaceæ, Cucurbitaceæ, Calyceraceæ, and Valerianaceæ. The diagnoses of the species, and even the characters in the claves to the genera, being entirely in Spanish, and not in Latin, renders it difficult to estimate the scientific value of the work, and at all events detracts from its usefulness.

A CATALOGUE of valuable works on many branches of science, and including the *Transactions* of a number of learned societies, has been issued by Mr. B. Quaritch, who offers the works for sale.

MESSRS. WILLIAM WESLEY AND SON have issued a new number of their "Natural History and Scientific Book Circular," containing a classified catalogue of nearly two thousand books and pamphlets on geology, including works from the libraries of the late Mr. W. Topley and Mr. Richard Meade.

THE *Transactions* of the Leicester Literary and Philosophical Society (vol. v. part iii., January 1899) contain a presidential address delivered by Mr. A. Colson on electricity and its uses, and papers on ovules, by the Rev. T. A. Preston, and on the structure and life-history of the cockroach, by Mr. W. J. Hall.

AMONG the lectures to be given during April at the Royal Victoria Hall, on Tuesday evenings at 8.30, are the following:—April 4 (Easter Tuesday): Mr. W. H. Shrubsole, on "Switzerland, past, present, and future." April 11: Mr. F. W. Rudler, on "The Geology of London." April 18: Prof. Lloyd Morgan, on "Instinct and Intelligence in Animals."

THE fifth volume of the *Annales du Bureau des Longitudes* (Gauthier-Villars et Fils), which is dated 1897, but has only recently come to hand, contains several memoirs of interest. The first of these consists of a very complete account of the work done in determining the differences of longitude between San Fernando, Santa Cruz de Tenerife, Saint-Louis, and Dakar, besides a set of measures for determining the value of *g*, by Messrs. Bouquet de la Grye, Cecilio Pujazon, and Driencourt. This mission, it may be remembered, commenced its work in the year 1885, and was supplied with an excellent set of instruments. In the succeeding memoir, M. Bigourdan reports on the astronomical, physical and meteorological observations made at the camp at Joal (Senegal) during the total eclipse of the sun on April 18, 1893. The report contains a full account of the measurements for determining the position of the station, besides numerous tables and diagrams of the meteorological observations. From the astrophysical point of view the next report, by M. Deslandres, on his observations of the same eclipse is, perhaps, of more interest. M. Deslandres' equipment was chiefly spectroscopic, and he made great use of photography. In his report, he points out very clearly the necessity of such spectroscopic observations for settling and advancing certain questions relative to the solar atmosphere; and in Chapter iv. briefly summarises the history of hypotheses to explain the origin and different forms assumed by the corona. The memoir is accompanied by some fine heliogravures of the eclipse station and the corona. The last section of this volume is devoted to a report on the international conference on fundamental stars, which took place in 1896, including Dr. Gill's propositions for the values of astronomical constants.

IN the year 1896, although many observing parties went to several places along the line of totality from which the total solar eclipse of August could be observed, it turned out that, owing to extremely bad weather conditions, only those who went to Novaya Zemlya were fortunate enough in obtaining observations. The late Sir George Baden-Powell, it will be remembered, took a small party of English observers in his yacht to that region, and it was there also that a party of Russian observers had taken up their station. A very detailed account of the work done by this latter expedition has just come to hand, and it will be found in vol. viii. (No. 1) of the *Memoirs of the St. Petersbourg Imperial Academy of Sciences* (Physical Mathematical Class). In addition to the astronomical observations referred to in this volume, there are given descriptions of the surveys and collections made by the expedition to their station. The volume contains numerous beautiful illustrations of the eclipse station, groups, rock-formations, glaciers, together with numerous large scale maps of the region traversed. Unfortunately, the whole memoir is published in the Russian language, so its utility will to a great extent be restricted.

THE additions to the Zoological Society's Gardens during the past week include a Vervet Monkey (*Cercopithecus lalandii*), a Levaillant's Cynictis (*Cynictis penicillata*) from South Africa presented by Mr. J. E. Matcham; two Black-backed Jackals (*Canis mesomelas*) from South Africa, presented respectively by Mr. William Hare and the Trustees of the South African Museum; a Golden Agouti (*Dasyprocta aguti*) from South America, presented by Dr. G. L. Johnson; a Tawny Owl (*Syrnium aluco*), European, a Common Kestrel (*Tinnunculus alaudarius*), British, presented by Lady Evelyn Riddell; a White-tailed Eagle (*Haliaetus albicilla*) from Northern Asia, a Great Black-headed Gull (*Larus ichthyaëtus*) from Western Asia, presented by Dixon Bey; a Suricate (*Suricata tetradactyla*) from South Africa, deposited; two Coscoroba Swans (*Coscoroba candida*) from Antarctic America, a Long-tailed Duck (*Harelda glacialis*), North European, purchased; a Hybrid Macaque Monkey (between *Macacus cynomolgus*, ♂, and *Macacus rhesus*, ♀), a Crested Porcupine (*Hystrix cristata*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN APRIL :—

April 1. 14h. Saturn in conjunction with moon. Saturn 2° 16′ North.
5. Pallas in opposition to the sun.
7. 16h. 30m. Transit (ingress) of Jupiter's Sat. III.
13. Perihelion passage of Swift's comet (1899 *a*).
15. Venus. Illuminated portion of disc = 0·750. Apparent diameter = 14″·6.
Mars. Illuminated portion of disc = 0·900. Apparent diameter = 7″·5.
15. 11h. 26m. to 12h. 8m. Occultation of μ Geminorum (mag. 3·2) by the moon.
15. 12h. 35m. Minimum of Algol (β Persei).
17. 10h. 44m. to 11h. 8m. Occultation of 3 Cancri (mag. 6·0) by the moon
18. 9h. 24m. Minimum of Algol (β Persei).
19. 9h. 10m. to 10h. 14m. Occultation of *h* Leonis (mag. 5·4) by the moon.
20. Epoch of Lyrid meteoric shower (radiant 271° + 33°).
22. 11h. 12m. to 12h. 20m. Occultation of B.A.C. 4006 (mag. 5·7) by the moon.
24. Ceres in opposition to the sun.
25. 7h. Jupiter in opposition to the sun. At this time the planet will be about 1° from λ Virginis (mag. 4·6).
Polar diameter of Jupiter = 41″·2.
26. Ceres about ½° N. of ϕ Virginis (mag. 5).
26. 9h. 53m. to 11h. 1m. Occultation of B.A.C. 5023 (mag. 5·8) by the moon.
27. Predicted date of perihelion passage of Holmes's periodical comet (1892 III.).
28. 11h. 56m. to 13h. 6m. Occultation of θ Ophiuchi (mag. 3·4) by the moon.

The planet Jupiter will be well visible during the month, though his position is about 12 degrees south of the equator. The remarkable hollow in his great southern equatorial belt, and the remains of the famous red spot of 1878–81, may be observed on or very near the central meridian of the planet at the following times :—

	h.	m.		h.	m.
April 7	11	31	April 19	11	23
12	10	38	24	10	30
17	9	45	29	9	38

Saturn will be conspicuously displayed in the morning sky, and rises before midnight after the middle of the month. Considered as a telescopic object, however, his low position, nearly 22 degrees south of the equator, is a disadvantage, and will seldom allow the details of his surface to appear well defined.

ORBIT OF COMET 1896 III. (SWIFT).—Prof. R. G. Aitken, of the Lick Observatory, has collected all the observations of this comet that were available, and, after a thorough discussion, has made a definite determination of the orbit (*Ast. Nach.*, Bd. 148, Nos. 3550–51). The elements prove to be hyperbolic, and are as follows :—

T = 1896, April 17·6473143, G.M.T. ± 0·00057326d.

π = 179° 59′ 15″·40 ± 3″·95
Ω = 178 14 51·48 ± 6·74 } M. Eq. 1896·0
i = 55 34 24·69 ± 8·88
q = 0·5662857 ± 0·00001347.
e = 1·0004757 ± 0·00009985.

SATURN'S NINTH SATELLITE.—A few further particulars respecting Prof. W. H. Pickering's important discovery are now to hand. The instrument used was the new photographic doublet, 24 inches aperture and about 160 inches focus, which was presented to the Harvard College Observatory by Miss Catherine Bruce. Attempts have been made in previous years to find satellites by photography, but these turned out unsuccessful in consequence of the relatively low rapidity of the lens. Last summer, however, the attempt was again made at the Harvard Observatory at Arequipa, Peru, with this new extremely rapid lens. The four successful photographs were taken on the nights of August 16, 17 and 18, 1898, each plate being exposed for about two hours. The number of stars shown on a plate is estimated as 100,000.

In searching for the satellite two plates were placed film to film, so that each star was indicated by two dots. On the first two plates examined an isolated point was found near the planet. A similar isolated point was found on each of the other plates but in different positions with respect to the stars. The plates having been taken at an interval of two days, Saturn had moved in its orbit, and the images on the plates being found to have moved in the same direction, this furnishes strong evidence of the reality of their being due to a satellite and not to accidental defects of the plates. The new satellite is so faint that there is little possibility of its observation with any but the largest instruments.

MEASURING EXTREME TEMPERATURES.[1]

II.

Extension of the Range of the Gas-Thermometer.

