THURSDAY, FEBRUARY 11, 1904.

EARLY CIVILISATION IN BABYLONIA.

The First of Empires. By W. St. Chad Boscawen. Pp. xxix+356. (London: Harper and Brothers, 1903.) Price 10*s.* 6*d.* net.

THE appearance of Mr. St. Chad Boscawen's book on the "First of Empires" will, we believe, be welcomed by many, and we have no hesitation in saying that it will prove a very acceptable addition to the small library of trustworthy works on Babylonian archæology which is to be obtained in the English language. Mr. Boscawen is well known as a lecturer upon Oriental archæology and antiquities, and especially on the branch of them which brings the student into close relationship with the Bible, and there is no doubt that he has a good, working, first-hand knowledge of the cuneiform inscriptions; this being so, his book possesses a value which is not enjoyed by any other popular work on his subject. And here, before we proceed to criticise the "First of Empires," it will be well to describe its contents briefly.

The chapters in the volume are nine in number, and these are followed by four appendices, which are, in turn, supplemented by a tolerably full index. The first five chapters deal with the beginnings of Babylonian civilisation and the relations which appear to have existed between Egypt and Chaldæa, the next three discuss the life and times of Khammurabi and the famous "Code" of this king, and in his last chapter Mr. Boscawen describes the beginnings of literature. The breadth of the subject which Mr. Boscawen has undertaken to describe in a popular manner is thus considerable, and the examination which we have been able to make of his work convinces us that he has succeeded remarkably well. We must remember that we are dealing chiefly with texts, most of which were written more than four thousand years ago, and even experts are not agreed as to the exact meaning of scores of words which are of frequent occurrence; and, if we confess the truth, sufficient time to digest the immense number of facts which have been recovered during the last few years has not yet been given to Mesopotamian archæologists and cuneiform scholars. For this reason Mr. Boscawen and all other true students of cuneiform literature find it impossible to be dogmatic in the present state of the science of Assyriology, and it is necessary for professors of Semitic archæology to pause before they bid us throw overboard all our preconceived and existing notions on matters of vital interest and importance.

That certain changes of opinion are necessary is very evident, for from Egypt, Babylonia and Assyria have come forth such a great mass of evidence and fact that a careful reconsidering of their mental position is incumbent upon all those who would possess in their minds the true history of the countries which have played such a prominent part in the development of civilisation. Mr. Boscawen's own position is quite pronounced. He comments adversely on the works which, though professedly scientific, actually made the Biblical element predominant, and declared as an axiom that Moses was the author of the Pentateuch; this mischievous system was inaugurated by the late Mr. George Smith, and he was followed by a number of far inferior workers and students, who, not finding the whole of the contents of Genesis in the cuneiform tablets, quickly abandoned the study for one more congenial. All the evidence now available proves that Ezra and his "Great Synagogue" drew largely upon Babylonian legends of the Creation and Flood for the narrative which they re-wrote or "edited," and that Babylonian literature has an antiquity some two or three thousand years greater than that of the writings which are attributed to Moses, and even of the oldest portions of them.

We must now face the fact that the Hebrew text of the Bible has undergone various editings, and we must be content to have the literature of the Hebrews subjected to the same analysis and examination as the literature of any other Oriental people. Mr. Boscawen cites in proof of careless editing, and perhaps of a plurality of authors, the fact that the Hebrew text of the Pentateuch, as it now stands, contains two versions of the Creation Story, parts of two versions of the Flood Story, three versions of the Ten Commandments, and so on. Want of space will not admit even of brief allusions to the fusion of legends of events which took place in Babylonia, or to the various "editings" to which the scribes were compelled to submit the literary works in their hands in order to bring them up to the level of the requirements of their day, but it is quite clear that what went on in the great libraries of Babylonia also went on in the scribes' chambers of the Jewish synagogues in Babylon. When once the reader has made up his mind to these inevitable conclusions, it will be quite easy for him to assign to Eastern archæology its full value in the solving of problems connected with the relations which existed between the Hebrews and the nations round about them, and the whole subject will assume its true proportions on his mental horizon.

In the first chapter of his work Mr. Boscawen treats of the lands of Nimrod, *i.e.* the countries which are commonly called Assyria and northern and southern Babylonia, and in a series of brief paragraphs he shows how the later historic kingdoms were developed from very ancient centres of government which were founded by people who made their way into Mesopotamia from a country lying to the north-east, and who spoke a non-Semitic language. The story of the earliest growth of civilisation in Babylonia forms the subject of the second chapter, and we are led on easily from the time when men were learning to make baskets and mats, and to draw rude figures of animals and objects, to the time when they possessed an elaborate system of writing, and had become consummate sculptors. From the numerous monuments which have been discovered on the sites of several ancient cities in Lower Babylonia, we learn that long before B.C. 4000 the civilisation which had been established in the country by non-Semitic invaders had taken deep root, and had reached a very perfect state. To illustrate this fact Mr. Boscawen supplies a facsimile of part of the inscription of Manishtusu, King of Kish, with an English translation, and the list of modified picture signs on p. 57 is not the least interesting portion of the chapter. Inserted in the chapter, somewhat oddly it seems to us, comes "The Legend of Creation," and Mr. Boscawen illustrates the old tradition of the fish-headed, man-god Oannes, who taught men to read and to write, and to sow, and to reap, and to build, from the Legend of Adapa. The alleged relation of the Garden of Eden with the grove of Eridu is discussed, and we are glad to see that Mr. Boscawen prints Mr. R. C. Thompson's translation of that portion of the tablet upon which it has been so inadequately based, and that he considers Mr. Thompson has succeeded "to a certain extent"; in our opinion Mr. Thompson's arguments are conclusive and his proofs final, but error dies very hard.

Mr. Boscawen's third chapter deals with the obvious affinity between the primitive civilisation of Mesopotamia and that of Egypt, and he skilfully drives home his arguments with the facts that have been deduced from the excavations of J. de Morgan at Nagada, in Egypt, and at Shushter (*i.e.* Shushan the Fortress, or Susa). Passing over two chapters, we now come to the consideration of the life and times of Khammurabi the Great. A few years ago Mr. L. W. King, of the British Museum, published a valuable monograph on Khammurabi, giving all the original texts from tablets in the British Museum and elsewhere, with English translations; it was tolerably easy to gather from this work that Khammurabi was a ruler of no mean order, but no one ever imagined how great a law-giver he was until the discovery of his famous "Code" by J. de Morgan at Susa. This wonderful document contains about 282 distinct "laws," and we shall hardly be overstating the case when we say that it is fully as comprehensive as the Hebrew Code, which is associated with the name of Moses, whilst it is certainly a thousand years older. It is wrong to say that it is the oldest code in the world, for that which is represented in the so-called Negative Confession of the Book of the Dead is far older. Since the publication of the original text by Father Schiel, many works have appeared on the subject, but the fullest monograph, and one which is of great importance from a comparative point of view, is that by Prof. D. H. Müller, of Vienna, who discusses at great length the relation of Khammurabi's code with that of Moses, and with the Twelve Tables.

For those, however, who lack the time and leisure necessary for comparing modern renderings of this difficult Babylonian text, but who wish, nevertheless, to obtain a good general idea of its contents, we commend the rendering given by Mr. Boscawen in his eighth chapter. The meanings of a number of words which are used in a technical sense are, of course, doubtful, but, speaking generally, the sense of the "Code" of Khammurabi has been well made out. The space at our disposal will not permit us to consider in detail the contents of Mr. Boscawen's chapter on the beginnings of literature, but we may say that the general reader will find in it a large number of interesting facts, as well as extracts from translations of Assyrian texts, made both by himself and by other experts. The book is well illustrated, and will, we believe, be widely read.

BIOLOGY AND ARCHÆOLOGY OF CENTRAL AMERICA.

Biologia Centrali-Americana; or Contributions to the Knowledge of the Fauna and Flora of Mexico and Central America. Edited by F. Ducane Godman and Osbert Salvin.

Archaeology. By A. P. Maudslay. 4 vols. text; 4 vols. plates. (London: R. H. Porter and Dulau and Co., 1889–1902.)

FROM the time of the Spanish conquerors up to our own, a glamour of romance, mingled with hopes of easily gained riches, has hung over the ruined cities of Central America. The fortunate chance that prevented Mr. J. L. Stephens from performing his consular functions in Central America on behalf of the United States Government first gave the modern world a true idea of their character and rendered easier the explorations that have been made during the sixty years that have passed since his account appeared. His book and the drawings of his English colleague, Catherwood, form no unworthy monument to the talents and industry of the two explorers, and will compare favourably with most of the contemporary works in the more trodden fields of archæology.

The modern student, however, is an exacting taskmaster; he realises that no domain of archæology can be profitably studied without reference to others, and he insists upon accurate measured drawings, carefully oriented ground plans, and reproductions by processes that eliminate as far as possible the chance of personal bias or error. Given time, money and intelligent enthusiasm he can obtain all these, though it is but rarely that these conditions have been so harmoniously conjoined as in Mr. Maudslay's "Archæology" in the "Biologia Centrali-Americana." That such a publication as the "Biologia" should have a section devoted to archæology is entirely due to the old friendship subsisting between the author and the munificent editors, Mr. Ducane Godman and the late Mr. Osbert Salvin, who generously offered to include the results of Mr. Maudslay's researches in their magnificent publication. Students of American archæology as well as Mr. Maudslay can only be grateful to them for the elasticity that they have given to their biology. Four volumes containing about 400 plates, measuring 18 inches by 12, and as many volumes of quarto text, admirably printed, represent a whole that few publishers would hesitate to regard as an unprofitable speculation, where the subject treated is American antiquities. Mr. Godman has added another leaf to the crown of English men of science, though it is probable that appreciation will be less in his own country than beyond the Atlantic.

It seems by no means unlikely that the completion of this great work, which has taken fourteen years in the doing, will place the study of the Maya hieroglyphs and other remains on a surer basis than has heretofore been possible. Mr. Maudslay systematically gives, where possible, photographs of the monuments and inscribed slabs, and, as many of these are injured, puts beside the photograph a careful outline drawing with any restorations for which authority may exist. Thus his plates provide an invaluable *corpus* of Maya inscriptions, absolutely trustworthy on the point of accuracy, which cannot but serve as a starting point for their interpretation. It must not, however, be thought that this monumental work is silent as to the meaning of the hieroglyphs, for a stout appendix of 144 pages contains a detailed explanation of their purpose and meaning. This contribution is not from the pen of Mr. Maudslay, but is written by Mr. J. T. Goodman, a Californian enthusiast on the subject of Maya history. From his too modest preface we gather that he has spent twelve years in conjunction with Dr. Gustav Eisen, of San Francisco, in this study, and that the present work is only a preliminary sketch, written expressly to accompany Mr. Maudslay's work.

Mr. Goodman has but little respect for the methods of those who have, or should have, attempted the interpretation of the mysterious writings, and his position may be stated in his own words, that he has lost confidence in the ability of learning, but retains faith in the genius of ignorance. Such a confession may act as a deterrent or an attraction; but its candour and courage are manifest. Mr. Goodman writes of the "Archaic system" found at Palenque, Copan, Tikal and elsewhere, that "all the inscriptions so far brought to light are of a purely chronological character, destitute of any real historical importance." This of itself is no mean discovery, if further research should confirm it, and it must be confessed that the elaborate tables here published have been extensively used by subsequent workers.

It is impossible here to do more than state that from the external evidence, Spanish and other, Mr. Goodman's scheme is probable. One of his fixtures may be mentioned to give an idea of the vast sea of chronology on which we are embarked, viz., that the period chronicled in the existing Maya inscriptions was the beginning of the last quarter of their grand era, marked by the observance of its 280,000th year! Truly the New World is the older one, and instead of looking for the origin of American civilisation on this side of the world we should try the other way about. Whether or no the ancient culture of the American continent is indigenous is a question not likely to be answered in our time. The one point on which all are agreed is that if any connection or influence existed it must have been at a time so remote that geological rather than chronological methods of computation must be invoked.

It is, therefore, somewhat childish to insist upon small coincidences, the occurrence of particular patterns and the like. The existence of the oriental game of *pachisi* is certainly a remarkable fact and worthy of note, and the resemblances in style between the architecture of Egypt and that of Central America are equally so. But all primitive folk have games, and the evolution of *pachisi* in two independent centres is conceivable; while the architecture both of Egypt and of ancient America is, after all, little more than the piling of stone upon stone. The decorative part of the buildings is another matter. If, however, it could be shown that there was an identity of method in computing time between the Maya and any of the nations of antiquity in the eastern hemisphere, that would be truly a step towards fulness of knowledge. One point related to such matters has, as a matter of fact, been already satisfactorily determined, viz., the identity of orientation of temples in Yucatan and in Egypt, pointing to sun-worship at the same seasons and the use of the same northern stars in both countries, according to Sir Norman Lockyer. Here truly is a good solid basis for relations or communication between the two, and so good a starting point should prove fruitful both of accurate observation in the future, and show the direction that serious investigations should take. It is to the United States that the world naturally looks for sustained efforts to solve the archæological problems of Central America, and there are many signs that well-equipped students will not be wanting. Meanwhile, England may justifiably take pride in having produced the most important book on the subject, while Mr. Maudslay is to be congratulated on the completion of a *magnum opus* involving so great an amount of personal labour—a labour of love it certainly was—and on the possession of a friend like Mr. Godman to put his results before the public in so worthy a guise.