THE methods of measurement so far considered are in a certain sense *arbitrary* in so far as they depend on extra, polation of empirical formulæ. If all these methods could be reduced by direct comparison to perfect agreement with each other, a definite scale of temperature would be attained to which all measurements could be referred, and which would leave nothing to be desired from a purely practical point of view. It is probable that this scale would not differ much from the theoretical or absolute scale of temperature. For theoretical investigations, however, without which no true scientific advance can be made, it is a matter of such fundamental importance to refer every measurement to the absolute scale, that no opportunity should be neglected of extending the possible range of accurate observation with the gas-thermometer, because this instrument affords at present the closest approximation to the absolute or theoretical scale. A consideration of the difficulties of the methods of gas-thermometry at present in use will lead naturally to the best methods of extending the range and accuracy of the instrument.

Defects of Bulb-Methods.

In the ordinary method of gas-thermometry a *bulb* containing the gas is exposed to the temperature to be measured, and the observation consists in determining either the expansion of volume or the increase of pressure of the gas. The principle is very similar to that of the ordinary liquid in glass thermometer, but the apparatus is more cumbrous and difficult to use on account of the necessity of observing both the volume and the pressure of the gas. This method is very accurate at moderate temperatures, but the difficulties increase very rapidly above 1000° C. Above 1200° C. it is doubtful whether such measurements are of any greater value than those obtained by extrapolation. Apart from the difficulty, which is common to nearly all methods at high temperatures, of maintaining a uniform and steady temperature, the bulb-method of gas thermometry is liable to the following special sources of error.

(1) Changes in volume of the bulb.
(2) Leakage and porosity.
(3) Occlusion or dissociation.

In order to investigate these sources of error a special form of porcelain air-thermometer (Fig. 3) was designed by the writer, and was constructed in Paris in December 1886, under the supervision of W. N. Shaw, F.R.S., of Emmanuel College, Cambridge. A figure and description of this instrument were published in the *Phil. Trans.* A., 1887. The same form has since been adopted by MM. Holborn and Wien in their experiments on the measurement of high temperatures at the Reichsanstalt. Thick tubes of 3 sq. mm. cross section, marked AC, BD in Fig. 3, were connected at each end of the cylindrical bulb BA. The length CD could be directly observed at any time with reading microscopes, and the linear expansion of the bulb could be deduced. The volume of the bulb could also be gauged at any time with air, and the mean temperatures of the separate portions AB, AC, BD, could be determined by means of platinum wires extending along the axis of the instrument. This was a most essential part of the apparatus, as the wires afforded a means of accurately reproducing any given set of conditions, and of testing the performance of the gas-thermometer at high temperatures in respect of all the various sources of error above mentioned. (1) It was observed that the volume of the bulb underwent continuous changes, chiefly in the direction of contraction, and that the shrinkage was not symmetrical, being apparently greater in the circumference than in the length of the cylinder. (2) To prevent leakage, and to close the pores of the material, it is

[1] Discourse delivered at the Royal Institution, on March 10, by Prof. H. L. Callendar, F.R.S. (Continued from p. 497.)

necessary to have the porcelain bulb glazed both inside and out. The glaze becomes sticky, and begins to run at a temperature below 1200° C., and the bulb begins to yield slightly and continuously to pressure above this point. (3) With some gases there appear to be slight traces of chemical action or occlusion of the gas by the walls of the bulb at high temperatures. It is for this reason preferable to use the inert gases nitrogen or argon as the thermometric material. In any case, the limit of high temperature measurement would be reached when either the gas, or the material of the bulb, began to dissociate or decompose. Deville and Troost, employing CO_2 for filling the porcelain bulb, found the temperature of the B.P. of zinc nearly 150° higher than with air or hydrogen. This they attributed to a partial dissociation of the CO_2 at the temperature as low as 930° C. Some experiments made by the writer appeared, however, to indicate that the effect was due to chemical action between the gas and the porcelain.

For these and other reasons it appears very doubtful whether any improvement or extension of range can be expected from the use of glazed porcelain. If an attempt is made to employ any of the more refractory kinds of fire-clay, there is the difficulty of finding a suitable glaze, and of eliminating leakage and porosity. The writer suggested the use of bulbs of fused silica some years ago (*Proc.* Iron and Steel Institute, 1892), and endeavoured to get such bulbs constructed, but without success. This material possesses many of the requisite qualities, but is for this very reason extremely difficult to work. Metallic bulbs of platinum or platinum-iridium are by far the most perfect in respect of

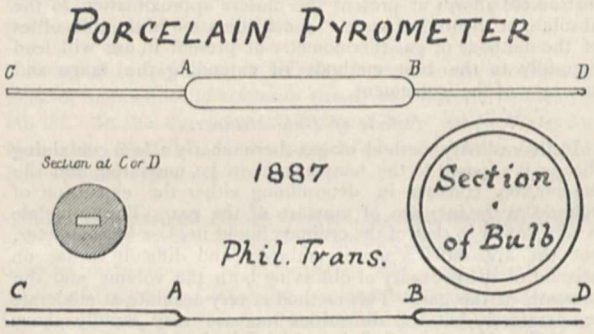


FIG. 3.

constancy of volume, regularity of expansion, and facility of accurate construction; but unfortunately, as Deville and Troost showed, they have such an inveterate tendency for occluding or dissolving gases at high temperatures, that the use of metallic bulbs has been practically discontinued, in spite of their obvious advantages in other respects.

Advantages of "Resistance"-Methods.

After making many vain experiments, the writer was forced to the conclusion that the ordinary bulb-methods did not promise any satisfactory solution of the problem of extending the range of the gas-thermometer, and that it was necessary to attempt a radically new departure. The optical method, depending on the measurement of the refractivity of a gas at high temperatures, and the acoustical method, depending on the observation of the wave-length of sound, although of great theoretical interest, did not appear to promise sufficient delicacy of measurement or facility of practical application. Experiments were therefore made on the methods of effusion and transpiration, which had been occasionally suggested by previous writers, but have not as yet, so far as the author is aware, been practically investigated as a means of measuring temperature on the absolute scale. The method of effusion consists in observing the resistance to the efflux of gas through a small hole or orifice in a thin plate. In the method of transpiration the gas is made to pass through a fine tube instead of a small orifice, and the resistance to its passage is observed in a similar manner. These methods may be called "resistance-methods" to distinguish them from the ordinary or "bulb-methods" of pyrometry. They are closely analogous to the now familiar resistance-method of electrical pyrometry, and possess many of the advantages of that method in point of delicacy and facility of application. One very obvious and material advantage, especially for high temperature work, is the smallness and sensitiveness of the instrument as compared with the bulb of an ordinary gas-thermometer. But the most important point of difference, which led the writer to the adoption of these methods, is that the measurements are practically unaffected by occlusion or evolution of gas by the material of the tubes. There is a *continuous* flow of gas through the apparatus. This flow is very large in proportion to any possible leakage, and it is therefore possible to employ platinum tubes with perfect safety.

The Method of Effusion.

The method of effusion may be very simply illustrated by means of a fine hole in the side of a large and thin platinum tube which is heated by an electric current. The current of air is heated in its passage through the tube before it effuses through the orifice. The heated air expands in volume, and the resistance to effusion is increased in proportion to the temperature to which the air is heated. The increase of resistance may be shown by means of a gas-current-indicator or "rheoscope," which consists of a delicately suspended vane deflected by a current of gas. A mirror is attached to the vane, and the deflection is measured by the motion of a spot of light reflected on to a scale, exactly as in the case of the mirror galvanometer, when used for indicating changes of electrical resistance. As a standard of comparison, to show the changes of temperature of the tube, the changes of electrical resistance of the same tube are simultaneously shown by means of a suitable ohmmeter.

The method of effusion is a beautifully simple method, and gives a nearly uniform scale; but it has two disadvantages, which it shares with the thermo-electric method of measurement. (1) It necessarily measures temperature at a point, namely at the point of effusion, and cannot be easily arranged to give the mean temperature throughout a space. (2) It is difficult to make the effusion resistance sufficiently large for purposes of accurate measurement. A large resistance means a very fine hole, and it is not easy to satisfy the theoretical conditions of the problem with sufficient accuracy and eliminate the effects of viscosity.

The Method of Transpiration.

The method of transpiration is more complicated, and does not give so uniform a scale, or so simple a formula. It has the great advantage, however, that the theoretical conditions of flow may be realised with unlimited accuracy, and that the transpiration resistance can be measured with a degree of precision very little, if at all, inferior to the corresponding electrical measurement.

The complication of the transpiration problem arises from the fact that the flow depends on the increase of the viscosity of the gas, as well as on its expansion. The viscosity of liquids in general decreases very considerably with rise of temperature. That of water, for instance, is six times less at the boiling point than at the freezing point. If the viscosity of gases diminished in a similar manner, it might happen that the transpiration resistance would decrease with rise of temperature. Maxwell was the first to give a theoretical explanation of the behaviour of gases in this respect. On certain simple kinetic assumptions, he showed that the viscosity should increase in direct proportion to the absolute temperature. Since the expansion follows the same law, the transpiration resistance on Maxwell's hypothesis should increase in proportion to the square of the temperature. This would give a fairly simple formula, and would make the transpiration thermometer a very sensitive instrument, but the scale would be far from uniform. Maxwell made some experiments on the temperature variation of the viscosity between 0° and 100° C., which appeared to give support to his mathematical assumptions; but his apparatus did not happen to be of a very suitable type for temperature measurement, and it is clear that he did not regard this part of his experimental work with great confidence.

The question of the viscosity of gases was next attacked with great vigour in Germany by a number of different physicists. They ultimately succeeded in proving that the law was not quite so simple as Maxwell had supposed, and that the rate of increase of viscosity was less than that of volume. A summary of some of the principal results obtained, over the range 0° to

100° C., is given in the following table, in which the rate of increase is expressed by finding the power n of the absolute temperature T to which the viscosity is most nearly proportional. The most concordant results were obtained by the method of transpiration, and gave an average of ·76 for the index n in the case of air. The more condensible gases gave larger values for the rate of increase, but the value for hydrogen appeared to be smaller.

TABLE III.—*Variation of Viscosity v with Temperature T. Formula,* $v/v_0 = (T/T_0)^n$.

Observers.	Dates.	Values of Index n (0° to 100° C.) Air.	O_2.	H_2.	CO_2.
Maxwell... ...	1866	1·00			
Meyer	1873	·61 – ·83			
Puluj	1874	·47 – ·65			
Obermayer ...	1875	·76	·80	·70	·94
Wiedemann ...	1876	·73			·93
Warburg ...	1876	·74 – ·77		·63	
,, and Kundt	1876	·72		·69	
Holman... ...	1876	·74 – ·80			

It will be observed that the results are not very concordant, but the experiments are much more difficult and liable to error than might be supposed. The most accurate method was that employed by Holman, but even in this case the margin of uncertainty is considerable. It would evidently be impossible to employ the method of transpiration to any advantage for the determination of temperature unless a far higher order of accuracy could be easily attained. After repeating the majority of the more promising methods in detail, including the original method of Maxwell, the writer came to the conclusion that they were entirely unsuitable for the purposes of thermometry, and would have abandoned the attempt entirely if he had not fortunately succeeded in finding a more perfect way.

Application of Electrical Analogies.

In studying the flow of electricity through conductors, which is in many respects analogous to that of a fluid through a fine tube, electricians have been compelled, from the intangible nature of the fluid with which they work, to elaborate the most delicate and powerful methods of investigation. One of the most useful of these methods is generally known as the Wheatstone-bridge method, and is used for measuring the resistance of a conductor to the passage of an electric current. The method is equally applicable and equally exact for determining the resistance of a fine tube to the passage of a gas. The writer was already very familiar with the application of this method in all its refinement of detail to electrical resistance thermometry. The suggestion for applying it to the closely analogous problem of transpiration was supplied by the researches of W. N. Shaw, F.R.S., who had already applied it, in connection with certain experiments on ventilation, to the effusion of air through large orifices at ordinary temperatures.

Shaw's Effusion Balance.

The apparatus used by Shaw (described in the *Proc. Roy. Soc.*, vol. xlvii., 1890) consisted of boxes to represent rooms, with apertures about half a square inch in area to represent ventilators. Two of these apertures were made in the form of adjustable slits. The circulation of air through two rooms in parallel was maintained by a gas burner, and the slits were adjusted to make the pressure in the two rooms the same, as indicated by the absence of flow in a connecting tube, containing a pivoted needle and vane as a current detector. The balance was shown to be independent of the air-current when that was varied from one to four cubic feet per minute. The effusion resistance of an aperture was also verified to be approximately proportional to the square of the reciprocal of the area, with apertures of similar shape. This method of investigation was admirably adapted to problems in ventilation, in which the phenomena depend mainly on effusion through relatively large apertures. It would, however, be difficult to adapt to the problem of temperature measurement. It would not be easy to make an aperture which could be continuously varied without changing its shape, and at the same time to measure the change of area with sufficient accuracy, if the area were small enough to prevent appreciable cooling of the thermometer by the current of air flowing through it. There is also the disadvantage that the pressure-difference varies as the square of the current; so that, if very small currents are used, the effects of viscosity become more important, and the balance ceases to be independent of the current, unless everything is symmetrical and at the same temperature in corresponding parts.

For these reasons it seemed preferable, in applying the Wheatstone-bridge method to air-currents, to employ fine tubes as resistances, and to eliminate the effects of effusion as completely as possible, at least in the resistance-measuring part of the apparatus. With transpiration resistances the current is directly proportional to the pressure difference, the electrical analogy is much closer, and the theoretical conditions can be very accurately realised.

The Transpiration Balance.

The Wheatstone-bridge method of measurement proved to be so exact and so perfectly adapted to the problem of transpiration thermometry, that, after some preliminary experiments, the writer had a very elaborate apparatus constructed, in the year 1893, which was in every detail the exact analogue of an electrical resistance thermometer. The fine wire resistances of the electrical apparatus, in terms of which the change of resistance of the thermometer is measured, are replaced in the transpiration box by a graduated series of fine tubes, which can be

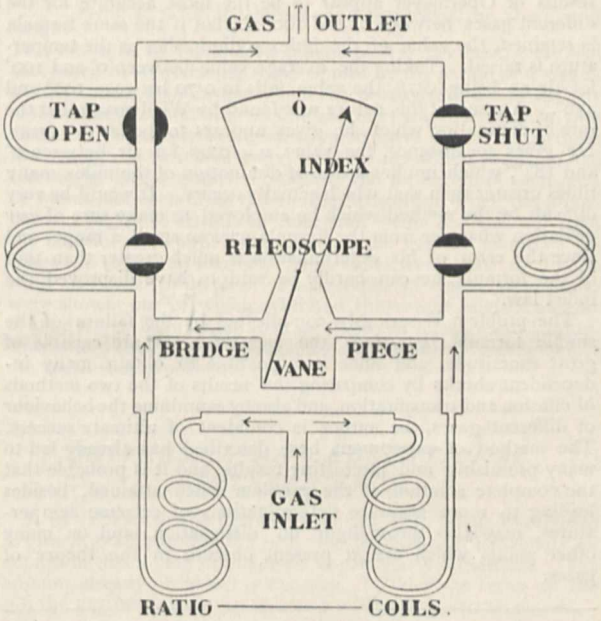


FIG. 4.—Diagram of transpiration balance.

short-circuited by means of taps of relatively large bore, corresponding to the plugs of negligible resistance in the electrical resistance box. The galvanometer is replaced by a rheoscope, constructed after a pattern devised by Joule for a different purpose, which can be made to rival in delicacy the best modern electrical instruments. The pyrometer itself consists of a fine tube of platinum instead of a wire, and is fitted with "compensating leads" to correspond with those of the electrical instrument. All the details of the methods of observation and calibration are faithfully copied from the electrical apparatus, and the result, so far as the measurement of transpiration resistance is concerned, are equally satisfactory.

Fig. 4 is a diagram of a working model of the transpiration balance, which was exhibited at the lecture. This model has a vertical needle for index, and a pivoted mica vane, which is deflected when a current flows through the bridge piece. It is constructed to work on the ordinary lighting-gas pressure, and to give its maximum deflection for a 10 per cent. change of resistance with the gas about half off. With all the taps off, the resistances on either side are equal, and there is no deflection. In the diagram the balance is supposed to have been disturbed by opening one of the taps. The apparatus actually used for temperature measurement has sixteen taps, and a mirror rheoscope, and is a thousand times more sensitive.

Variation of Viscosity with Temperature.

In order to apply the method to the measurement of extreme temperatures, it is not sufficient to be able to measure resistance. It is also necessary to determine the law of the variation of viscosity with temperature. Here, again, recourse must be had to the method of extrapolation. Fortunately, in the present instance, the temperature can be measured through a very wide range, and the range of extrapolation, being limited by the melting point of platinum, is not very great in comparison. It should be possible therefore, by sufficiently varying the conditions of the experiments, and by comparing the behaviour of different gases throughout the whole range of temperature, to arrive at a very fair degree of certainty with regard to the essential nature of the phenomenon. Owing to want of leisure for the work, the author's experiments have not as yet extended over a sufficient range of temperature, except in the case of air, to warrant the publication of any general conclusions with regard to the law of variation of viscosity, or of any results at high temperatures obtained by the method of extrapolation. It may be stated, however, that the formula above quoted, according to which the viscosity varies as some power n of the temperature, though fairly exact over a moderate range of temperature, fails entirely when tested at higher points. The results of Obermayer appear to be the most accurate for the different gases between 0° and 100° C., but if the same formula is retained, the value of the index n diminishes as the temperature is raised. Taking the average value between 0° and 100° for air as being 0·76, the value falls to 0·70 between 100° and 450°. A result of this nature was found by Wiedemann, but the rate of diminution which he gives appears to be far too great. He gives, for instance, the value $n = 0{\cdot}67$ for air between 0° and 184°, which implies a rate of diminution of the index many times greater than that which actually occurs. It would be very difficult by the method which he employed to make sure of *any* deviation whatever from the formula over so small a range, and since the error of his determination is much greater than that of the formula, he can hardly be said to have disproved the index law.

The problem is seriously complicated by the failure of the simple formula; but since the measurements are capable of great exactitude, and since it is possible to obtain many independent checks by comparing the results of the two methods of effusion and transpiration, and also by examining the behaviour of different gases, the author is confident of ultimate success. The method of experiment here described has already led to many promising and interesting results, and it is probable that the complete solution of the problem when attained, besides leading to more accurate determinations of extreme temperatures, may also throw light on dissociation and on many other points which are at present obscure in the theory of gases.

CENTRAL AMERICAN ARCHÆOLOGY.[1]

OWING to difficulties raised by the Honduras Government, the directors of the Peabody Museum have unfortunately been obliged, since the year 1895, to suspend work at the ruins of Copan, and Mr. Gordon, the leader of their expeditions in Honduras, was directed to turn his attention to other points of antiquarian interest in the neighbourhood. His reports to the Museum are now published.

In April 1896, and June 1897, an examination was made of some caverns which had been discovered in the limestone cliffs rising abruptly from the rocky bed of a mountain stream, distant about four miles from the ruins of Copan. The nature of the ground made the entrance of the caves very difficult and somewhat dangerous of approach.