FRICTION IN MACHINERY.

Friction and its Reduction. By G. U. Wheeler. Pp. viii+171. (London: Whittaker and Co., 1903.) Price 3*s.* net.

A Treatise on Friction and Lost Work in Machinery and Mill-Work. By R. H. Thurston. Pp. xi+425. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd., 1903.) 7th edition. Price 3 dollars.

MR. WHEELER'S book is a reprint in the main of a series of articles contributed by the author to a technical journal, but a considerable amount of new matter has been added; it deals fairly completely with the subject of friction in machinery and the means adopted for its reduction. The first two chapters are devoted to a discussion on the importance of the subject from a mechanical engineer's point of view, and to brief statements of the laws of solid, rolling, and fluid friction. Then follow a series of chapters bringing together in a very convenient form for reference all the experimental work on the subject of friction likely to be of value to those engaged in the design of machinery.

We would point out, however, that the author has failed in several cases to give exact references to the original sources from whence his tables and other data have been obtained; this is unfortunate, as very often those making use of the book will be anxious to refer to the original memoirs. Some account is then given of the physical properties, such as specific gravity, flash point, temperature of solidification, &c., of the most important of the oils now used for lubricating purposes, and a description of the apparatus commonly employed in connection with their determination.

Though the illustrations are, as a rule, clear enough, there are a few instances where it is difficult to follow the author's description of pieces of apparatus owing to the fact that symbols used in the letter-press description are not printed on the corresponding illustration.

After a brief description of the various appliances used in connection with the distribution of the oil to the working parts of machines, the author discusses the comparative value of various lubricants from the point of view both of cost and of suitability for different classes of work. Ball-bearings and roller-bearings are dealt with in two chapters, but this part of the book is by no means so complete as the earlier portions; the last chapter, which explains "forced" lubrication, might with advantage be considerably extended in any new edition. The book, however, will be found very useful for reference purposes, both by those engaged in the design and by those who have charge of machinery on a large scale; information previously scattered through various publications has been brought together into a very compact form.

The fact that Prof. Thurston's book has now reached its seventh edition is a proof of how well it has done its work in spreading among engineers a knowledge of the importance of sound investigation into the energy losses brought about by friction and the best means of lessening them. The author, whose death we had so recently to deplore, has added much fresh matter in this new edition, and brought up to date the chapters dealing with experimental investigations on friction. In the additions Prof. Thurston describes the latest researches in regard to friction in high speed electric generators and motors, and in turbines; the experimental work of Lasche is summarised very fully and clearly, and his graphical methods of recording the results of various experiments by the three coordinate system are explained, the three coordinates being pressure, velocity and temperature of lubricant. The chapters dealing with lubricants and the best methods of testing them have also been considerably revised, and amongst other additions we notice several sections treating of roller and ball bearings. The book is now probably the best reference work on friction at the disposal of engineers engaged in the design of machinery.

T. H. B.

THE FLORA OF THE SWISS ALPS.

Geschichte und Herkunft der schweizerischen Alpenflora. By M. C. Jerosch. Pp. vi+253. (Leipzig: W. Engelmann, 1903.) Price 8s. net.

THE attempt to trace the origin of a flora is so much a matter of speculative argument that it is only natural to find very divergent opinions expressed by different authorities. The object of this book is not to offer a new theory regarding the origin of the flora of the Swiss Alps, but to bring together the views which have been put forward by leading botanists, partly for reference, partly with the object of comparing them and criticising them so far as it is possible to criticise the evidence of experts.

The primary basis upon which to formulate hypotheses is obtained by a comparison of the flora of the Swiss Alps with the floras of other regions in which many of the same plants are found. The occurrence of similar forms in the Arctic and Alpine regions is well known, and from the appearance of the species in different mountainous or Arctic regions it is possible to separate them into groups, such as the Arctic Alpine, the mid-European-Alpine group, and so on. The next step is to consider where these forms may have originated. Take, for instance, a form which appears in the Arctic regions, in the Altai Mountains, and also in the Swiss Alps. Was the original progenitor a native of any of these districts, or even elsewhere? By what path did it travel from one locality to another, and when? Some information may be gained by consulting geological records, and for this purpose the salient features of the post-Tertiary formations are submitted. A most important consideration is the effect of the Glacial period, whether the conditions were too severe or whether a portion of the present Alpine flora could have existed during the Glacial epoch; this has an important bearing on the age of the endemic species in the Alpine flora. On this, as on all hypothetical points, there is a great diversity of opinion. Christ, Heer, and Schröter are amongst those who favour a pre-Glacial origin, but Schulz, Nathorst and Clement Reid hold the view that vegetation was very much reduced at the best during the Glacial period.

Then follows the most difficult because the most speculative question, which refers to the original home of these plants. To consider again those forms which have now found suitable conditions in such scattered and diverse areas as the Arctic regions, the Alps, and the Altai Mountains, the Arctic region is postulated as the original source by Heer, Chodat and Pokorny; Hooker regards Scandinavia as the probable original home; Christ refers them back to the temperate regions of northern Asia, and considers that the Arctic regions merely represent the line of travel; and finally Briquet offers an entirely different solution, since he favours the possibility of the same species having originated in more than one locality.

These examples will give some idea of the complex and difficult problems which confront the systematist who endeavours to unravel the past history of even a highly specialised flora, and will indicate how widely diverse are the explanations which are offered by well qualified investigators. It will be inferred that the writer has had no easy task in stating briefly and impartially the various arguments. To weigh up definitely the pros and cons is impossible, but the criticisms of the author are very fair, and display considerable acumen. The scope of the book is indicated by the fact that the bibliography covers ten pages, and not the least interesting chapters are those which discuss the origin of species and the climate of the Alps.

OUR BOOK SHELF.

The Planning and Fitting-up of Chemical and Physical Laboratories. By T. H. Russell, M.A. Pp. xx+178. (London: B. T. Batsford, 1903.) Price 7*s*. 6*d*. net.

THE young college graduate at the present time frequently finds himself confronted with the problem of installing a science laboratory in the school which he may have chosen as the scene of his first teaching experience. The laboratory in which he has been working has, it may be, developed through various stages of incompleteness into an institution capable of supplying his every want, whether in the form of apparatus or of other equipment. The student has, however, in most cases taken but little part in this gradual evolution, and in general feels greatly at a loss if compelled afterwards to work in some institution less elaborately equipped. Still more difficult is his task if called upon to equip a new laboratory, and perchance in a building which the architect has most satisfactorily designed for any purpose but that of a science laboratory. Much assistance can be gained by those placed in such a position from the excellent little book before us, which deals in a practical manner with the general design and equipment of an elementary, chemical, or physical laboratory. Dimensioned drawings are provided of suitable working benches and other fittings, and in addition, useful notes as to the best manner in which to apportion the space available.

For the satisfactory planning of a university or college laboratory, considerably more experience than can be gained from a book of this kind is, of course, necessary. The author seems to have noted carefully the best practice in some of our own more recently equipped institutions, but has made some rather curious omissions which one would be glad to see remedied in future editions of the book. What physical or even chemical laboratory at the present day is complete without a satisfactory electrical equipment? The design of the most suitable and convenient system of distributing the electric current to different parts of the laboratory is one of the most difficult problems which have to be faced. Yet the author makes absolutely no mention of such fittings, neither does he give even general hints which would be of guidance in this matter.

It is, moreover, to be regretted that no use is made of Continental experience, which, in the matter of laboratory equipment, is really very valuable. Since, in Germany, it is the custom to publish full descriptions of any new and important laboratory, it would have been a very simple matter to at least refer to such literature. The new chemical laboratory of Prof. Emil Fischer in Berlin makes a particularly valuable study to anyone dealing with laboratory design, the completeness and elegance of the installation being probably unique so far as a teaching institution is concerned.

However, so much that is good can be found in the book that it is almost ungrateful to point out such omissions. R. S. H.

The Highlands of Bukhara. Part ii. Hissar, the Range of Peter the Great, and the Alai. St. Petersburg, 1902. By V. I. Lipskiy. Pp. 220; with 18 plates (Russian).

THIS is a new volume of the fine series of works on Central Asia published by the Russian Geographical Society. M. Lipskiy describes in it his journey across the western portion of the beautiful snow-clad Hissar Range, then the valley of Kafirnagan and the Surkh-ob, which flows at the southern foot of this range, and finally the range of Peter the Great, which runs parallel to the former, south of the Surkh-ob. This last range M. Lipskiy crossed four times, following three different passes, and he explored in more detail the picturesque region of glaciers in the eastern portion of the range, east of the Gardán-i-kaftár Pass. Three great glaciers, to which the traveller gave the names of Borolmáz (from a peak of the same name). Peter the Great's, and Oshánin's (from the first explorer of this range), are described in detail, and the descriptions are accompanied by excellent photographs. It is sufficient for the glacialist to cast a glance at some of these photographs in order to say that the present glaciers must be but small remains of a much greater glaciation, and that the valleys they now occupy must have once been filled deeply with ice. This is also the opinion of M. Lipskiy, who has discovered immense moraines across the upper valleys and other traces of a wide glaciation. The altitude of the range of Peter the Great seems to be less than it was supposed to be, namely, about 17,000 feet. That the Alai Range is a continuation of the Hissar Range can now be taken as certain, and consequently the range of Peter the Great must be a continuation of the Trans-Alai, a border-range of the western, Bukhara portion of the Pamir plateau. Traces of upheavals in a direction N.W. to S.E. seem also to exist. Throughout, in describing his mountaineering, M. Lipskiy gives lists of the plants he saw. P. A. K.

The British Journal Photographic Almanac, 1904. Edited by Thomas Bedding. Pp. 1604. (London: Henry Greenwood and Co.) Price 1*s*. net.

LIKE its predecessors, this volume is of considerable thickness, containing no less than 1604 pages. It is the forty-third yearly issue, and as usual contains a veritable mine of useful information which should appeal to every photographer. When so much matter is involved, it is difficult to refer to one subject more than another; attention, however, may be directed to the "epitome of progress," compiled by the editor, which contains an excellent *résumé* of the more important papers published throughout the past year. The main portion of the text matter is devoted to numerous short articles on miscellaneous photographic topics, tables of all descriptions, and a most complete collection of photographic formulæ and recipes. A great number of illustrations are scattered among the text, and the volume contains a mass of advertisements handy for reference. The fact that the 25,000 copies forming the edition were fully ordered several weeks before publication speaks volumes for the popularity of this book.

Erdmagnetismus, Erdstrom und Polarlicht. By Dr. A. Nippoldt, jun. Pp. 136. (Leipzig: G. J. Göschen, 1903.) Price 80 pf.

THIS volume, which is No. 175 in the excellent "Sammlung Göschen," well maintains the high standard of the series. It is difficult, indeed, to see in what way these tiny volumes could be improved. Most careful pruning must have been exercised by each author, and the result is a concise, compact summary of present-day knowledge. The subjects of the chapters are the magnetic elements, the permanent magnetism of the earth, the variations of the earth's magnetism, earth currents, and the aurora. The variations are illustrated by diagrams, and include secular, daily and annual variations and their theory, magnetic storms, the eleven-year period, and influence of the sun, moon and planets.

There are three plates showing magnetic distributions.

For mathematical theory reference is made chiefly to vol. lxxviii., "Theoretische Physik," in the same series. There is a sufficient literary summary provided.

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.*]

Science at Oxford and Cambridge.

I HAVE read with great interest Prof. Perry's article on "Oxford and Science" and his letter in NATURE of January 21, and assuming as I do that his remarks apply equally to Cambridge, I know that he has in no way overstated his case. There are one or two effects of the present system which I feel that he has scarcely brought out sufficiently strongly, and on which I lay the more stress, as I consider that they are harmful in more ways than one.

I well know the asphyxiating atmosphere of which he speaks, and I compare it to that of a septic tank the contents of which are reduced in time to the form of an innocuous but useless effluent. Had they been spread out over the country at large they would have been of value in raising up a fertile growth of scientific progress.

The university professor is generally in a position to disregard the apathy of his university, and to pursue researches for their own sake. In the case of the enthusiastic student who is desirous of embarking on a career of teaching combined with research, the effects of the present system are far more deadly, especially if he belongs to a small college where the mediæval atmosphere is usually most concentrated.

In the present day it is generally impossible, and if possible it is always highly inexpedient, that a man should devote his energies to research, pure and simple, without taking some part in the educational work which is being carried on all around him. But the man who, after taking a brilliant degree *in arts or science*, seeks to associate himself with the teaching and examining work of his college or university, frequently finds himself baulked at every step by the opposition of a hostile but influential *clique*, although he is being continually urged by his friends to remain at the university in the hope that he may ultimately obtain that recognition which is freely conferred on men of less originality. Although the dons of his college will not raise a finger to help him, they do everything in their power to dissuade him from engaging in such outside work as a man without teaching experience has a reasonable prospect of obtaining in these days of competition. When a good professorship falls vacant, they write testimonials belauding his original work, of which they know nothing, but his candidature breaks down as soon as questions are asked about his teaching experience.

[A striking contrast to this spirit is seen in the excellent work done by certain well organised departments, such as the Cavendish Laboratory and a few enlightened colleges.]

What I have attempted to describe is not the experience of a single individual; from the number of cases that have come before my notice I feel sure that it must be a common experience.

I now pass to the other side of the question. When a vacancy occurs in a university college, it frequently happens that there is one candidate whose brilliant distinctions place him far above his rivals, and whose appointment would *in all probability* greatly conduce to the success and welfare of the department of which he would have charge. The electors would gladly appoint him if *any* definite evidence could be adduced as to his capability of discharging the duties required of him, but failing such evidence they are obliged, after a long and protracted discussion, to choose the second candidate on their list.

I know men who have broken through the barrier, both from Oxford and from Cambridge. I am glad to have such men as colleagues, for I know that they are doing splendid work in raising up a high standard of university education throughout Greater Britain.

Our university colleges have not been afraid to establish scholar assistantships in departments in which the work is too heavy for the existing staff. Why should not the same procedure be adopted at Oxford and Cambridge? This would often enable the colleges to give their best graduates a good send-off into the world, and it would relieve the present teaching staffs of much burdensome routine work. We might even have college tutors waxing enthusiastic over scientific research! G. H. BRYAN.

The Radiation from an Electron moving in an Elliptic, or any other Orbit.

I HAVE been looking for a tolerably simple way of expressing the radiation at a distance from an electron, to avoid the work involved in reducing the general formulæ (NATURE, November 6, 13, 1902) in special cases. The result is

$$\mathbf{E}=\frac{\mu Q}{4\pi r}\ddot{\mathbf{s}}\sin\gamma, \tag{1}$$

subject to

$$R=v(t-t_1). \tag{2}$$

Here understand that Q is the charge moving in the path defined by the vector $\mathbf{s}$ from the origin at the moment t_1, and $\mathbf{E}$ is the electric force at the corresponding moment t at the point P at the end of the vector $\mathbf{r}$ from the origin, at distance R from Q, and γ is the angle between $\mathbf{r}$ and $\ddot{\mathbf{s}}$. That is, the electric force is the tangential part of the vector $\ddot{\mathbf{s}}\mu Q/4\pi r$, or the part perpendicular to $\mathbf{r}$. The magnetic force is perpendicular to $\mathbf{E}$, given by $E=\mu vH$. It is assumed that s/R is very small, but no assumption has been made about u/v, so the waves are fully dopplerised. The dot indicates time-differentiation at P.

Example. Elliptic orbit. Let

$$\mathbf{s}=\frac{1}{n}\left(\mathbf{i}u_2\cos nt_1+\mathbf{j}u_1\sin nt_1\right). \tag{3}$$

Then Q describes an ellipse in the plane x,y, axes u_2/n and u_1/n, where $n/2\pi$ is the frequency. It is the spring or pendulum kind of elliptic motion. Describe a spherical surface with centre at the centre of the ellipse, and project $\mathbf{s}$ upon the surface, and insert the result in (1). Then we get

$$E_\theta=\frac{\mu Q}{4\pi rn}\cos\theta\frac{d^2}{dt^2}\left(u_2\cos\phi\cos nt_1+u_1\sin\phi\sin nt_1\right), \tag{4}$$

$$E_\phi=\frac{\mu Q}{4\pi rn}\frac{d^2}{dt^2}\left(u_2\sin\phi\cos nt_1-u_1\cos\phi\sin nt_1\right), \tag{5}$$

expressing the θ and ϕ components of $\mathbf{E}$ at the point r,θ,ϕ, if θ is measured from the z axis, and ϕ from the plane z,x.

Yet one thing more. The connection between t and t_1 is

$$nt_1=n\left(t-\frac{r}{v}\right)+\frac{\sin\theta}{v}\left(u_2\cos\phi\cos nt_1+u_1\sin\phi\sin nt_1\right), \tag{6}$$

which gives

$$\dot{t}_1=\left\{1-\frac{\sin\theta}{v}\left(u_1\sin\phi\cos nt_1-u_2\cos\phi\sin nt_1\right)\right\}^{-1}, \tag{7}$$

which is required when (4) (5) are differentiated. This process introduces the factor $\dot{t}_1^3$, and so, at high speeds, converts the radiation into periodic pulses, as in the case of a circular orbit (NATURE, January 28, p. 293). Put $u_1=u_2=u$ in the present formulæ to reduce to the circular. The analysis to simply periodic vibrations may be done in a similar way. If the motion in the elliptic orbit is of the planetary kind, the equation (3) is replaced by a much less manageable one. Electrons can conceivably vibrate in both these ways, according as the centre of force is condensed positive electricity, or is the centre of diffused positive electricity.

This is not the place for detailed proofs, but I can indicate one way of representing the matter which has some interest apart from the speciality of orbital motion. Given that Q is moving anyhow, it may be shown that my general formula for $\mathbf{E}$ may be converted to

$$\mathbf{E}=\frac{\mu Q}{4\pi}\ddot{\mathbf{R}}_1+\frac{\mu Qv}{4\pi R^2}\left(\dot{\mathbf{R}}-3\dot{R}\mathbf{R}_1+v\mathbf{R}_1\right) \quad (8$$

This gives $\mathbf{E}$ at P, at distance R from Q, and $\mathbf{R}_1$ is the unit vector $\mathbf{R}/R$. The centre varies as we shift P, because Q is moving. It is always to be understood that Q and P are at every moment of time uniquely connected when $u<v$. Any value given to t fixes a corresponding value t_1 for Q, and its position as well. This formula (8) is a very curious way of representing $\mathbf{E}$, and physically very unnatural. But the form of the first part is such that it leads easily to the radiational formula above given. Reject the second part of $\mathbf{E}$ in (8), because it varies as R^{-2}. Then carry out d^2/dt^2, and reject the R^{-2} part again. There is left

$$\mathbf{E}=\frac{\mu Q}{4\pi R}\left(\ddot{\mathbf{R}}-\ddot{R}\mathbf{R}_1\right). \qquad (9)$$

Lastly, put $\mathbf{R}=\mathbf{r}-\mathbf{s}$; then $\ddot{\mathbf{R}}=-\ddot{\mathbf{s}}$; and if s/r is very small, $\ddot{R}=-\ddot{\mathbf{s}}\mathbf{r}_1$. So we come to the formula (1) above, as required. I hope this will be satisfactory. If not, there are lots of other much more complicated ways of doing the work.

OLIVER HEAVISIDE.

January 28.

Corrections in Nomenclature: Orang Outang; Ca'ing Whale.

KINDLY allow me a line or two in NATURE to point out that *Orang outang* is not the correct designation for the large anthropoid of Borneo and Sumatra, although it has now obtained, perhaps, what may seem a prescriptive right in our language. Nevertheless, it is as well to be accurate as not. *Orang utan* (or *outan*, if preferred), the correct Malay name for this ape, signifies (as is well known) *Orang*, man, and *utan*, forest, *i.e.* the forest man, in contradistinction to the *Orang dusun*, or village (civilised) man. *Orang utang* (or *outang*) is nonsense. *Utang* means *debt*, something *owing*. The correction has been made often before, but the occurrence of the erroneous combination in the latest abstract of the *Proceedings* of the Zoological Society and in a recent zoological work induces me to venture, in the interest of accuracy and of those who understand the Malay language, again to direct attention to the proper spelling.

In a previous issue of NATURE (March, 1901) you kindly afforded me space to point out the erroneous use also of "*ca'ing*" for "*ca'in*," as the Anglicised (or Scotticised) appellation for *Globiocephalus melas*. My friend Sir H. H. Johnston, I observe, in his recent elegant work on British mammals uses "ca'ing whale." I hope he will accept this small correction for his second edition. Ca'in is, of course, really equivalent to "call in." "Call" in the Scottish vernacular = ca' = drive: the "drive in" whale. Here the use of "ca'ing" = calling would be inappropriate, as the *whale* does not "call," either in the sense of "bellow" or "drive." If, however, it be argued that "ca'ing" does stand for "calling," the essential word "in" is omitted, and ought to be supplied. The pilot whale is the species, which in the islands to the north of Scotland so frequently occurs in large "schools," when it is invariably "driven in" for capture on the shore by a surrounding fleet of boats.

HENRY O. FORBES.

Museums, Liverpool, January 30.

Strange Winter Scenes connected with Lough Neagh.

AT the close of the long frost in February, 1895, strange phenomena occurred in connection with Lough Neagh, in the north of Ireland, the largest lake in the United Kingdom, and one of the larger ones of Europe, covering as it does an area of upwards of 150 square miles. The lake had been frozen over for a fortnight, and thousands of people had indulged in skating on ice almost as smooth as glass.

On February 22, the last day but one of the skating, though unknown to the multitudes gathered near Antrim, the ice in the central portion of the bay broke up, but left intact a sheet of about a third of a mile wide along the south-eastern shore. At a point about six miles from Antrim, this unbroken shore portion was at intervals of a few yards for a mile and upwards raised into little tunnels or bridges, from beneath which pieces of ice, large and small, along with some boulder stones of considerable size, were shot on to the land, eventually forming a ridge varying in height from two to fourteen feet, and perhaps twenty feet broad at the base. The jingling and crashing heard during the operation, which lasted for two days, were very great, and to some persons residing near most alarming. Ice has often been seen piled up along the shore at certain points, five or six feet high, but this has been shore ice thrown up by waves, whereas the ridge referred to was not shore ice, that, as stated, remaining unbroken for a third of a mile out.

I met with only one person who had witnessed a similar scene to the one described. She had resided near the lake all her life, and remembered the long frost of 1814–15, when the lake was frozen over and a great ice ridge was thrown up. On both occasions a person could walk along the road near the lake and yet not see it, in consequence of the intervening ridge. Where did the ice forming this ridge come from? And what was the force employed to convey it to, and shoot it on to the shore?

At a spot on the same south-eastern shore of Antrim Bay, about midway between that previously mentioned and Antrim, a similar scene in one respect, but on a greatly reduced scale, was witnessed. A man when passing along a lonely, wooded part of the road, at a considerable distance from the lake, heard great hissing and fizzing, in a jerky, intermittent manner. On making his way through the underwood to the place from whence the sounds proceeded, he was astonished to see a large stone, estimated to be several hundredsweight, being ejected from beneath the raised ice, and at the same time large quantities of water squirted from the apertures near it. Immediately the propelling force ceased, the stone fell back and the squirting stopped. It was somewhat risky to venture near, but three persons did so to see if they could withstand the propelling force of the water giant, but they found the effort ineffectual, and got drenched for their pains. Through some obstruction, or the stone being too heavy, it was not ejected from the lake.

It would be interesting to know the causes of these phenomena, and also whether they have been observed in connection with lakes elsewhere.

If further information is desired by any reader interested in this matter, I shall be happy to give it if able.

The Manse, Antrim, January 26.

W. S. SMITH.

The α Rays of Radium.

IN Mr. Soddy's article on radio-activity in your issue of January 28, he remarks as peculiar the fact that the α rays possess the "property of being more difficult to deviate for any given strength of field the greater the distance of air traversed." Surely if these rays consist of positively charged material particles, their velocity must diminish in proportion to the distance of air traversed, and hence their magnetic effect, and consequently their deviability, must diminish also.

I have unfortunately missed Prof. Rutherford's proof as to the probable difference in speed with which the α particles from the successive disintegrations are shot off. Could Mr. Soddy supply the reference, as there seems no obvious reason why this should be so?

J. T. NANCE.

Bromsgrove School, Worcestershire, February 2.

IT is true, as Mr. Nance points out, that the velocity of the α rays may be expected to diminish in proportion to the distance of air traversed, and it follows, therefore, that the magnetic deviability should correspondingly increase, for the displacement experienced by the particle in unit time by a constant magnetic force from the position it would occupy if no force were acting is constant. With diminishing velocity the displacement in unit distance, and therefore the angular deviation, must increase.

The complexity of the α rays of radium was referred to by Prof. Rutherford in his paper in the *Phil. Mag.* for February, 1903, in a footnote to p. 184. Only 25 per cent. of the α rays come from the radium, the remainder originating from its successive disintegration products, viz. the gaseous emanation and the matter causing the excited activity. As these three types of matter have no resemblance whatever in their material nature, it would be a remarkable coincidence if the α particles expelled in their several disintegrations happened to possess the same momentum in each case. This is the condition necessary for the α rays of radium to be deviated as a homogeneous pencil in a magnetic field.

FREDERICK SODDY.

Coloured Haze around the Moon.