In one of the chambers, nearly circular in shape and measuring 150 feet in diameter, "an excavation 20 feet long and 3 feet wide was made. After the surface layer of dust came a thin crust, which must have been caused by the presence of moisture at some period. It was only a few inches in thickness, and beneath it the material was very dry, soft, and loose, so that the men were able to remove it easily without the use of picks. In the surface crust and beneath it to a depth of three feet were found ashes, charcoal, and potsherds. The latter are not numerous, and are of a coarse quality. At a depth of three feet the potsherds and ashes and all signs of occupation disappeared; the material excavated grew lighter in colour, softer and looser. In appearance and behaviour it resembled quicklime, of which it largely consisted. Throughout the whole excavation the material removed rose in the air in thick clouds of suffocating dust. The excavation was carried to a depth of fifteen feet, where the bottom of the cavern was reached in part of the excavation. On the rock floor were absolutely no traces of occupation."

In a long passage, measuring about 80 by 20 feet, where the floor seemed to be more uneven than in the other chambers, and gave way to the pressure of the feet with a crushing sound, Mr. Gordon discovered that he was walking over the crumbling human bodies mingled with ashes and lime. A mass of charred and calcined bodies occupied the entire floor to the depth of about two feet, and the thick clouds of unsavoury dust, added to the stifling heat, made the work of examination most difficult and disagreeable. The chamber appears to have been used as a place for depositing the remains after they had been partly cremated elsewhere. None of the caves show any signs of recent occupation, but the condition of bones and of a wooden object, which was discovered, do not seem to Mr. Gordon to indicate any great antiquity. The excavations yielded no specimens of personal ornaments, or of carved stonework, and the pottery, of which several pieces were preserved entire, proved to be entirely different in character from that found in the neighbouring ruins of Copan. Mr. Gordon does not, however, think that the facts disclosed from the examination of the caves suffice to prove the existence of another race. "May it not be," he says "(to hazard a guess), that these cave relics belong, after all, to the same period as Copan itself, and are remains of the Copan people, or the devotees of some old cult among them whose temples were the caves, and whose vessels used in the ritual were of a design and character exclusively their own?"

In May and June 1896, and from March to June 1897, Mr. Gordon was occupied in examining the valley of the Uloa River, which flows northward through a forest-covered plain to the Gulf of Honduras. Above ground only a few vestiges of a former population are to be found, and the principal group of mounds, which was examined, yielded only one example of sculpture—namely, a very rough stone idol similar to the rude stone sculptures found in Nicaragua. However, during the rainy season the river cuts into its banks, and frequently leaves exposed to view cross sections of unconsolidated strata of sand and clay about thirty feet in height, which in some cases "present the continuous spectacle of broken pottery and fragments of bone from the surface of the water to within a few feet of the top. In places these objects are very numerous for stretches of several hundred feet, then diminishing gradually and almost disappearing for miles."

The principal excavations were made near the village of Santana, about twenty-five miles in a straight line from the mouth of the river. The objects found, consisting chiefly of fragments of pottery, were met with in distinct layers a few feet in thickness, separated by other layers, which also contained a few objects, but in much smaller numbers. In excavation No. 3, for instance, there were three principal layers at depths of twelve, twenty, and twenty-five feet; the last, in this case, by far the most extensive of the three. The pottery shows no signs of water-wearing, and it seems probable that the various articles "must have been put underground in the customary way in connection with burials, but not to the depth at which they are found at present. These burials must have been made during successive periods of occupation, separated by a series of inundations, each of which raised the general level of the ground several feet by the deposition of detritus from the mountains."

From an examination of the large collections which were made, Mr. Gordon is of opinion that the natives of this valley had attained a proficiency in the art of pottery not exceeded in any other part of Central America, and although the specimens display great variety in character, it is evident that the dominant influence was Maya. The absence of architectural remains, the most familiar and remarkable feature of Maya culture in other regions, he attributes to the absence of any available supply of building-stone in the valley of the Uloa.

"It is among the pottery vessels that the Maya affinities are

[1] "Memoirs of the Peabody Museum of American Archæology and Ethnology, Harvard University," Vol. i., Nos. 5-6. Researches in the Uloa Valley, Honduras; Caverns of Copan, Honduras. By George Byron Gordon.

most prominent. Of the number represented, either by entire specimens or by fragments, not only do the greater part exhibit technical qualities identical with the pottery from Copan, but especially in the conventional use of certain decorative motives, and in the employment of a graphic system common to that of the Codices and to the sculptured monuments of Maya, these affinities are very manifest. The same relationship makes itself felt, although in a less striking manner, in the other classes of objects. It is not claimed that this relationship, however intimate, covers the whole ground, or that there is any homogeneity throughout the whole body of ceramic products, as if it were the work of a homogeneous people and represented a culture developed from within. On the contrary, there is in the tendency towards diversity of type strong evidence of an admixture of races, or of extensive importations derived from a variety of sources."

The relation which the art of the Uloa Valley and the other confines of the Maya area bears to that of the great central Maya ruins is a matter of the deepest interest to archæologists. Although it is much to be regretted that Mr. Gordon is prevented from continuing his interesting researches amongst the ruins of Copan, it is no small satisfaction to know that he has found other work to do, in which his knowledge of Maya art will be fully utilised.

A most interesting series of photographic and other plates accompanies the "Memoirs."

A NEW VERTICAL COMPONENT MICRO-SEISMOGRAPH.

THE microseismograph, devised a few years ago by Prof. Vicentini, of Padua, is now well known as one of the most valuable of the vertical pendulums used in Italy for recording earthquake movements. With the aid of Dr. G. Pacher, several improvements have been made in it, the latest being the construction of a microseismograph for recording the vertical component of the motion (*Atti del R. Ist. Veneto di scienze*, &c., vol. lvii., 1899, pp. 65-89). In many of the details, it closely resembles the older instruments adapted for the horizontal components only. The chief points in which it differs from the latter are the following. The pendulum consists of a bar of iron 1·50 m. long, 75 mm. wide, and diminishing in thickness from 10 mm. at one end to 7 mm. at the other. Near the thin end the bar carries three discs of lead, weighing altogether about 45 kg. The other end is fixed in a bracket built into the wall, and so inclined that the bar, under the action of the heavy mass, is horizontal at the free end. The magnifying and recording apparatus consists of two levers made of aluminium tube. One of these, bent at right angles (the longer arm being vertical), is connected with the pendulum, and transforms its vertical movements into horizontal ones. The second lever is horizontal, and its longer arm ends in a fine thread of glass, the point of which records the movements of the pendulum, magnified about 130 times, on a strip of smoked paper which passes below it at the rate of 24 mm. per minute. The first experiments showed that for rapid vibrations the heavy mass remained in a practically stationary condition. Every passing carriage produced a group of rapid vibrations, with periods varying from one to two-tenths of a second. During the short time in which the instrument has been at work, several earthquakes have been registered, and Drs. Vicentini and Pacher have increased the interest of the vertical component records by appending also those of two other microseismographs, giving the horizontal components only. These show that the vertical movement predominates during the whole of the time when the ground vibrates rapidly in a horizontal direction; and that the same sudden changes of intensity characterise the seismograms of both apparatus. The new instrument also records the slow pulsations which follow the rapid vibrations, but much less distinctly than the vertical pendulums, and it consequently sooner attains a state of rest.

THE STUDY OF WAVES.

A CLAIM for the recognition of the study of wave structures of the earth's surface as a distinct and not unimportant branch of geography was advanced by Mr. Vaughan Cornish at the Royal Geographical Society on Monday. For the study he proposed the name kumatology, from κῦμα, a wave. Mr. Cornish illustrated numerous forms of waves by means of lantern slides, and described in detail some curious waves, of which photographs were shown, which travelled up-stream, not as a "bore," but without change or form. These may be observed in streams which plough their way through sandy beaches to the sea. The water-wave was really controlled by a submerged sand-wave, the up-stream flank of which was exposed to a heavy shower of sand from the turbid water. The stream being shallow and its surface in waves, the crest of the water-wave was pushed up-stream as the up-stream flank of the sand-wave received additions of material. The scour of the water was thereby deflected, and the lee slope of the sand-hill was scoured away just as fast as the weather slope grew. Thus the sand-hill moved up-stream, although every particle of sand and every particle of water travelled down-stream. Mr. Cornish showed photographs of ripple-marks mimicking organic forms, and of rippled clouds, and the ripple-ridging of hill-sides, and went on to deal with the rippling of sand by wind, of which he has made a special study. Tables of measurements were exhibited which proved that the shape of these ripples was approximately constant for wave-lengths from 1 to 145 inches. The shape was the same in desert sand as in the sand of the seashore, the mean ratio $\frac{\text{length}}{\text{height}}$ being 17·6 for the blown-sand ripples of the shore, and 18·4 for those of the desert, difference 3·9 per cent. He had succeeded in reproducing these ripples by the action of a steady artificial blast upon ordinary heterogeneous sand, but artificially assorted sand containing no fine particles was not thrown into ripples. For this it was necessary that there should be particles fine enough to be tossed away by the eddy which forms in the lee of the larger grains. Similarly the formation of sand reefs or waves had been observed in the Mississippi when the mixed detritus begins to settle, the finer stuff being churned up from the bottom, and swept away, leaving the coarser materials arranged in ridge and furrow. Sand-dunes were built up by the wind on similar principles. Photographs of desert sand-dunes were shown, one of which exhibited the recent encroachments of sand which have buried the road between Karachi and Clifton. The sand-dunes here are advancing as a train of waves before the south-west monsoon.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

A GENTLEMAN who desires to remain anonymous has offered to give 25,000*l.* towards the proposed Birmingham University on condition that a sum of 225,000*l.* is previously subscribed. The amount already promised is 135,000*l.* Under the terms of the gift the 225,000*l.* must be obtained within one year from now.