All last night there was a very strongly marked circular space of hazy reddish colour about the moon of about 20° radius; towards morning (2 to 4 a.m.) the colour was most pronounced.

The weather was very fine all night, the temperature being about 20° F. and the humidity from 30 to 40 per cent. There was very little haze in the lower atmosphere, the snow on the hill-tops being silvery white to the verge of the horizon, about 50 miles distant. Immediately above the horizon to S.W. there was, at 3 and 4 a.m., a belt of dark copper-coloured sky, the upper edge of which (at 3 a.m.) just touched the lowest part of the coloured space round the moon. There was some cirrus about the moon at times, and on this part of a halo was faintly marked at 2 and 3 a.m. At 4 a.m. filmy cirro-stratus radiating from the south was more general, and the halo was almost complete. The above phenomenon, however, seemed quite different from the ordinary cirrus haze, and so far as could be observed had no trace of either halo or corona connected with it. Angus Rankin.

Ben Nevis Observatory, February 1.

THE NEW EDUCATION AUTHORITY FOR LONDON.

By the provisions of the Education (London) Act, 1903, which comes into operation on May 1 next, the control of the education of London becomes a duty of the London County Council. After that date education in London is to be administered as an organic whole and is no longer to consist of separate, unrelated parts. In place of the London School Board administering the elementary education given in schools provided by the ratepayers, the London Technical Education Board regulating the instruction given in accordance with the Technical Instruction Acts, and the governing bodies supervising the work of various grades of secondary schools for boys and girls, the London County Council becomes the authority for the whole of London's education—elementary, secondary, technical and higher.

The Act which brings about this complete and momentous change enacts that the Council shall establish an education committee in accordance with a scheme made by the Council and approved by the Board of Education. Chiefly with this object in view the London County Council, on November 10 last, referred the Education (London) Act, 1903, to its General Purposes Committee to advise as to the practical steps to be taken for the administration of the Act. This committee reported to the Council at its meeting held on January 26, and the report, containing suggestions as to the constitution of the Education Committee which were adopted by a large majority of the Council, deserves the earnest attention of all who have at heart the educational welfare of the metropolis.

Before considering the result at which the Council has arrived, it is desirable to recall that the Act of 1903 was intended to adapt the Education Act of 1902 to the particular needs of London. In detailing the methods to be followed in appointing an education committee, the earlier Act directs county councils to provide for the appointment by the council, on the nomination, where it appears desirable, of other bodies, of persons of experience in education, and of persons acquainted with the needs of the various kinds of schools in the area for which the council acts. It may be remarked that of 271 schemes approved by the Board of Education, some two-thirds provide for such co-opted members with expert knowledge. County councils are also directed to include women as well as men among members of the committee. But the number of members to constitute the committee is left to the discretion of the council.

The report now presented to the London County Council recognises the preparation of a scheme for the Education Committee as the chief duty which falls to the Council under the new Act, and the General Purposes Committee seems to have considered with due care, if not with complete understanding, schemes adopted in various local areas throughout the country, the model set them by the constitution of the London Technical Education Board, and the duties to be performed by the new Education Committee. The result of their deliberation has been strongly to "advise the Council to place two objects before it in constituting the Education Committee—(1) that the committee shall be one which will work harmoniously with the Council in developing a complete and well co-ordinated system of London education; and (2) that its constitution shall be such as to retain one of the greatest public interests under real public control as far as possible." With these objects little fault can be found, and it should have been possible to ensure both these ends and yet to have secured the assistance of co-opted members with special knowledge of the needs of every grade of education in London from the primary school to the university. Yet the report continues: "We propose that the committee shall consist of thirty-five members of the Council, with the chairman, vice-chairman and deputy-chairman, and that in accordance with the provision of the Act five women should be added, to be chosen for their experience in education. We think that the committee would be strengthened by the appointment during the term of the first committee of members of the present London School Board, and we recommend that power should be taken to add five such members. The first committee would, therefore, consist of forty-eight members." These recommendations of the committee were, after a debate consequent upon a proposed amendment, adopted, "only a few hands being held up against" them.

The scheme thus approved by the London County Council has still to be sanctioned by the Board of Education, and it may yet be hoped that an arrangement will be arrived at by which the committee—with its thirty-eight county councillors, five women and five present members of the School Board—will be strengthened by the inclusion of men fully conversant with the higher educational needs of London. The London County Council seems hardly to have been sufficiently impressed with the gigantic proportions of the task before it in co-ordinating the existing unrelated educational forces in the metropolitan area, and with the difficulties to be overcome, difficulties which can only be appreciated adequately by those familiar with London's peculiar educational requirements and deficiencies. And this is the more remarkable in view of the excellent work accomplished by its own Technical Education Board during the last decade, on which board representatives of the City and Guilds of London Institute, the London Trades Council, the trustees of the London Parochial Charities, as well as of associations of schoolmasters have acted, apparently with a due sense of their responsibility, though, during the debate upon the report, the chairman of the Technical Education Board, while testifying to the usefulness of having experts on the board, said "he always found that they did not act or vote with the same sense of responsibility as did the members of the Council on that body." His subsequent remarks, however, seemed rather to indicate that his view of responsibility meant the application of the test whether the ratepayers would approve every expenditure sanctioned by the Board. But one of the reasons for the inclusion of co-opted members with special knowledge is that there shall be a greater chance of having an educational policy adopted which aims first to secure a good system of education and regards a small increase of the rates as a secondary consideration.

Readers of NATURE do not need to be reminded of the paramount importance of improving and completing the facilities for higher technical and for university education in London. As Sir Michael Foster said in the House of Commons, during the second reading debate on the Education Act of 1903, the new education committee and the reconstituted University of London must work together for the better education of the people of London, and the new committee must be interested in university as well as in secondary and elementary education. If, as the chairman of the General Purposes Committee remarked on proposing the adoption of the scheme outlined above, "the Education Act has any merit, it is that it co-ordinates the whole of the work of education in London." This being so, the University of London must be regarded as the necessary complement of any system of primary and secondary education in London, and the work of the University on one hand and of the schools on the other must be fashioned so that one completes what the other has appropriately prepared. To ensure this the new committee should in its deliberations be assisted by broad-minded men familiar with the work and aspirations both of the schools and of the University, and the ordinary councillor, appointed to perform a variety of administrative duties, cannot be expected to possess the necessary knowledge and experience.

The Acts to be administered clearly specify that "the local education authority shall consider the educational needs of their area and take such steps as seem to them desirable, after consultation with the Board of Education, to supply or aid the supply of education *other than elementary,* and to promote the general coordination of all forms of education," and "education other than elementary" includes not only secondary but technical and university education. It is unnecessary to point out—it has been so often done in these columns—that to aid higher education is by no means to interfere with its administration. Higher education is a matter of national importance, and is properly governed only by men with special training and varied experience. Though it would be a misfortune for any education committee to hamper the work of, say, a senate of a university by unintelligent and unnecessary dictation, it should be the aim of every such authority to encourage, assist and advance university work by every means in its power, and this can alone be effected by the presence at its meetings of expert members.

In July last we described proposals made by Lord Rosebery in a letter to the chairman of the London County Council for the establishment of a great institute of technology in London, and in a subsequent issue we recorded the fact that the Council had, in certain circumstances, agreed to provide some 20,000*l.* a year towards the maintenance of the educational work of such an institute. In view of such an arrangement as this it is surely desirable that there should be upon the new education committee some members at least fully conversant with university and higher technical education, even on such low grounds as to ensure that the Council obtains a due return for its public-spirited policy. So, if it were necessary, other instances of the practical importance of including representative persons with special qualifications upon the new committee could be given. The fact is there seems to be an ingrained dislike in this country to make use of experts. While abroad the opinions of great men of science are, even in national councils, treated with honour and respect, with us they are more or less ignored, and the example set in high places is followed by authorities of local importance only.

The London County Council is face to face with an opportunity, pregnant with possibilities, for equipping London educationally in a manner befitting the capital of a great Empire. But there is grave danger that the opportunity may be missed, and that London may continue ill-provided with facilities for the instruction of its sons and daughters in a manner to enable them properly to fulfil their destiny. So vital to our national welfare is this question of levelling up London's education that we can afford to neglect no means to ensure success; and to pass over and ignore completely the experience of those whose lives have been spent in studying educational and scientific requirements is a suicidal policy which we trust the good offices of the Board of Education will serve to avert.

SLEEPING SICKNESS.

SLEEPING SICKNESS, or African lethargy, is a disease the history of which we can trace back no further than 100 years. The first description that we know of is that of Winterbottom, who, writing of Sierra Leone in 1803, said: "The Africans are very subject to a species of lethargy which they are much afraid of, as it proves fatal in every instance." The disease has been met with along the whole of the west coast of Africa from the mouth of the Senegal to as far south as S. Paolo de Loanda. Cases have also occurred in the French Antilles, due to importation of African natives. To what extent it prevailed along the west coast of Africa in bygone days it is now impossible to say, but even at the present time many of the French possessions are perhaps as seriously affected as Uganda now is.

It exists also in the Congo basin, but probably not at all to the same extent as at present in Uganda. Regarding its distribution and its epidemic outbursts we require further information. Leaving aside these questions, it may be well to describe first the disease itself. Of its incubation period, eight to eighteen months are possible limits, but on this point also our knowledge is deficient. For convenience sake the progress of the disease is generally divided into three stages.

First stage:—The most characteristic sign that a patient has contracted the disease is a change in the facial expression. The intelligent aspect of the healthy native is replaced by a dulness, a heaviness, an expression of apathy which makes it easy to pick out the sufferer. If examined more closely the temperature may be found to be raised, and the patient may complain of headache, of indefinite pains in the body, especially over the chest.

Second stage:—The dulness of expression deepens, the gait of the patient attracts attention, it is shuffling. When spoken to the patient replies with slow, thick, mumbling speech. His tongue trembles, and a shakiness appears in the hands. The face is puffy and saliva may dribble from the mouth. The pulse is quickened, the temperature is raised. The patient sits about listlessly and is more and more disinclined for exertion. He speaks only if spoken to, then he nods and becomes drowsy again, passing gradually into the

Third stage:—All the signs are now well marked. The patient is in a state of almost complete somnolence. He lies helpless on his mat, oblivious of all around him, with filthy ulcers covering his emaciated body; thus the unfortunate being passes into a condition of complete coma—and death.

The whole course of the disease may last six months, often only two or three, and seldom twelve, and it is as true to-day as when Winterbottom wrote 100 years ago that it proves fatal in every instance. What, then, is the cause of this fatal disease? In order to appreciate fully the recent discovery of its nature it will be necessary to recall to our mind what we know of the nature of some other well-known diseases. Those who are at all familiar with works of travel on Africa will have read of the tsetse fly and the tsetse-fly disease in

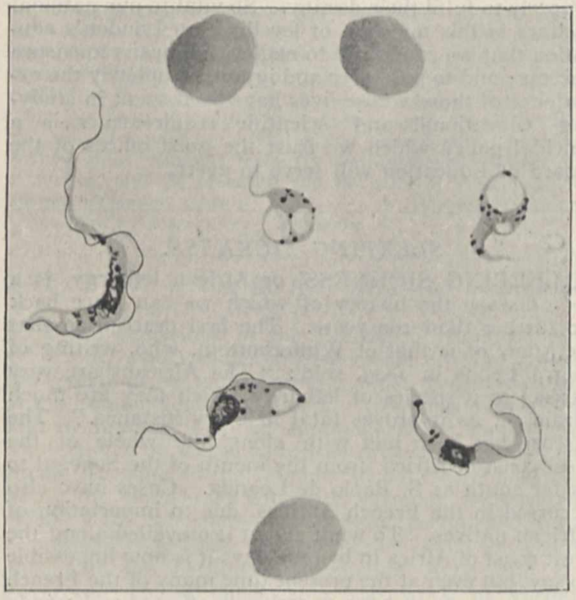


FIG. 1.

cattle—ngana. Travellers well know the danger to their cattle and horses of the "tsetse-fly belt," and various devices have been employed to escape the deadly bite of the fly, such as smearing the animals with dung and passing through "the belt" at night, when the flies, as a rule, do not bite, or even covering the horses with a suit of clothes.

The deadly fly disease ngana was first elucidated by Col. Bruce, R.A.M.C., F.R.S., who proved that the disease was due, not to a poison injected by the fly, as Livingstone had supposed, but to a living organism, microscopic in dimensions, worm-like in aspect, moving about in the blood. This organism—a trypanosome—the tsetse fly introduces into the blood at the time of biting. It should be clearly understood, moreover, that the fly derives this trypanosome, not from water, not from decomposing matter, but solely from the blood of another animal containing these trypanosomes. The disease is, in fact, contagious just as malaria is, and in this case also the contagion (the trypanosome) is transmitted, not by contact of the healthy with unhealthy animals, but only through the agency of a fly.

"Ngana," then, is a disease in cattle caused by a trypanosome. "Surra," a somewhat similar disease well known in India, is also caused by a trypanosome, likewise mal de Caderas in South America. These are diseases affecting animals, but in 1902 Dutton, who was working in Gambia, found for the first time a trypanosome in man (a European). This, too, was the cause of a fatal disease, for the patient died in Liverpool about a year later.

Trypanosomes, then, are the cause of fatal diseases in animals, and even in man, and in one of these—ngana—the mode of infection is by the bite of a tsetse fly. Let us now turn to recent discoveries in sleeping sickness.

In November, 1902, Castellani, in Uganda, examining the cerebro-spinal fluid of a case of sleeping sickness, found a trypanosome. Bruce and Nabarro, who arrived in Uganda in March, 1903, were struck with the importance of this discovery and forthwith took up energetically an examination of the disease in this direction, with the result that they found trypanosomes in the cerebro-spinal fluid of all cases examined by them, and, moreover, they also found them in the blood. Now in all experimental work, results are frequently almost valueless unless control experiments are made. Consequently it was next established that the cerebro-spinal fluid of those not suffering from the disease did *not* contain trypanosomes. But although the blood of patients suffering from sleeping sickness contains trypanosomes, yet they are present also in the blood (in 28·7 per cent. of the population) of natives in the sleeping sickness areas, *but not outside* these areas; a very important fact and one which might well have escaped detection had not the control experiments been made. To discuss completely this fact would take us too far, and indeed our knowledge is still incomplete on this point. Suffice it to say that the existence of trypanosomes among the natives (not suffering from sleeping sickness) indicates cases of "trypanosome fever," which we have seen has been known since Dutton's discovery in Gambia and which now we know to be a common disease among natives in certain regions, *e.g.* the Congo. Bruce and Nabarro, however, believe that these cases of trypanosome fever are initial cases of sleeping sickness. So long as the trypanosome is confined to the blood we have simply "trypanosome fever," but when the trypanosome gains an entry into the cerebro-spinal fluid, then the case becomes one of sleeping sickness with the characteristic symptoms. The commissioners concluded, in fact, that sleeping sickness was due to the trypanosome.

Now as ngana, a trypanosome disease, is transmitted by a tsetse fly, the question naturally arose, could this be established for sleeping sickness? In the first place a search was made for tsetse flies; they were easily found. In the next place, by a systematic collection of biting flies of all kinds from the district, it was found that the distribution of the disease and that of a certain species of tsetse fly was practically identical. In

FIG. 2.

fact, the tsetse fly involved (*Glossina palpalis*) is, like sleeping sickness, practically confined to the shores of Victoria Nyanza and the islands. This, then, was an important confirmation of the trypanosome nature of the disease. Further, also, it was proved by experiment that the fly could transmit the trypanosome from the unhealthy (sleeping sickness patient) to the healthy (monkey), and the monkeys succumbed, with symptoms, so far as it is possible to judge, resembling those in man, at any rate with identical changes found in the brain after death. The problem of the nature of the disease was thus solved in a very short space of time by this brilliant piece of work.

Of the treatment of sleeping sickness there is nothing to be said. No drug or other mode of treatment has any effect; the disease is always fatal. It is possible that in prevention more hope may be put; for the tsetse flies frequent thick jungle and shun open ground. A complete study of their habits will be necessary before one can express a definite opinion; but here, as in the problem of mosquito extermination, the task will probably be no easy one.

The illustrations represent (Fig. 1) trypanosomes from a case of sleeping sickness, after Bruce; (Fig. 2) a tsetse fly (*Glossina palpalis*) × 3, after Austen.

J. W. W. STEPHENS.

RADIO-TELLURIUM.

ACCORDING to a Press account of a recent lecture in Vienna, Prof. Marckwald illustrated in many striking and novel ways the intense activity of the body isolated by him from the Joachimsthal pitchblende and named radio-tellurium. The ionisation of the air in the immediate vicinity of the active substance is so intense that a current sufficiently strong to ring an electric bell was enabled to pass through it, the air forming part of the circuit. If a sheet of paper is interposed to screen the air from the rays of the preparation the effect ceases immediately and the bell stops ringing. Leyden jars were discharged without sparking by the substance, and other evidences of its great discharging power shown. All these effects were produced by a few hundredths of a milligram of the substance. Even the most active preparations of radio-tellurium, it is stated, are not self-luminous.

Prof. Marckwald obtained less than four milligrams of his substance from two tons of pitchblende. At first electrolytic methods were employed, but afterwards it was found that the active substance is completely deposited on a plate of bismuth or copper immersed for some days in the solution. The actual deposit consists almost entirely of ordinary tellurium, which possesses the power, so common in similar cases, of carrying down with it during the deposition the minute trace of active matter which is responsible for the radio-activity. The active constituent is separated from the tellurium by precipitating the solution with hydrazin hydrate. The tellurium precipitated is inactive, and the new body remains in the solution.

Prof. Marckwald is, however, alone in considering it to be a new substance. The radiations from it consist only of the α or non-penetrating variety, and this is the characteristic feature of polonium, discovered by Mme. Curie, who has protested against the name radio-tellurium being given to the body described by Prof. Marckwald. The activity of polonium, however, gradually decays, diminishing to half-value in about a year, whereas Prof. Marckwald states that the activity of his body is permanent. He also states, however, that the α radiation of the body is so powerful that he obtained sufficient light by the impact of the rays on a screen of phosphorescent zinc sulphide to be plainly visible to an audience of several hundred people. These two statements seem to be physically irreconcilable according to our present knowledge of the nature of the α rays, and it is to be hoped that Prof. Marckwald will give some account of the measurements by which he has concluded that the activity of radio-tellurium is permanent. Without in any way detracting from the merit of his splendid researches on the nature of the active substance, most men of science will agree with Mme. Curie in protesting against a new name being given to it in the present state of our knowledge. The practice of rechristening well-known bodies and sending them back to the country of their origin with new names and as new discoveries, which seems to be prevalent among some German organic chemists, would, if adopted in the case of the radio-active bodies, lead to the recognised number being exactly doubled.

FREDERICK SODDY.

NOTES.

THE article on the new education authority for London, which we print elsewhere in this issue, directs attention to a matter of vital importance to the educational interests of London. The County Council has approved a scheme by which the Education Committee concerned with the whole of the work of secondary education in London is to be made up practically of county councillors, without any persons possessing expert knowledge of science, art, literature, or education upon it, selected from outside the council. This committee, if approved by the Board of Education, would differ from the educational authorities appointed by county councils in most parts of the country, and appears contrary to the intentions of the Act under which it is constituted. Doubtless expert opinion will be obtained by the council, but the danger is that a committee constituted like that proposed for London may not know when expert guidance is necessary, and can certainly not be in sympathetic touch with all the lines along which educational progress should be made. The only way by which the interests of higher education in London can be satisfactorily represented is by the appointment of persons with special knowledge upon the committee; and by neglecting this factor of success in order to avoid the sectarian difficulty which might be involved in the selection of men and women outside the council to serve upon the committee is in our opinion a serious mistake.

THE gold medal of the Royal Astronomical Society has this year been awarded to Prof. G. E. Hale, director of the Yerkes Observatory, for his method of photographing the solar surface and other astronomical work. The president of the society, Prof. H. H. Turner, will deliver the address at the anniversary meeting on Friday, February 12. The American Ambassador will be present at the meeting, and receive the medal on behalf of Prof. Hale.

THE sudden death of Mr. W. G. McMillan, the secretary of the Institution of Electrical Engineers, announced last week, will be widely regretted. Mr. McMillan was laid up with a chill a short time ago, which developed into an attack of pleurisy, but he seemed to be well on the way to recovery when his sudden death from heart failure took place on January 31. Mr. McMillan, after a distinguished career at King's College, was appointed to a post under the Indian Government as chemist and metallurgist to the Ordnance Factories near Calcutta. This position he held for five years, and on his return to England he was elected to the lectureship in metallurgy at Mason College, Birmingham, which position he held until 1897, when he was appointed secretary of the Institution of Electrical Engineers. Mr. McMillan has written largely on electrometallurgical subjects, his "Treatise on Electrometallurgy" and his translation of Dr. Borcher's "Electrometallurgy" being the standard English works on this branch; he recently contributed the articles on electrochemistry and electrometallurgy to the new volumes of the

"Encyclopædia Britannica." As secretary of the Institution of Electrical Engineers he not only showed a remarkable power of hard work and organisation, but endeared himself to its members by his unfailing courtesy in a way that will make them all feel his loss as that of a personal friend.

THE lecture at the Royal Institution to-morrow, February 12, will be delivered by Mr. W. N. Shaw, F.R.S., on the subject of "Some Aspects of Modern Weather Forecasting."

SATURDAY last, February 6, was the hundredth anniversary of the death of Joseph Priestley, philosopher and divine. In Leeds the event was suitably commemorated by the congregation of Mill Hill Chapel, where Priestley was minister for some six years, and also by the Priestley Club. The members of the club, to the number of fifty, dined together, and the president, Dr. T. E. Thorpe, C.B., F.R.S., afterwards gave a public address on "The Life and Work of Joseph Priestley" in the Philosophical Hall. At Warrington the same day Dr. Thorpe unveiled a memorial tablet at the house which Priestley occupied during his stay in that town.

THERE appears to be no longer any doubt as to the presence in Lake Victoria Nyanza of medusæ indistinguishable from those of Lake Tanganyika, and the fact cannot be without its effect upon the acceptance of the view put forward by Mr. J. E. S. Moore that the fauna of Lake Tanganyika differs from that of the other East African lakes in alone possessing evidences of a marine origin. On December 1, 1903, Prof. Ray Lankester exhibited at the Zoological Society some medusæ from Victoria Nyanza obtained by Mr. Hobley on August 31, 1903, and sent to London by Sir Charles Eliot. A doubt being raised by some supporters of Mr. Moore's theory as to these medusæ having really come from Lake Victoria and not from Lake Tanganyika, Sir Charles Eliot, in a letter dated Mombasa, December 20, 1903, wrote to Prof. Lankester saying that the medusæ were collected by Mr. Hobley himself in the Kavirondo Gulf, by the side of which the railway terminus is situated, and that the water was full of them. Mr. Hobley, at the request of Sir Charles Eliot, had endeavoured to study the life-history of the medusæ, but he failed to keep them alive for more than a few days. The specimens sent to London were said by Mr. R. T. Günther to be indistinguishable from the *Limnocnida tanganyicae* of Lake Tanganyika. It is interesting in this connection to note that the Victoria medusæ were discovered quite independently in the same locality (Kavirondo, in the Kisumu district), and apparently at about the same time of year. According to *Globus* (January 28, p. 84), M. Ch. Alluaud, on the day of his arrival at Lake Victoria, discovered a marine medusa similar to that of Lake Tanganyika, and communicated an account of his discovery to the Paris Geographical Society on September 19, 1903.

THE weekly weather report, dated January 30, issued by the Meteorological Council, which gives the total rainfall from January 3, shows that the amount has been above the average in all districts except the east of Scotland and north-east of England, the greatest excess being in the Channel Islands. Dealing with the calendar month and with individual stations, the excessive rainfall was very marked. At Blacksod Point, in the north-west of Ireland, the fall amounted to 7·93 inches on thirty days (3·18 inches above the average). At Dunrossness (Shetlands) rain was measured every day, but the excess was only 1·40 inches. In the north-west of England there were considerable differences, *e.g.* Holyhead had 4·37 inches, but Liverpool only 2·08 inches. In the south-east of England the excess amounted to about 0·6 inch; at Greenwich rain fell on twenty-two days, the total amount being 2·51 inches.

VERY high tides were expected in the ordinary course on the coasts of the British Isles and France last week, but owing to a combination of other circumstances there was a phenomenal intensification of the tidal wave. Early in the morning of February 2 the tide had reached a dangerously high level round the Scilly Isles, and later our western coasts, as far north as the Irish Sea, were similarly affected; also the western half of the English Channel and the coast of Brittany. On the following day there was an abnormally high tide along the eastern half of the Channel, and even as far north as Dunbar, on the Firth of Forth, there was considerable damage attributed to the same cause. Tidal rivers, like the Thames, overflowed their banks, there being, in addition to the exceptionally high tides, an immense volume of fresh water brought down from the inland districts, where on several successive days rain had fallen heavily and laid vast tracts of country under water. The great height of this spring tide is doubtless largely due to the rather deep cyclonic depression which was signalled off our south-western coasts on February 1. On the morning of February 2 its centre was close to Scilly, where the barometer had fallen below 29 inches, or an inch below the normal, a deficiency of pressure which of itself would account for a considerable increase in the height of the water. Moving slowly into the English Channel, the centre was, on the morning of February 3, situated between Torquay and Portland, and by the following morning it had passed across the south-east of England to the Yorkshire coast, where it filled up subsequently. The official weather reports indicate that the disturbance caused comparatively little wind, there being few records of so much as a moderate gale.

THE death is announced of the Baron de Ujfalvy, known for his anthropological researches and his travels in Central Asia.

REPORTS have reached us of the discovery of a human skeleton in cave-earth at Cheddar. As relics of various ages are entombed in the Mendip cavern-deposits, we hope that the evidence will be carefully scrutinised, and that it may be possible to determine the age of these human remains.