THE Paris correspondent of the *Chemist and Druggist* states that M. Dabout, doyen of the Paris Faculty of Sciences, and Prof. Lippmann are to represent the Paris University at the jubilee celebrations of Sir George Stokes at Cambridge next June. The Faculty of Medicine and the School of Pharmacy will send delegates to the Congress to be held at Berlin from May 24 to 27, for the purpose of studying the means of combating tuberculosis, especially amongst the lower classes.

ON the recommendation of the Lord-Lieutenant the Queen has approved of the appointment of Prof. Alexander Anderson as president of the Queen's College, Galway, in succession to Mr. W. J. M. Starkie, who has become Commissioner of National Education in Ireland. Prof. Anderson was a student of Galway, and has held for many years the chair of Natural Philosophy in the College, which chair he will retain. He was a high wrangler at Cambridge, a Fellow of Sidney Sussex College, and also a Fellow of the Royal University of Ireland. He is well known for his many contributions to the literature of physics, and for the manner in which he has developed the science school in the Galway College.

AN interesting investigation has just been commenced in the engineering department of the Massachusetts Institute of Technology. The object is to determine the modulus of elasticity or the deflection due to a load applied for a long interval (in this case, a year) in comparison with that due to a suddenly applied load. It appeared from tests made many

years ago at the Institute that the "time" modulus was about one half that for the sudden application. The old tests were all on sticks of moderate size. The new apparatus is capable of taking eight 6 × 12 hard pine beams at one time, and giving a fibre stress of 2500 pounds on each beam. The machine has just been set up with eight beams subjected to a load producing a fibre stress of 2000 pounds. The deflections of each beam are measured with a micrometer. The deflections are measured daily during the early part of the experiment. Record will be kept of these deflections, and of any other change that takes place through the summer and into the next year. Tests will soon be undertaken on the strength of timber as affected by moisture.

IT has been known for some time that increased attention was to be given to the study of geography at Oxford. The announcement is now made that a fully equipped school of geography, or a geographical institute, will shortly be established under the superintendence of the University Reader in Geography, Mr. H. J. Mackinder. The Royal Geographical Society has offered 400*l.* a year for five years towards the maintenance of this school, on condition that the University contribute an equal sum. The delegates of the Common University Fund have agreed to contribute 300*l.* towards the University's share, and early in the Easter term the Curators of the University chest will be asked to add another 100*l.*, and there is every reason to believe that Congregation will approve the decree. The scheme will be under the supervision of a Committee of eight; four, with the addition of the Vice-Chancellor *ex officio*, to represent the University, and three the Royal Geographical Society. The Reader will act as director of the school, and will have an assistant, besides two lecturers who will deal with special aspects of the subject.

THE address delivered by Mr. James Stuart, M.P., on the occasion of his installation as Lord Rector of the University of St. Andrews in January last, has been published by Messrs. Macmillan and Co., Ltd. The argument pursued is of special interest to those who urge that increased attention should be given to science in our Universities; it is summed up as follows: "We are in a period of great change. The Universities should form the connecting link between the past and the future. To do this they must respond to new demands and take up a more extended view of the professions for which they prepare, and of the subjects which they teach. If they do, it will be greatly to the advantage both of them and of the nation." Mr. Stuart acknowledges that engineering has almost won its way into our University system, but even yet the subject is inadequately represented. Engineering and the profession of teaching are two of many callings of mankind which ask for and require University recognition, because their subject-matter has become at last capable of organised and scientific treatment. For the same reasons, trade and commerce should be brought within the pale of the University system. Mr. Stuart not only advocates the inclusion of a larger number of professions within the purview of the Universities, but also a wider extension of the range of subjects for general education.

A COPY of the report of the Technical Education Committee of the Derbyshire County Council, dealing with the work accomplished during the session 1896–7, and with the financial statements for two years, 1896–8, has been received. Though the annual income of the Committee amounts to 10,000*l.*, it is found quite inadequate for the educational work required in the county. The endeavour of the Committee has consequently been rather to supplement than to supersede local effort. The work of the Agricultural Department is mainly carried on in connection with the University College at Nottingham, and the Midland Dairy Institute at Kingston, Notts. The teaching of mining is similarly closely connected with that of the Firth College, Sheffield. In this way, while having due regard to the requirements of the students in their own county, the Committee are helping to extend the usefulness of institutions concerned with higher education. As already mentioned, the Derbyshire Education Committee has been recognised by the Department of Science and Art as being responsible for the science and art instruction in its area, and the steps which the Committee have since taken are duly recorded in the report. There seems to have been a falling off in the number of scholars attending evening continuation, science, art, and technology classes during the session 1897–8. We are glad to notice that the work of developing public secondary schools throughout Derbyshire has received considerable attention, and that proper assistance towards the provision of practical instruction in science in such schools is being given.

DURING the past two years (says the *British Medical Journal*) the University of New Mexico has been carrying on a scientific investigation of the climatology of the Mexican plateau, especially with respect to its beneficial effects in cases of tuberculosis and analogous diseases. Statistical information has been collected, and special studies in the variation in vital capacity among students in the University and the public schools of the territory have been carried on. The biological and bacteriological departments, under the special direction of President Herrick and Prof. Weinzirl, have taken up the study of air and water and the conditions of sepsis, &c. It has been hoped to extend this investigation to include the physical and chemical characteristics of the climate, and also a study of the blood changes due to altitude, with special reference to the virulence and curtailment of the diseases in question. Not long ago Mrs. Walter C. Hadley made to the University a proposal to give the sum of 10,000 dollars to be used towards the erection of a building to contain the laboratories for these and allied researches. The gift is made conditional upon the authorities raising a further sum of 5000 dollars for the completion of the building and a similar sum for equipment. The Regents have agreed to establish the chair necessary to continue and prosecute the research, and have undertaken to do their best to obtain the supplemental moneys required by the terms of Mrs. Hadley's donation.

APPRECIATIVE reference has frequently been made in these columns to the munificent gifts made by Sir W. C. McDonald to the McGill University, Montreal. A Toronto correspondent of the *Times* gives, in yesterday's issue, an account of these and other benefactions, and expresses the hope that they will inspire the friends of science in England to do for Cambridge what generous benefactors have done for the McGill University. The new chemistry and mining department of the University, opened in December, is the last of a series of three magnificent structures built, equipped from top to bottom, and endowed by Sir W. C. McDonald. The first is devoted to physics; the second to engineering; the third to chemistry and mining. All these buildings have been constructed within the last five years. The engineering building cost 400,000 dollars, to which an endowment of 85,000 dollars for maintenance has been added. On the physics building 250,000 dollars have been expended, and the maintenance fund is 150,000 dollars. For the chemistry and mining buildings 425,000 dollars were at first given for construction and maintenance, but a further sum of 180,000 dollars has, since the beginning of the new year, been added to place the endowment on a thoroughly secure basis, thus making in all more than half a million dollars which have been spent upon this department alone. In the construction and equipment of the building, the donor gave absolute *carte blanche* to the architects and the men of science to whom was entrusted the work of carrying out the designs, and they were therefore free to ransack like institutions throughout the world to find everything that was best in the way of outfit and equipment. From top to bottom everything seems complete, and the best that money can buy, the result being that, so far as the departments referred to are concerned, McGill University is now as perfectly equipped as any institution in the world.

SCIENTIFIC SERIALS.

Symons's Monthly Meteorological Magazine, March.—Extremes of temperature in London and its neighbourhood for 104 years. This is a very useful little table for reference, showing the monthly absolute maxima and minima temperatures observed at the apartments of the Royal Society (Somerset House) from 1794–1843; at the Royal Observatory, Greenwich, from 1841–1890; and at Camden Square, from 1858–1897. During this long series, the absolute maximum is 97°·1, at Greenwich, in July 1881, and the absolute minimum 4°·0, at Somerset House, in December 1796, and at Greenwich, in January 1841. This table also shows that the reading of 64°·8, recorded at Camden Square on February 10 last (to which we recently referred), was more than 2° higher than any temperature in February in the neighbourhood of London since 1794.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 9.—"On the Structure and Affinities of *Matonia pectinata*, R. Br., with an Account of the Geological History of the Matonineæ." By A. C. Seward, F.R.S., University Lecturer in Botany, Cambridge.

The genus *Matonia* has long been known as an isolated type among existing ferns. It is represented by two species, *M. pectinata* R. Brown and *M. sarmentosa* Baker, both confined to the Malayan region. Matonia has not hitherto been examined anatomically, and its reference by several writers to an intermediate position between the Cyatheaceæ and Gleicheniaceæ, is based on the structure of the sorus, which, in the small numbers of sporangia and in its circular form, resembles the latter family, while the presence of an indusium and the position of the annulus afford connecting links with Cyatheaceous ferns.

In *Matonia pectinata* the frond has a characteristic pedate habit, with numerous long pinnæ having slightly falcate linear segments, practically all of which appear to be fertile. The sori are circular in form and indusiate, consisting of about eight large sporangia with an oblique incomplete annulus. The dichotomously branched rhizome, which grows on the surface of the ground, is thickly covered with a felt of multicellular hairs, and gives rise to long-stalked fronds from its upper face, and a few wiry roots, which may arise from any part of the surface of the stem.

The material which rendered possible the investigation of the anatomical structure was generously supplied by Mr. Shelford, of the Sarawak Museum, Borneo.

The stem is polystelic, and of the gamostelic type; there may be two annular steles, with the centre of the stem occupied by ground-tissue, or in shorter branches of the rhizome a third vascular strand may occupy the axial region. Each stele consists of xylem tracheids and associated parenchyma, surrounded by phloem composed of large sieve-tubes, with numerous sieve-plates on the lateral walls, and phloem parenchyma; an endodermis and pericycle surround each stele, and in the case of the annular steles these layers occur both internally and externally. At the nodes the outer annular stele bends up into the leaf-stalk, and a branch is given off also from the margin of a gap formed in the inner annular stele; the axial vascular strand may or may not be in continuity with the meristele of the leaf. The petiole is traversed by a single stele, similar in shape to that of certain Cyatheaceous ferns.

The most interesting feature in the structure of the pinnules is the marked papillose form of the lower epidermal cells. The roots have a triarch stele enclosed by a few layers of thick brown sclerous cells.

In structure *Matonia pectinata* presents points of agreement with several families of ferns, on the whole approximating more closely to the Cyatheaceæ than to any other family; but the peculiarities are such as to fully confirm the conclusion previously drawn from external characters that Matonia should be placed in a separate division of the Filices.

In Matonia we have a survival of a family of ferns, now confined to a few localities in Borneo and the Malay peninsula, and represented by two living species, which in the Mezozoic epoch had a wide geographical rage, being especially abundant in the European area.

"New Form of Light Mirrors." By A. Mallock. Communicated by Lord Rayleigh.

The author in this paper describes a new form of light mirror, which he thinks may be useful in cases where extreme lightness and good definition have to be combined.

The mirrors are formed by stretching the thin films left on the surface of water, after a few drops of a solution of pyroxyline in amyl acetate have been allowed to spread there and evaporate, over rings whose edges have been ground to a true plane.

The contraction of the film in drying causes it to approach so closely to the plane in which the edge of the ring lies, that when used as a reflector, the definition is equal to that obtained from a worked glass surface of the same area, at any rate until the film is more than two and a half inches in diameter.

A two-inch diameter mirror may be made weighing considerably less than ten grains.

The author found considerable trouble, not yet completely overcome, in silvering the films; but success in this matter appears to depend entirely on securing extreme surface cleanliness both of the films and silvering bath, the films being in this respect enormously more sensitive to surface tension influences han glass.

"On the Gastric Gland of Mollusca and Decapod Crustacea: its Structure and Functions." By C. A. MacMunn, M.A., M.D. Communicated by Dr. M. Foster, Sec. R.S.

In 1883 the author communicated a paper to the Royal Society in which he described a pigment occurring in the so-called liver of Invertebrates, which from its resemblance to plant chlorophyll he named entero-chlorophyll, and in the *Philosophical Transactions* (Part i., 1886), a further contribution was published.

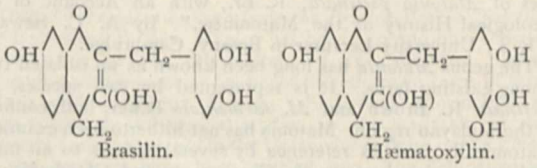
In the present paper the histology of the gland is dealt with, and additional observations made by means of the spectrophotometer, and otherwise, are described.

Great difficulties attend the preparation of the gland for microscopical purposes; the author has, however, succeeded in getting very satisfactory sections by means of formol—20 to 30 per cent.—followed by 95 per cent. alcohol, and embedding in celloidin. The sections being stained by hæmalum, eosin, mucicarmine, thionin, "Soudan III.," &c. Curves obtained by means of the spectrophotometer show that entero-chlorophyll and plant chlorophyll are not identical, but when the latter is changed into the well-known "modified" form, the maxima and minima correspond. From this and other data it appears that entero-chlorophyll is food chlorophyll which has been acted on by the digestive juices. A study of sections confirms this view, as one can see the entero-chlorophyll actually within the intestinal epithelium of *Patella*, *Mytilus*, &c., *dissolved in a fatty medium*, and between these epithelial cells, leucocytes, which carry it to the gastric gland and elsewhere, are seen insinuating themselves. In addition to its other functions, the gastric gland appears to be an organ of excretion.

Physical Society, March 24.—Prof. Oliver Lodge, F.R.S., President, in the chair.—Mr. W. R Cooper read a paper by Mr. A. P. Trotter on the minor variations of the Clark cell. The author describes a series of experiments in which he compared the E.M.F. of certain standard cells at frequent intervals from July 1896 to February 1897, at Cape Town, where the temperature of the double box containing the cells varied between the limits 13° C. and 28° C. One cell was selected for comparison with all the others. No special precautions seem to have been taken to keep the temperature of this selected cell constant. The observed differences between the E.M.F. of the respective cells rarely exceeded 0·001, corresponding to about a quarter of an inch on the slide-wire of the potentiometer. Details as to the area of the slider-contact are not stated; the readings were generally taken to the fourth decimal, *i.e.* to one-tenth of a millivolt, and occasionally to one-fourth of this. Temperature was read to 0·1° C. on a mercury thermometer placed through a hole in the double box containing the cells—not in the cells themselves. Mr. E. H. Griffiths said that the paper appeared to have value only in so far as it showed that Clark cells at Cape Town behaved in a manner that agreed with common knowledge and general experience everywhere else. Their variations depended upon shifts of temperature, and the consequent changes in the degree of saturation of the liquid. From his own experiments during seven years, upon forty-two Clark cells, he had shown that if temperature was kept constant to within 0°·01 C., the steadiness and uniformity of all the E.M.F.s was most remarkable. They started with discrepancies, but at the end of the time it was impossible to detect any differences. It was of little use to put a thermometer anywhere but within the cells; very slight changes of temperature caused serious changes in the degree of saturation of the liquid. The existence of the capricious lag of E.M.F. behind temperature precluded the possibility of formulating a temperature correction for Clark cells. In the case of Callendar cells there was no lag; their E.M.F. varied slightly with temperature, by a definite amount, which could be corrected by a coefficient. Mr. W. R. Cooper said the method of comparison used by the author was unsuitable, because to arrive at the differences of E.M.F. necessitated the measurement of the E.M.F. of each cell. The variations only amounted to a few ten-thousandths of a volt. The length of potentiometer-wire corresponding to a thousandth of a volt was only a quarter of an inch; under such conditions it would be difficult to ensure accuracy. A method of opposition would have been preferable. Mr. Cooper had found that Board of Trade cells only vary about

one ten-thousandth of a volt between themselves from day to day. Cells of the H-form vary about one-fifth of that amount.—Prof. J. D. Everett then read a paper by Dr. E. H. Barton and Mr. W. B. Morton, on the criterion for the oscillatory discharge of a condenser. The object of the paper is to inquire how the condition for the oscillatory discharge of a condenser is modified when the ordinary differential equation of the second degree is supplemented by the terms added by Maxwell to take account of the distribution of current in the (straight) wire. The coefficients of these terms are relatively small, so that the algebraic equation giving the periods is a quadratic with small terms of higher order added. The effect of these higher terms is, first, to introduce very rapid vibrations of small amplitude; and, next, to displace the roots of the unaltered quadratic. The nature of the discharge—oscillatory, or non-oscillatory—may be taken to be determined by these principal roots, and the critical case is when they are equal. The condition for equality is obtained, by the property of the derived function, as a series of powers of the small coefficients of the equation, which may be carried by successive approximation as far as is desired. The paper also treats the question by an alternative, and more physical, method, which consists in replacing the resistance, inductance, and capacity that occur in the ordinary formula, by modified values. This gives the criterion correct to the third order in the small terms. It is shown that a condenser satisfying the critical condition on the simple formula would, when the added terms are taken into account, give an oscillatory discharge. Prof. Lodge said that the result naturally to be expected of "throttling," viz. the increase of resistance, and decrease of self-induction, due to the current keeping to the outside of the conductor, would tend rather to damp out the oscillations than to favour them. Prof. Everett observed that the equation was no longer a quadratic, and that the quadratic criterion as to whether the discharge was oscillatory or non-oscillatory, did not hold. The paper appeared to be consistent with itself, and he considered that the authors had satisfactorily proved, in their discussion of the equation of current, that the effect of "throttling" was to increase the tendency towards the oscillatory mode of discharge. Prof. Lodge admitted that the quadratic criterion did not hold; he thought it most likely that the authors, who evidently had gone into the matter with care, were right. At the same time he wished to call attention to the singular and unexpected character of their conclusion. If it turned out that it was correct, *i.e.* that there was no slip in sign, it was a result upon which he would desire to congratulate them.—The President proposed votes of thanks, and the meeting adjourned until April 21.