A REUTER message from Amsterdam states that a telegram from the Governor of the Dutch East Indies, dated February 4, reports an eruption of the volcano Merapi, in the district of Klaten, accompanied by a rain of red-hot stones. Twelve people were burned to death and twenty severely injured.

A SLIGHT earthquake shock was recorded at the Liverpool Observatory, Bidston, on February 1 at 3.25 a.m. On February 2 several people felt distinct shocks of earthquake in Jersey. Between 4 a.m. and 6.45 a.m. six slight shocks were experienced, and crockery and windows rattled and furniture was shaken. Prof. Milne informs us that his records do not show any traces of disturbances corresponding to the shocks at Jersey, which therefore must have been local and very small.

THE silver medal of the Bavarian Academy of Munich has been awarded to Dr. Rudel, of Nuremberg, for his work on climatology.

THE deaths are announced of Prof. A. Edmund Hess, professor of mathematics at Marburg, and of Dr. Christian Heinzerling, formerly lecturer at Darmstadt.

ACCORDING to the *Physikalische Zeitschrift*, Prof. Curie has declined the Cross of the Legion of Honour on the ground of the important part played by his wife in the discovery of radium.

ITALIAN chemists propose to commemorate the seventieth birthday of Prof. Ugo Schiff, of Florence, who has worked for forty years in Italy. Dr. Guido Bargioni, 111 Via Aretina, Florence, has been entrusted with the arrangements.

AT a meeting of the French Physical Society on January 15 the following officers were elected:—vice-president, Prof. H. Dufet; vice-secretary, Prof. Langevin; ordinary members of council (elected for three years), Madame Curie, M. Hamy, Dr. Marage, M. Perrin; non-resident members, Prof. Blaserna (Rome), M. Maurin (Rennes), Prof. Miculescu (Bucharest), Prof. Tissot (Brest). M. d'Arsonval occupies the presidential chair in succession to M. C.-M. Gariel.

THE Municipal Council of Paris has adopted a proposal of M. Bussat for the foundation of a laboratory of applied physiology. M. Bussat has himself sketched out a scheme of the work which should be undertaken in such a laboratory, relating to the alimentary value of foodstuffs, muscular work, intoxication, &c., and he suggests that the director should give publicity to the work of the laboratory by means of courses of lectures addressed to the pupils of the professional and normal schools of Paris.

REFERRING to a suggestion made by "R. F. M." in last week's NATURE (p. 318), in the course of a letter on scientific uses of the kinematograph, Mrs. D. H. Scott sends us a copy of her paper "On the Movements of the Flowers of *Sparmannia africana*, and their Demonstration by Means of the Kinematograph," published in the *Annals of Botany* of September, 1903. The paper was noticed in our issue of November 26, 1903 (vol. lxix. p. 90).

WE have received a copy—presumably a corrected printer's proof—of a pamphlet in which Mr. W. H. Parkes proposes to deal with the "Cause of Gravitation and the Mechanism of the Universe." A sufficient indication of the character of the paper is afforded by the two opening sentences, which we here reproduce:—"Anything that is moved into an egg-shaped curve or path by external force thereby becomes attractive. This, I believe, is the cause of the universal force called gravitation, and I think it should be proved by experiments which I am not in a position to carry out."

IN the course of a paper on the land and fresh-water molluscs of Mexico, published in the *Proceedings* of the Philadelphia Academy for December, 1903, Mr. H. A. Pilsbry records from that area the remarkable slug-like snail, *Metostracon mima*, first described from Michoacan in vol. iv. of the *Proceedings* of the Malacological Society of London.

WE have received a copy of a "Guide to the Horniman Museum and Library," London Road, Forest Hill, issued by the London County Council. The manner in which this little book is drawn up strikes us as being admirably suited to the purpose for which it is intended, and in general the information appears trustworthy. On p. 31 we note, however, the statement that the duck-mole alone of the monotremes has a marsupial pouch, which is obviously an error, since the structure in question attains its fullest development in the echidna, and should be described as a mammary pouch.

WE have received from Mr. W. M. Brewer a paper on the rock-slide at Frank, Alberta Territory, Canada (*Trans. Inst. Mining Eng.*, Newcastle-on-Tyne, 1903). This enormous landslip or rock-slide occurred on April 29, 1903, overwhelming the coal-mining town of Frank, which was situated at the base of Turtle Mountain. Prior to the catastrophe, that mountain reached an altitude of about 3500 feet above the neighbouring Old Man or Crow's Nest river valley. Subsequently it was found that the summit had been lowered by about 1000 feet, and that from sixty to eighty million tons of rock must have been precipitated. One immense mass, estimated at fifteen thousand tons, was moved to a distance of two miles (see Fig. 1). Indeed, the débris was scattered over an area of nearly two square miles. The base of Turtle Mountain consists of Cretaceous shales and sandstones, in which a 10-foot seam of coal has been extensively worked. The mass of the mountain is formed of Carboniferous limestone. The plane of separation between the two series is a thrust-fault along which the limestone-beds are highly contorted and shattered. Above, the limestone rose in a precipitous face overlooking the town of Frank, and it presented a threatening appearance before the rock-slide took place. It seems evident that the stability of the mountain had been weakened by the mining operations at its base. For the past two or three years about 200 tons of coal per day have been worked out, so that the area was honeycombed with tunnels, while the main level is reported to have been driven for nearly 5000 feet parallel to the stratification of the rocks. Thus the towering mass of limestone, which is traversed by many joint-planes, was weakened, and a vast portion of the summit that had for ages been subject to the weathering influence of heavy snowfalls, frosts and rains, suddenly gave way and caused the disaster.

FIG. 1.—View of Boulder weighing 15,000 tons.

A THIRD edition of Mr. W. T. Lynn's "Astronomy for the Young" has been published by Messrs. Sampson Low, Marston and Co., Ltd.

MESSRS. J. AND A. CHURCHILL have published a third edition of "A Manual of Botany," vol. i., Morphology and Anatomy, by Prof. J. Reynolds Green, F.R.S.

WE have received from M. G. E. C. Gad, of Copenhagen, a copy of "Annales de l'Observatoire Magnétique de Copenhague," edited by Herr Adam Paulsen, the director of the Meteorological Institute of Denmark. The publication contains the hourly values of the magnetic elements for the years 1899 and 1900.

THE February number of the *Geographical Journal* contains several articles of exceptional importance and interest. Sir Thomas Holdich writes on the Patagonian Andes, giving a valuable summary of his recent work in connection with the Chile-Argentina Boundary Arbitration. A paper by Prince Kropotkin, of which the first part is here published, throws much new light on "The Orography of Asia." Dr. Otto Nordenskjöld and Dr. Gunnar Andersson contribute an account of the work of the Swedish Antarctic Expedition. The completed paper "On a Flat Model which Solves Problems in the Use of the Globes," by Prof. Everett, gives a number of interesting results in addition to those contained in his letter to NATURE of July 30, 1903.

WE have received a copy of a paper by Dr. P. T. Austen, reprinted from the *Scientific American* Supplement, and bearing the title "The Chemical Factor in Human Progress." The reader will find the influence of chemical knowledge upon the development of the industries, of agriculture, of sanitation, &c., discussed in a very interesting manner, and the pamphlet is well worthy of notice.

WE have received a copy of a German pamphlet by B. Kolbe the object of which is to show the manifold applicability of the differential thermoscope and a six-fold manometer in experimental demonstrations of the phenomena and laws of heat. Thirty important experiments are described which can be carried out with the aid of these instruments, and excellent illustrations of the method of demonstration are given.

THE report of the International Committee on Atomic Weights has just been issued, and only two changes are recommended from the table of values for 1903. The value for cæsium has been changed to 132·9, and that for cerium to 140·25 (O=16). The report directs attention to the inadvisability of using glass vessels in experimental atomic weight determinations, and suggests the use of vessels of pure silica, so-called quartz-glass, in all such investigations. A redetermination of the atomic weights of gallium, indium, columbium, tantalum, mercury, tin, bismuth, antimony, palladium, vanadium, phosphorus, and silicon is regarded as necessary.

IN the December (1903) *Sitzungsberichte* of the Vienna Academy of Sciences, Prof. C. Doelter describes a form of crystallisation microscope adapted to the determination of the melting points of silicates and silicate mixtures. The attainment of high temperatures is effected by means of a small electric oven, 5 centimetres high, mounted on the object stand, and in the apparatus described a temperature of 1200° C. can be reached. The distance between the object and objective during the observation is about 27 millimetres, and by a special arrangement of asbestos plates and a spiral tube carrying ice-cold water the microscope and the objective can be kept quite cool, even when the substance under examination is subjected to a temperature of about 1200° C.

IN vol. xlv. of the *Zeitschrift für physikalische Chemie* Dr. E. Baur describes some interesting experiments on colour-sensitive silver chloride. Mixtures of the chloride and of the subchloride Ag_2Cl prepared by treatment of colloidal silver solutions with insufficient chlorine water were mixed with about 5 per cent. of gelatin. Plates prepared with the product so obtained give the spectrum in its natural colours after one hour's exposure. The phenomenon is independent of the relative amounts of chloride and subchloride in the mixture. The author inclines to the view that several colour-sensitive forms of the subchloride exist, which are transformed into one another under the influence of the different spectral rays.

THE first number of the *British Journal of Psychology*, edited by Prof. James Ward and Dr. W. H. R. Rivers, has been published by the Cambridge University Press. The scope of the *Journal* is already known from the circular previously issued; it comprises psychology in the widest sense of the term, and is pledged to "side with no school and have no predilections"; it is not a "periodical," it has no fixed time of publication; it is rather designed to be a medium for the production of original articles and reports of experimental work. The contents of the present, presumably typical, number include an article on "The Definition of Psychology," by Prof. Ward; a sketch of Telesio's psychology, by J. Lewis McIntyre; and two important contributions on the experimental psychology of vision, by Prof. C. S. Sherrington and Prof. W. McDougall. The juxtaposition of Telesio and the experimental psychologists is itself a lecture on that progress which this *Journal* will assuredly support and stimulate.

THE additions to the Zoological Society's Gardens during the past week include a Ring-necked Parrakeet (*Palaeornis torquatus*) from India, presented by Miss M. Bull; four Hybrid Silver Pheasants (between *Euplocamus nycthemerus* and *Phasianus colchicus*), presented by Mr. H. S. Gladstone; two Black-headed Lemurs (*Lemur brunneus*) from Madagascar, presented by Mr. H. C. Jenkins; a Tayra (*Galictis barbara*) from South America, a Vulpine Phalanger (*Trichosurus vulpecula*) from Australia, a Levaillant's Amazon (*Chrysotis levaillanti*) from Mexico, a Malabar Parrakeet (*Palaeornis peristerodes*), three Hardwick's Mastigures (*Uromastix hardwicki*) from India, a Pennsylvanian Mud Terrapin (*Cinosternum pennsylvanicum*) from North America, deposited; a Racket-tailed Parrot (*Prioniturus platurus*), an Everett's Thick-billed Parrakeet (*Tanygnathus everetti*) from the Philippine Islands, two Red Lories (*Eos rubra*) from Moluccas, two Blue-streaked Lories (*Eos reticulata*) from Timor Laut, a Tabuan Parrakeet (*Pyrrhulopsis tabuan*) from the Fiji Islands, two Wonga-wonga Pigeons (*Leucosarcia picata*) from New South Wales, purchased.

OUR ASTRONOMICAL COLUMN.

REPORT OF THE HARVARD COLLEGE OBSERVATORY.—In the forty-eighth annual report of the Harvard College Observatory, Prof. E. C. Pickering, the director, again directs attention to the urgent need for cooperation in the study of the greater unsolved astronomical problems, and indicates the methods of procedure whereby the greatest results might be obtained from the least expenditure. In the solution of many of these problems the numerous photographs already obtained at Harvard would, if the funds necessary for their reduction were forthcoming, be of inestimable value.

The body of the report deals with the work accomplished during the year ending September 30, 1903, the observations made with each instrument being treated separately.

More than 15,000 photometric light comparisons have been made with the East equatorial, the computed error of each set of sixteen settings only amounting to three or four hundredths of a magnitude. Photometric measurements of the light of Jupiter's satellites, whilst undergoing eclipse, have been made during fifteen eclipses. The variability of some 2000 stars, suspected by other observers, has been definitely determined, and it is estimated that the time of minimum of Algol variables can be determined to within two minutes with this instrument.

The director has made 71,992 settings of the 12-inch meridian photometer during 143 nights, and by interposing a shaded glass has found it possible to compare magnitudes of such widely different orders as those of Sirius and a twelfth magnitude star. Another modification of this instrument permitted the light of the sky during the daytime, at twilight, and at night, the brightness of various portions of the moon and of the sky at various distances from it, to be compared, and a range of more than seventeen magnitudes was found to exist between the extreme values obtained. During the period covered by the report Mrs. Fleming classified the spectra and measured the light of 3506 stars, situated south of declination $-60°$, for the Southern Draper Catalogue. It is hoped that this zone will be completed shortly, and a catalogue containing nearly 4000 stars, all fainter than the ninth magnitude, published.