Chemical Society, March 16.—Prof. Dewar, President, in the chair.—After the presentation of a daguerreotype of Dalton to the Society by the President, the following papers were read:—The boiling point of liquid hydrogen as determined by a rhodium-platinum resistance thermometer, by J. Dewar. After successfully overcoming the experimental difficulties, the author has prepared considerable quantities of colourless liquid hydrogen for the purpose of determining its boiling point. A pure platinum resistance thermometer gave the boiling point as 35° absolute, whilst a rhodium-platinum resistance thermometer gave the boiling point as 27° absolute; by the use of a constant volume hydrogen thermometer working under reduced pressure the boiling-point of liquid hydrogen was found to be 20° absolute.—Influence of substitution on specific rotation in the bornylamine series, by M. O. Forster. The author has prepared and examined methylbornylamine, dimethylbornylamine, ethylbornylamine, diethylbornylamine, *n*- and iso-propylbornylamine, butylbornylamine, benzylbornylamine, and ortho- and para-nitrobenzylbornylamine in order to determine the influence of substitution upon the specific and molecular rotations of bornylamine.—Contribution to the characterisation of racemic compounds, by A. Ladenburg. The author amends his definition of racemism in the light of the experiments of Kipping and Pope.—Rotatory powers of optically active methoxy- and ethoxy-propionic acids prepared from active lactic acid, by T. Purdie and J. C. Irvine. Methylic methoxypropionate and ethylic ethoxypropionate, prepared from the lævo-lactates by the action of alkyl iodides and silver oxide, have the specific rotations −95·53° and −79·69° respectively; this confirms the previous conclusion that the high activity of the alkyl lactates made from the silver salt is due to the presence of alkyl-oxypropionates.—On brasilin and hæmatoxylin (II.), by A. W. Gilbody and W. H. Perkin, jun. From a study of the oxidation products of dimethylbrasilin, the authors conclude that brasilin and hæmatoxylin have the following constitutions:—



Brasilin. Hæmatoxylin.

—Crystallisation of dynamic isomerides. A correction, by T. M. Lowry.

Geological Society, March 8.—W. Whitaker, F.R.S., President, in the chair.—An analysis of the genus *Micraster*, as determined by rigid zonal collecting, from the zone of *Rhynchonella Cuvieri* to that of *Micraster cor-anguinum*, by Dr. A. W. Rowe. The author has endeavoured to show, by means of rigid zonal collecting on a large scale, from the white chalk of the southern and south-eastern coast-sections of England, that the genus *Micraster* is one and the same form gradually evolving from the more simple to the more complex. In doing this, he also contends that the genus may be divided into definite groups, each or several of which are absolutely diagnostic of the various chalk zones, as defined by Barrois. The conclusions arrived at point to the regular and continuous deposition of the white chalk, and strikingly confirm the general accuracy of Barrois's zoning. The paper gives a minute comparison and description of the genus *Micraster* from a general point of view, and from that of a group, and deals particularly with the essential details of the test of the especial groups characteristic of each zone. The author claims that, so far as *Micraster* is concerned, each zone is marked by a definite facies of essential characters of the test, which are purely horizontal, and that all species and varieties, however divergent they may apparently be, occurring at any given horizon, are stamped with the impress of these marked horizontal features. The author proves that, while in an isolated instance, one may be unable to decide the horizon in the white chalk whence a specimen of *Micraster* was derived, in the ninety-nine other cases the diagnostic features described by him point unerringly to the exact horizon, and thus afford a valuable aid to stratigraphical geology, especially as the essential zonal features of the test are easily made out in the field.—On a sill and faulted inlier in Tideswell Dale (Derbyshire), by H. H. Arnold-Bemrose. The compact dolerite in the marble-quarry in Tideswell Dale has been generally described as a lava; but Sir A. Geikie, in his "Ancient Volcanoes of Great Britain," suggested the possibility that it might be a sill. In the present paper the author endeavours to prove that the rock is really a sill.

Entomological Society, March 15.—Mr. G. H. Verrall, President, in the chair.—Mr. Tutt exhibited a very fine series of *Epunda lutulenta* captured by the Rev. C. R. N. Burrows last autumn near Mucking in Essex. This series, while agreeing in the main with Borkhausen's typical form, varied *inter se* in such a manner as to give almost parallel forms to those so well known from Scotland and Ireland, yet they had the ordinary blackish-fuscous ground colour, and not the intense black peculiar to the latter. Mr. Merrifield showed some Lepidoptera collected in the latter half of May and the first week of June, near Axolo (Venetia), Riva, and Bozen. They included some very fine specimens of *Syrichthus carthami*, a very large *Syntomis phegea*, and examples of *Pararge egeria* intermediate in colour between the Northern and Southern European forms. Mr. G. T. Porritt exhibited a series of extreme forms of *Arctia lubricipeda*, var. *fasciata*, and also some examples of what appeared to be a new form of the species. Mr. O. E Janson exhibited an inflorescence of *Araujia albens*, Don., together with a butterfly which had been entrapped by getting its proboscis jammed in one of the flowers. It was found at Monte Video.

Royal Microscopical Society, March 15.—Mr. E. M. Nelson, President, in the chair.—The President called attention to a fine example of Wilson's screw-barrel microscope which had been presented by the Treasurer. The instrument was probably 150 years old, and would be a valuable addition to the Society's collection.—The President then said Mr. Curties had sent for exhibition an old microscope made by Chevalier, *circa*

1840; it was an early example of microscopes made after the introduction of achromatism.—Mr. Rousselet exhibited and described a mounted specimen of a rare rotiferon, *Trochosphaera solstitialis*, first found by Staff-Surgeon Gunson Thorpe in China. It had since been found in America, and the specimen now exhibited was probably the first seen in this country. The first species of this genus discovered *T. aequatorialis*, was found in the Philippine Islands by Prof. Semper, who described it in 1872.—Mr. Lewis Wright then gave an exhibition of microscope slides by means of his improved projection microscope, and demonstrated the progress made since he gave his previous exhibition before the Society fourteen and a half years ago. Several improvements had been made in the interval: in the condensers it had been found better to use four lenses, by which spherical aberration was practically abolished. He had also learned from the President the necessity for adjusting the cone of light to the aperture of the objective. The fine adjustment had been improved, and great advances had been made in objectives. An important improvement had been made in the screen, which was covered with a thin coating of silver, by which the brilliancy of the pictures was greatly increased. It was found that with a plain silvered surface the image could only be seen by persons in front of the screen; but by having the surface minutely striated vertically, persons seated at the sides could see quite well.—Dr. Hebb said another paper had been received from Mr. Millett, being Part v. of his report on the Foraminifera of the Malay Archipelago, which, on account of its technical character, he proposed should be taken as read.—It was announced that at the next meeting a paper would be read by Dr. Lionel S. Beale, on "The bioplasm of man and the higher animals, and its influence in tissue formation, action and metabolism—a microscopical study."

Zoological Society, March 21.—Dr. W. T. Blanford, F.R.S., Vice-President, in the chair.—Mr. E. T. Newton, F.R.S., exhibited and made remarks upon some fossil remains of a Mouse from Ightham, Kent. He pointed out that the name under which he had described the specimens in 1894, viz. *Mus abbotti*, had been previously employed by Waterhouse for a Mouse from Trebizond, and that he proposed to substitute *Mus lewisi* for that name. A communication was read from Dr. G. Stewardson Brady, containing an account of the Copepoda collected, chiefly by means of the surface-net, by Mr. G. M. Thomson, of Dunedin, and by Mr. H. Suter, on behalf of the Zoological Museum of Copenhagen. It was shown that several species were identical with well-known European forms, and others were closely allied, but many were entirely distinct and presented very interesting peculiarities.—Mr. W. P. Pycraft gave an account of the osteology of the Tubinares. He pointed out the Stork-like character of the group, which had not been before emphasised, so far as regards osteological features.—Mr. F. E. Blaauw gave an account of the breeding of the Weka Rail (*Ocydromus australis*) and Snow-Goose (*Chen hyperboreus*) in his park at Gooilust, North Holland. The Rails could not, on several occasions, be induced to complete the periods of incubation, always eating the eggs after sitting for a few days. One young one was eventually hatched by placing an egg under a Bantam-hen. The Snow-Goose (a female) paired with a male Cassin's Snow-Goose (*Chen caerulescens*), and laid and hatched three eggs. The young birds, it was stated, were apparantly assuming the plumage of the male parent.—Mr. W. E. de Winton read a paper on two species of Hares from British East Africa, specimens of which had been collected by Mr. Richard Crawshay. One of them, from the plains of the Upper Attie, was referred to *Lepus somalensis*, Heugl., a species which had not previously been recorded south of Somaliland. The other species from Kitwi, a short-eared form, which somewhat resembled the Nyasaland Hare (*L. whytii*), but differed in its black-tipped fur and also in its dentition, was named *L. crawshayi*, sp. nov.—A communication was read from Dr. A. G. Butler, containing an account of the Butterflies collected by Mr. Crawshay in British East Africa in 1898. Specimens of 62 species (which were enumerated in the paper) were contained in the collections, three of which were made the types of new species, viz. *Acraea astrigera*, *Scolitantides crawshayi*, and *Pyrgus machacosa*.

CAMBRIDGE.

Philosophical Society, March 6.—Mr. J. Larmor, President, in the chair.—Notes on the Binney collection of Carboniferous plants. I. Lepidophloios, by A. C. Seward. In 1872 Binney described some unusually perfect sections, prepared from stems found in the clay-iron-stone of the Coal-Measures near Dudley, which he referred to two species, *Lepidodendron Harcourtii* Witham and *Halonia regularis* Lind. and Hutt. The specimens now form part of the Binney collection in the Woodwardian Museum. All the sections (four in number) must undoubtedly be referred to the same species, and most probably to *Lepidophloios fulginosus* Will.—A note on the way in which bones break, by Dr. Joseph Griffiths. After describing the construction of the shaft of a long bone and pointing out that bone in the adult is hard and tough but not brittle, Dr. Griffiths showed that the long bones are adapted to resist pressure when applied from end to end, that is, in their length. He then demonstrated by means of specimens of bones he had experimentally fractured, the way in which they break on the application of a bending force, of a direct blow and of a blow on the free extremity when a portion of the other end was fixed.—On the origin of magneto-optic rotation, by J. Larmor. The object of this note is to point out that it is possible to deduce the Faraday effect from the Zeeman effect by general reasoning as regards any medium in which the optical dispersion is mainly controlled by a series of absorption bands for which the Zeeman effect obeys the above law, without its being necessary to introduce any special dynamical hypothesis. For this law ensures that the effect of the magnetic field on the periods of the corresponding free vibrations of the molecules is the same as that of a bodily rotation, say with angular velocity ω, round its axis: while the complete circular polarisations of the Zeeman doublets, viewed in the direction of the axis, show that their states of vibration are symmetrical with respect to that axis.

EDINBURGH.

Royal Society, March 6.—Prof. McKendrick in the chair.—Prof. A. Crichton Mitchell read a paper on the convection of heat (Part i.), in which Newton's law of cooling was discussed. In most of the references to Newton's law, the circumstances under which Newton declared the law to hold are either disregarded altogether or mentioned in the vaguest way. By his own experiments on the cooling of a copper ball in a steady current of air, Prof. Mitchell found that Newton's law of cooling was accurate up to temperature differences of 100° C. in steady currents of air of as much as ten miles per hour. The stronger the current the quicker the cooling; but the discussion of the precise law connecting the two was reserved for a future communication. The results suggested the possibility of a form of anemometer, in which the speed of the wind might be measured by its cooling effect on, for example, a wire heated by a steady electric current.—Dr. Buchan presented a detailed account of the meteorology of Ben Nevis (Part ii.). Such important questions as the differences of temperature and pressure at the base and the summit of Ben Nevis were discussed, and were shown to be intimately connected with the cyclonic or anti-cyclonic conditions existing or approaching. The observed relation between pressure and height had led to an important correction to Laplace's well-known formula. When applied to the reduction to sea-level of observations in Scandinavia and other localities, the Ben Nevis empirical formula brought consistency where, with the use of Laplace's formula, there had been obvious discrepancy. In the discussion of the diurnal barometric variation, it had been found necessary to separate the cloudy and clear days; and this had suggested applying the same method to analyses of the meteorological statistics of other places. It thus appeared that the influence of cloud was to produce an evening maximum, and completely change the form of the daily barometric curve.—Dr. Hugh Marshall, in a note on polarisation phenomena observed in quantitative electrolytic determinations, mentioned that, in the case of certain solutions, the completion of the electrolysis of the metal was shown by a sudden rise in the potential difference of the electrodes. The addition of a small quantity of the metal to the solution produced an immediate fall of this potential difference to its normal value.—Dr. Noël Paton gave an account of a detailed examination of a study by Drs. Dunlop, Macadam, and himself on the influences of diphtheria toxin on the metabolism. The metabolism in simple fasting was compared with the metabolism in fasting with fever in dogs; and among the more important results obtained were these: (1) the increase in fever of the proportion of nitrogen not as urea; (2) the non-increase of the proportion of nitrogen

in ammonia; (3) the increase in the proportion of neutral sulphur, but not in the sulphur as sulphuric acid, thus explaining the non-increase of ammonia and corresponding with diminished elaboration of urea; (4) non-increase in the proportion of phosphorus as phosphates, indicating the absence of an increased decomposition of nuclein compounds; (5) no alteration in the proportion of potassium and sodium, such as has been described by Sachowski as occurring in fever in man; (6) decrease in the excretion of chlorine out of proportion to the decrease in the bases, raising the question of what acids take the place of hydrochloric acid in the urine.—Dr. Gregg Wilson, in a paper on the first foundation of the lung in Ceratodus, showed that the lung arises, as in amphibians and higher forms, in a mid-ventral gut in the pharynx, immediately posterior to the gill region. This expands into a considerable unpaired vesicle, which in later stages grows round the gut till it lies dorsally.—Dr. Gregg Wilson also read a paper on the embryonic excretory organs of Ceratodus, in which the pronephros was shown to be of amphibian type, having two nephrostomes opening directly into the anterior of the body cavity. Later there is a pronephric chamber formed, as in amphibia, by secondary fusion of the gut and body wall. Into this region of the cœlom the glomerulus projects. The backward growth of the union of gut and body wall finally leads to the closing of the nephrostomes and the obliteration of the pronephric chamber.

PARIS.

Academy of Sciences, March 20.—M. van Tieghem in the chair.—The President announced to the Academy the death of M. Naudin, Member of the Botanical Section.—Action of hydrogen sulphide and alkaline sulphides upon the double cyanides, by M. Berthelot. This paper contains thermochemical data for the reactions between AgCN.KCN, $Hg(CN)_2KCN$, $Zn(CN)_2 2KCN$, and hydrogen or sodium sulphides.—Maximum quantity of chlorides contained in sea air, by M. Armand Gautier. The greatest amount found was 0·022 mgr. of common salt per litre of air.—Astronomical and magnetic observations made on the eastern coast of Madagascar, by M. R. P. Colin.—Observations of the Swift comet (1899 *a*), made at the Toulouse Observatory with the 23 cm. Brunner equatorial, by M. F. Rossard.—Observations of the Swift comet (1899 *a*), made at the Observatory of Besançon by M. P. Chofardet, by M. J. Gruey.—On the lines of curvature of certain surfaces, by M. E. Blutel.—On some applications of the law of parallelism to bundles and congruences, by M. C. Guichard.—On some arithmetical properties of analytical functions, by M. Paul Staeckel.—On the unsymmetrical alternating current arc between metals and carbons, by M. A. Blondel. The oscillations are given in the form of curves, fifteen of which are reproduced in the paper.—On the increase of the mean intensity of the current by the introduction of the primary of the coil, in the case of the Wehnelt electrolytic interrupter, by M. H. Pellat. In a circuit at 110 volts, containing the Wehnelt commutator but not the primary of the coil, an ammeter showed four to five amperes. The introduction of the additional resistances of the primary of the coil increased the current to twenty-five amperes, the additional impedance thus considerably increasing the mean current strength. This paradoxical result is shown to be in accordance with the known laws of induction.—On an isomer of menthoxylic acid, by M. Georges Leser.—On the electro-negative character of certain unsaturated organic radicals, by M. Ernest Charon. The propylenic group, $CH_3.CH=CH-$, has much more marked electro-negative properties than the vinyl group, $CH_2=CH-$.—Action of formaldehyde upon albumenoid materials. Transformation of peptones and albumoses, by M. Charles Lepierre.—Silico-tungstic acid as a reagent for alkaloids, by M. Gabriel Bertrand. The reagent proposed is $12WO_3.SiO_2.2H_2O$, or its sodium salt, in 5 per cent. solution. It has the advantages of giving well-defined salts, absolutely stable, the analysis of which can be made with exactitude. Its high molecular weight is also advantageous. The precipitates formed have the composition

$$[12WO_3.SiO_2.2H_2O + 4\,\text{alk.} + nH_2O];$$

analyses are given of the salts with pyridine, morphine, and strychnine.—Researches on the physiological value of the pyloric tubes in certain Teleostia, by M. Th. Boudourg.—An old Russian legend relating to a fall of stones, by M. Stanislas Meunier.

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (mathematico physical section) part iv. for 1898, includes the following memoirs communicated to the Society:—

October 29, 1898.—W. Voigt: On the connection between the Zeeman and the Faraday effects.

November 26.—H. Ludendorff: On a remarkable property of certain equations in the theory of characteristic planets.—W. Voigt: Theory of the phenomena observed by Macaluso and Corbino. Double refraction of sodium vapour in the magnetic field at right angles to the lines of force.

DIARY OF SOCIETIES.

WEDNESDAY, APRIL 5.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY, APRIL 6.

LINNEAN SOCIETY, at 8.—On *Carex Wahlenbergiana*: C. B. Clarke, F.R.S.—On the Discovery and Development of Rhabdites in Cephalodiscus: F. J. Cole.

FRIDAY, APRIL 7.

GEOLOGISTS' ASSOCIATION, at 8.—The Geology of Brittany, with Special Reference to the Whitsuntide Excursion: Dr. Charles Barrois.

BOOKS AND SERIALS RECEIVED.

BOOKS.—Die Optischen Instrumente: C. Leiss (Leipzig, Engelmann).—Kritik der Wissenschaftlichen Erkenttnis: Dr. H. v. Schoeler (Leipzig, Engelmann).—Light Railways at Home and Abroad: W. H. Cole (C. Griffin).—A Manual of Locomotive Engineering: W. F. Pettigrew and A. F. Ravenshear (C. Griffin).—Die Kontinuität der Atomverkettung: Dr. G. Hörmann (Jena, Fischer).—The New Science and Art of Arithmetic: A. Sonnenschein and H. A. Nesbitt (Sonnenschein).—Le Climat de la Belgique en 1897: A. Lancaster (Bruxelles, Hayez).—Life of Admiral Sir Wm. R. Mends: B. S. Mends (Murray).—True Tales of the Insects: L. N. Badenoch (Chapman).—Explorations in the Far North: F. Russell (Iowa).

SERIALS.—Economic Journal, March (Macmillan).—Journal of the Royal Horticultural Society, April (Victoria Street).—Journal of the Chemical Society, March (Gurney).—Physical Review, February (Macmillan).—Good Words, April (Isbister).—Sunday Magazine, April (Isbister).—Chambers's Journal, April (Chambers).—L'Anthropologie, tome x. No. 1 (Paris).—Humanitarian, April (Duckworth).—Bulletin of the American Mathematical Society, March (New York).—Science Gossip, April (Strand).—Century Magazine, April (Macmillan).

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