A large number of photographs have been obtained with the 13-inch Boyden and the 8-inch Bache telescopes at Arequipa, and a number of excellent light curves of Eros (from March 30 to August 19), showing a range of 0·5 to 1·0 magnitude, were obtained with the former instrument by Prof. Bailey. Four hundred and thirteen photographs, including eighty-seven of Eros, were obtained at the same station with the Bruce photographic telescope.

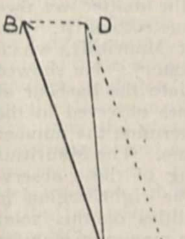
The meteorology of the upper air has been studied at the subsidiary observatory at Blue Hill, where fifteen kite flights, twelve of which were the monthly flights for the international series, were performed. The average height above sea-level attained by the meteorograph was 6450 feet, and the maximum height was 12,070 feet.

It is hoped that in a few months the Revised Harvard Photometry, containing the photometric magnitudes of all stars brighter than magnitude 6·5, about 9000 in all, together with the spectrum class of each star and its designation in other catalogues, will be published.

A set of fifty-five $8'' \times 10''$ contact prints from the original negatives, taken with the Harvard and Arequipa anastigmatic lenses, which cover the whole sky and contain all stars down to the twelfth magnitude, may be obtained by astronomers from the director for the sum of 15 dollars.

THE DIRECT AND RETROGRADE ROTATIONS OF THE PLANETS.—In a paper communicated to No. 3925 of the *Astronomische Nachrichten*, Prof. W. H. Pickering discusses the various theories which have been promulgated in explanation of the direct and retrograde rotations of the planets. Dismissing the theories of Laplace, Kirkwood, Faye and Trowbridge as insufficient, on the grounds that they presuppose abnormal conditions in the case of Neptune, and do not account for the perpendicular rotation of Uranus, he points out that the different motions may be explained by the tidal action of the sun in the following manner:—

Taking the case of Uranus as an example, let the line AB in the diagram represent the plane of the equator when this plane passes through the sun, let AC represent the plane of the planet's orbit and imagine the planet beyond the sun. Then the point A on the equator of the planet would, in the rotation, travel in the direction AB. The sun's attraction, in producing an annual tide, will produce a force AC acting on the particle A, with the consequence that A will travel along the resultant AD instead of along AB. This force AC will diminish during the planet's revolution until, after a quarter of a revolution, it will be zero. After half a revolution, when the plane of rotation again passes through the sun, the senses of both AB and AC will be reversed, but the effect on the planet's rotation will be the same as in the first case. This process will continue until ultimately the two planes will coincide when a direct rotation has been established.



THE "INVARIABLE PLANE" OF THE PLANETARY SYSTEM.—In No. 3923 of the *Astronomische Nachrichten*, Prof. T. J. J. See publishes the results of a detailed discussion of the accuracy of the data now available for the determination of Laplace's "Invariable Plane" of the planetary system. The elements of this plane are dependent upon the masses of the planets and the elements of their orbits, and the plane, when determined, would form a constant reference plane of great utility for the orbits of planets and comets. The transformations necessary to reduce star-places to this plane would be too cumbersome for practical utility.

Prof. See, in the first place, explains the mathematical process by which the elements of the plane are obtained when the planetary data are known, and then gives the results previously obtained. In the second part of his paper he reviews and discusses the values hitherto obtained for the mass of each of the planets, and deduces that for the mass of Jupiter, which, owing to its relatively large magnitude, acts as the most important factor of the reduction, the uncertainty does not amount to more than 0·0001 of the whole.

The elements obtained by Prof. See are as follows:—

$$\gamma = 1° \; 35' \; 7''·74, \quad 5☊ = 106° \; 8' \; 46''·688 \left\{ \begin{array}{c} \text{Ecliptic and mean} \\ \text{equinox 1850} \\ \text{Jan. 0·0 G.M.T.} \end{array} \right.$$

where γ = the inclination of the plane, and ☊ = the longitude of its ascending node on the fixed ecliptic of 1850·0.

In a subsequent table the author gives the longitudes of the ascending nodes and the inclinations of the planetary orbits on this "Invariable Plane," and, from a computation based on the relative positions of the planets at the epoch of 1850·0, he concludes that the actual shifting of the plane due to improvement in the data of the masses is not likely to exceed $1''$ for γ and $1'$ for ☊, a degree of accuracy approximating to that of our knowledge of the ecliptic and equator. He considers that a value for the inclination of which the probable error did not exceed $\pm 0''·20$ would suffice for all practical considerations, and points out the importance of further work on the determination of the planetary masses, which only need to be a little more certain in order to produce this ideal result.

SIMULTANEOUS SOLAR AND TERRESTRIAL CHANGES.[1]

THERE are very many cases recorded in the history of science in which we find that the most valuable and important applications have arisen from the study of the ideally useless. Long period weather forecasting, which at last seems to be coming into the region of practical politics as a result of the observation of solar changes, is another example of this sequence.

The first indications of these changes on the sun, to which I have referred, are matters of very ancient history, and so also is the origin of some of the branches of observation on which the study of them depends.

I will begin by referring to these and to the conclusions arrived at in relation to simultaneous solar and terrestrial changes previously to the last twenty-five years.

The facts that there are sometimes spots on the sun, and that there is a magnetic force which acts upon a needle, seem to have been known to the ancient Chinese. In more modern times the inquiries, with which we are now concerned, date from the times of Galileo (1564–1642) and Kepler (1571–1630).

To Galileo, Fabricius, and Scheiner we owe the first telescopic observations of the spots on the sun; to Kepler, the basis of spectrum analysis, which has not only revealed to us the chemistry of the sun and of its spots, but enables us to study daily other phenomena, the solar prominences, which will in all probability turn out to be more important for practical purposes than the spots themselves.

It is only quite recently that the importance of the study of the prominences in this direction has been indicated, so that we have to deal, in the first instance, with a long period of years in which only the spots and their terrestrial echoes were in question.

According to Prof. Wolf (as quoted by Prof. Köppen), Riccioli, in 1651, shortly after the first discovery of sunspots, surmised that some coincidence might exist between them and terrestrial weather changes (Blanford, Bengal, Asiat. Soc. *Journ.*, lxv., part ii., 1875, p. 22).

In the first year of the last century, Sir Wm. Herschel directed attention to this subject (*Phil. Trans.*, 1801, p. 265). He wrote:—

"The first thing which appears from astronomical observations of the sun is that the periods of the disappearance of spots on the sun are of much greater duration than those of their appearance.

[1] Paper presented to the International Meteorological Committee at Southport, September 11, 1903. By Sir J. Norman Lockyer, K.C.B., F.R.S.

"With regard to the contemporary severity and mildness of the seasons, it will hardly be necessary to remark that nothing decisive can be obtained. An indirect source of information, however, is opened to us by applying to the influence of sunbeams on the vegetation of wheat in this country. I do not mean to say that this is a real criterion of the quantity of light and heat emitted by the sun, much less will the price of this article completely represent the scarcity or abundance of the absolute produce of the country.

"On reviewing the period 1650–1713, it seems probable, from the prevailing price of wheat, that some temporary scarcity or defect of vegetation has generally taken place when the sun has been *without* those appearances which we surmise to be symptoms of a copious emission of light and heat.

"To those acquainted with agriculture who may remark that wheat is well-known to grow in climates much colder than ours, and that a proper distribution of rain and dry weather are probably of much greater consequence than the absolute quantity of light and heat derived from the sun, I shall only suggest that those very circumstances of proper alternations of rain and dry weather and wind, &c., favourable to vegetation, may possibly depend on a certain quantity of sunbeams being supplied to them."

Herschel's suggestion was a daring one, for however perfect our national statistics may have been in relation to the price of wheat, there was nowhere kept up a continuous record of the changes observable on the sun's surface, nor had there been any serious attempt made to determine the law underlying them.

In 1825 this serious attempt was made, and by Schwabe, of Dessau, who discovered a cycle of about eleven years in the solar changes. Wolf afterwards took up the question.

Herschel had associated the variation in the number of spots with that in the price of corn, the connecting link being sunshine or weather. It was to him a question of meteorology.

A year after the publication of Herschel's papers, Wollaston extended the early spectrum work of Kepler and Newton by discovering that in the solar spectrum there were many dark lines; these were for the first time mapped by Fraunhofer in 1814.

Soon after 1850 it became a question of the connection of sun-spots with terrestrial magnetism as well as with meteorology. A new idea was introduced.

Lamont, Sabine, and Allan Broun discovered that there was a well marked coincidence between the variations of magnetic effects, as observed on the surface of our planet by delicately suspended magnets, and the quantity of spotted area observed on the sun. This in later telegraphic days is not merely a pious opinion which does not interest anybody, because, when the magnetic changes are very considerable and the disturbances arrive at a maximum, it is very difficult to get a telegram from London to Brighton.

The period around the year 1860 was rendered ever memorable by a still further extension of Kepler's and Newton's work, which at once explained the dark lines observed in the solar spectrum by Wollaston and Fraunhofer.

Hitherto undreamt-of attacks on the nature of the sun became possible. The names of Kirchhoff, Bunsen, Ångström, Stokes, Balfour Stewart will go for very long down the stream of time, because they showed us that in spectrum analysis we had the power of practically conversing, chemically, with the distant worlds in space, and these distant worlds, of course, included the sun, although it is practically our neighbour.

It was now established that the solar radiation came from the incandescence of metallic vapours and gases in the sun's atmosphere, the metals and gases being for the most part those with which we are familiar on the earth. Not only was a high temperature demonstrated in this way, but it was further shown that above the sun's apparent surface there was an absorbing atmosphere, consisting of vapours cooler than those below, but yet hot enough to be composed of the steam of iron and other metals.

In 1865, De la Rue, Stewart, and others, in an attempt to get the periodicity of the solar phenomena still more accurately determined, started work at Kew; while the former observations were carried on by Schwabe and Wolf by the eye, photography, which was then being introduced into astronomical work by the labours of Warren De la Rue, was for the first time now utilised, and a picture of the sun was taken each day.

In 1866 a new method of observing solar changes, which consisted in throwing an image of the sun on the slit plate of a spectroscope, revealed the fact that the spectra of spots differed from that of the photosphere generally; certain lines were widened in the spot spectrum (Lockyer, *Proc.* Roy. Soc., October 11, 1866).

In 1867 a connection between changes in spotted area and in terrestrial temperatures was pointed out by Baxendell (*Memoirs* of the Manchester Lit. and Phil. Soc., third series, vol. iv., pp. 128 *et seq.*). He noticed a distinct and very striking relation between the number of sun-spots and the ratio which exists between the difference of the mean maximum temperature of solar radiation and the mean maximum air temperature on the one hand, and that of the mean temperature of the air and of evaporation on the other.

In 1868 a spectroscopic method was discovered of observing in full daylight the "prominences" or "red flames" which hitherto had only been glimpsed during eclipses, and it was established that, closely surrounding the sun ordinarily seen, there was an envelope, named the chromosphere, of incandescent gases and vapours, hydrogen, and a new substance named helium chief among them (Lockyer, *Proc.* Roy. Soc., October 20, 1868).

Many spectroscopic observations made on the spots and prominences about this time indicated great changes in the solar temperature in different regions, and possibly, therefore, changes in the amount of heat radiated earthwards. From the changes thus actually seen it was easy to imagine that there might be a cycle of terrestrial changes depending no longer on the sun's presentation to us in its daily and yearly rounds, but on physical changes in the sun itself, requiring, perhaps, many years to accomplish.

In 1869 Janssen showed (*Comptes rendus*, vol. lxviii. (1869), pp. 367 *et seq.*) that by a special arrangement of the spectroscope an image of the sun, showing the prominences both on the disc and surrounding it, might be obtained.

It was not very long before it was found that the reaction of these solar changes on the earth was not so limited as had formerly been thought. This was an idea started by Dr. Stone, of the Royal Observatory at the Cape of Good Hope, Piazzi Smyth, of the Royal Observatory of Edinburgh, and others, about the years 1870 and 1871, but the most striking Imperial contribution to the matter we owe to the labours of a distinguished meteorologist, Dr. Meldrum, director of the observatory at Mauritius, which has since become the Royal Alfred Observatory. He showed that the number of wrecks which came into the harbour of the Mauritius and the number of cyclones observed in the Indian Ocean could enable anyone to determine the number of spots that were on the sun about the time. The Mauritius is most admirably suited for the making of these observations, because the tropics are really the right region in which to try and estimate the possibilities of this solar action. Meldrum found, in fact, that the maximum number of cyclones was associated with the maximum number of sun-spots. He wrote (NATURE, vol. vi. p. 357, 1872):—

"During the period 1847–72 it is found that some years have been remarkable for a frequency, and others for a comparative absence of cyclones.

"1847–51 were characterised by cyclone frequency.
"1852–57 ,, ,, ,, comparative calm.
"1858–63 ,, ,, ,, cyclone frequency.
"1864–68 ,, ,, ,, decrease.
"1868–72 ,, ,, ,, great increase.

"It will be seen that the years correspond with the maxima and minima epochs of sun-spots. It appears to me that there is more than a mere coincidence as to time.

"The numbers of wrecks during these periods also show a similarly regulated frequency."

Poey, investigating shortly afterwards the cyclone condition in the West Indies (*Comptes rendus*, November 24, 1873, p. 1222), found that the greater number of years of maxima of storms fall from six months to two years, at the most, after the years of maxima of solar spots.

Out of twelve maxima of storms, ten coincide with maxima periods of spots. Out of five minima of storms, five coincide with minima of spots.

It will be seen that the results from both the East and West Indies are the same. Next came the question of a rainfall cycle corresponding to the solar spots ("Solar Physics," Lockyer, 1874, p. 425).

When I was preparing to go to India, in 1871, to observe the eclipse, Mr. Ferguson, the editor of the *Ceylon Observer*, who happened to be in London, informed me that everybody in Ceylon recognised a cycle of about thirteen years or so in the intensity of the monsoon—that the rainfall and cloudy weather were more intense every thirteen years or so. This, of course, set one interested in solar matters thinking, and I said to him:—"But are you sure the cycle recurs every thirteen years, are you sure it is not every eleven years?" adding, as my reason, that the sun-spot period was one of eleven years or thereabouts, and that in the regular weather of the tropics, if anywhere, this should come out.

It afterwards turned out that the period in Ceylon was really of eleven years, five or six years dry and five or six years wet, and that a longer period of about thirty-three years was recognised.

Mr. Meldrum passed from cyclones to rainfall by a very obvious step, because cyclones are generally accompanied by torrential rains. A study of the rainfalls of Port Louis, Brisbane, and Adelaide led him to the conclusion that a case had been made out for a supposed periodicity.

On my return from India I looked up the Cape and Madras records for the periods available, and found that they followed suit, hence I quite agreed with Dr. Meldrum that investigations were desirable, and I wrote as follows ("Solar Physics," pp. 424–5):—

"Surely in meteorology, as in astronomy, the thing to hunt down is a cycle, and if that is not to be found in the temperate zone, then go to frigid zones, or the torrid zones and look for it, and if found, then above all things, and in whatever manner, lay hold of, study it, record it, and see what it means. If there is no cycle, then despair for a time if you will, but yet plant firmly your science on a physical basis, as Dr. Balfour Stewart long ago suggested, before, to the infinite detriment of English science, he left the Meteorological Observatory at Kew; and having got such a basis as this, wait for results. In the absence of these methods, statements of what is happening to a blackened bulb in vacuo, or its companion exposed to the sky, is, for research purposes, work of the tenth order of importance."

With reference chiefly to Dr. Meldrum's paper, I added:—

"Surely here is evidence enough, evidence which should no longer allow us to deceive ourselves as to the present state of meteorology. A most important cycle has been discovered, analogous in most respects to the Saros discovered by the astronomers of old, indeed, in more respects than one, may the eleven yearly period be called the Saros of meteorology, and as the astronomers of old were profoundly ignorant of the true cause of the Saros period, so the meteorologists of the present day are profoundly ignorant of the true nature of the connection between the sun and the earth.

"What, therefore, is necessary in order to discover the true nature of this nexus? Two things are necessary, and they are these. In the first place, we must obtain an accurate knowledge of the currents of the sun, and secondly, we must obtain an accurate knowledge of the currents of the earth. The former of these demands the united efforts of photography and spectrum analysis, and the second of these demands the pursuit of meteorology as a physical science, and not as a mere collection of weather statistics. When these demands are met—and in spite of the Mrs. Partingtons who are endeavouring to prevent this, they will soon be met—we shall have a science of meteorology placed on a firm basis—the meteorology of the future."[1]

At this time the Indian authorities were quite alive to the importance of such investigations as these. India is in the tropics, India is a child of the sun, the inhabitants depend almost entirely upon the beneficent rains which seemed, in some way or another, to depend upon solar action. India also had then the germs of one of the best equipped meteorological organisations which exist on the surface of the planet, and the meteorologists felt that there was something behind their meteorological registers which might be assisted by taking a very official step and going to headquarters, headquarters being the sun. When I was in India in 1872, Lord Mayo, the then Viceroy, did me the honour to ask me to go to Simla with the view of choosing a site for a proposed solar physics observatory. That is thirty years ago! Unfortunately, I was secretary of the Duke of Devonshire's Commission, which was then sitting, and I could not get leave, and therefore could not go; the scheme, which was then before the Indian authorities—which, if I may say so, was altogether grandiose and extravagant—fell through.

[1] I very much regret that, in the article quoted, my reference to Carlyle's German "Dry as dust," as a patient inquirer who would eventually apportion credit to all meteorological workers, has been misunderstood by some of my German friends. Relying on imperfect dictionaries, which have told them that a mere "bookworm" was meant, they have missed the high compliment I intended to pay them.

In 1873 the idea of the possible connection of solar and magnetic changes had got so far that the magnetic and meteorological department of the Royal Observatory at Greenwich, which had been established in 1838, received an important addition. A photoheliograph was set up in order to continue the daily photographic record of the sun's surface, begun at Kew in 1865.

In the same year Köppen found that the maximum temperature occurs in the years of sun-spot minima and the reverse; years with many spots are cool years.[1]

Of special importance for the connection between the temperature on the earth's surface with the sun's spotted area is the fact that the temperature curve (mean number for the whole earth) and the curve representing the sun-spotted area are identical in all the irregularities.

In the tropics in the

Year before the sun-spot *Min.*, the temperature is 0·41° higher than the mean.
Year before the sun-spot *Max.*, the temperature is 0·32° lower than the mean.
The variation is thus 0·73°.

By this time spectroscopic observations of the solar changes had proved that the sun was hottest when there were most spots, thereby upsetting the old idea that the spots acted as screens and reduced the radiation at sun-spot maximum. Köppen's result, therefore, was a paradox, and was thus explained by Blanford (Bengal, Asiat. Soc. *Journ.*, 1875):—

"The temperatures dealt with by Prof. Köppen are of course those of the lowest stratum of the atmosphere at land stations, and must be determined *not by the quantity of heat that falls on the exterior of the planet, but on that which penetrates to the earth's surface, chiefly to the land surface of the globe.* The greater part of the earth's surface being, however, one of water, the principal immediate effect of the increased heat must be the increase of evaporation, and, therefore, as a subsequent process, the cloud and the rainfall. Now a cloudy atmosphere intercepts the greater part of the solar heat, and the re-evaporation of the fallen rain lowers the temperature of the surface from which it evaporates and that of the stratum of air in contact with it. The heat liberated by cloud condensation doubtless raises the temperature of the air at the altitude of the cloudy stratum; but at the same time we have two causes at work, equally tending to depress that of the lowest stratum. As a consequence, an increased formation of vapour, and therefore of rain, following on an increase of radiation, might be expected to coincide with a low air-temperature on the surface of the land" (see also Blanford, NATURE, April 23, 1891, vol. xliii. p. 583).

The next important advance had to do with atmospheric pressure. In 1875 Mr. F. Chambers, the director of the Bombay Observatory, found that

"The variation of the yearly mean barometric pressure at Bombay shows a periodicity nearly corresponding in duration with the decennial sun-spot period" (Meteorology, Bombay Presidency, August, 1875, S. 26, p. 12).

The years round 1875 were rendered very important by the number of new organisations established to record and

[1] W. Köppen, "Über mehrjährige Perioden der Witterung" (*Zeitschrift. f. Meteorologie*, Bd. viii., 1873, pp. 241–248 and 257–268).

demonstrate various classes of observations with which we are concerned in this short history. Meteorological inquiries on a large scale were organised at home and in India, and observatories were established at Potsdam, Paris, and London, with the main object of studying solar changes. At the same time steps were taken to resume observations in the tropics. It is not out of place here to make a brief reference to what was done in Britain and in India.

The Government took this action in consequence of a strong recommendation of the Royal Commission on Science, presided over by the late Duke of Devonshire, for the establishment by the State of an observatory of solar physics in which inquiries relating to the nature of the sun and its changes should be fostered, and various investigations which were necessary should be carried on.

The commission also proposed that similar institutions should be established in various parts of the Empire.

The ground on which the Royal Commission, and subsequently a memorial presented to the Government by the British Association, urged this new departure was that, in the opinion of a considerable number of scientific men, there was a more or less intimate connection between the state of the sun's surface and the meteorology of the earth, and they directed attention to the fact that recent independent investigations on the part of several persons had led them to the conclusion that there was a similarity between the sun-spot period, periods of famine in India, and cyclones in the Indian Ocean. The memorialists concluded by saying:—

"We remind your Lordships that this important and practical scientific question cannot be set definitely at rest without the aid of some such institution as that the establishment of which we now urge."

The Lords of the Committee of Council on Education referred this memorial to a committee, consisting of Prof. Stokes, Prof. Balfour Stewart, and General Strachey, for their opinion as to whether a commencement might not be made to give effect to the proposals of the memorialists by utilising the chemical and physical laboratories at South Kensington, as the proposed observatory must be more chemical and physical than astronomical. The following paragraph appeared in the terms of reference:—

"Although we are not at present in a position to consider the establishment of a physical observatory on a comprehensive scale, we believe that some advantage can be gained if a new class of observations can be made with the means at command, since the best method of conducting a physical laboratory may thus be worked out experimentally, and an outlay eventually avoided which, without such experience, might have been considered necessary."

While the discussion as to the establishment of a solar physics observatory in this country was going on, Lord Salisbury, who was then Secretary of State for India, permitted me to send him a memorandum on this subject. In it I pointed out that what we wanted, especially in reference to solar inquiries, was to learn, day by day, what the sun was really doing, which India and other tropical countries always could tell us, while it seemed almost impossible that we should ever get sufficiently continuous records in England.

I gave the following extracts:—

"Solar research is now being specially carried on in Europe at—

"(1) Potsdam, in the new Sonnenwarte.

"(2) Paris, in the new physical observatory.

"(3) Rome and Palermo.

"(4) South Kensington, in connection with the Science and Art Department.

"(5) At Greenwich, Wilna, and other places it is carried on in a less special way.

"In these European observatories, however, especially in the more northern ones, we are attempting to make bricks without straw, that is, the climate is such that the observations are often interrupted, at times for weeks together, while, in addition to this, in winter the sun's altitude is so small that fine work is impossible.

"While this state of things holds in Europe, in India, on the other hand, one has an unlimited and constant supply of the *raw material*, by which I mean that here one can, if one chooses, obtain observations of the finest quality in sufficient quantity all the year round. I may even go further, and say that, limiting my remark to English ground, we have in India a *monopoly* of the raw material."

The prayer of the memorandum was granted, and shortly afterwards I had the pleasure of sending out one of my assistants to India. Unfortunately, he died soon after the first series of daily photographs of the sun had been commenced, but eventually the Trigonometrical Survey Department took the matter up, an observatory was built at Dehra Dun, and India began its work, and I am thankful to say that it has gone on continuously ever since.

It was not until 1879, and after a letter from the Duke of Devonshire, that a sum of 500*l*. was taken on the estimates to replace the assistance formerly obtained by myself from the Government Grant Fund administered by the Royal Society, and to allow of more research work being undertaken. At the same time the Solar Physics Committee was appointed. The object sought was to make trial of methods of observation, to collect and discuss results, to bring together all existing information on the subject, and to endeavour to obtain complete series of observations along the most important lines.

This State action was taken because the sun has to be studied, if studied at all, continuously, because it is ever changing, and the more we study it the longer are the cycles which we find to be involved; hence, all inquiries into its nature must be on an Imperial basis. Individuals die, nations remain. Nor is this all. Observatories are not only wanted in the centres of intellectual activity where research can be conducted in a scientific atmosphere, but there must be others to obtain the necessary observations in those favoured regions of our planet in which the maximum of sunshine can be depended upon.

The then Astronomer Royal, Sir George Airy, was most sympathetic, and as a result of this State action the little observatory at South Kensington was shortly afterwards enlarged; it has considerably grown since then, but it is still in the experimental stage. Although, perhaps, I am not the one to say it, I am prepared to take the responsibility of stating that it is now one of the best equipped for its special work in the world. It certainly is the shabbiest to look at. Irreverent comparisons have been made even in the House of Commons, the general appearance of its wood and canvas huts having been likened to that of a more or less disreputable looking travelling menagerie, but, at all events, it is instrumentally efficient, and that for the present must be sufficient.

During the last quarter of a century a great deal of work has been going on, and the colonies and dependencies of Britain have also been doing yeoman service; very little has been said about it, because not all departments are in the habit of advertising themselves, and Blue Books are not as a rule light reading. In the first place, the Indian daily photographic record, which was weak during a month or two during the south-west monsoon, was supplemented by the erection of a duplicate instrument at the Mauritius, and I am again thankful to say that the work has gone on at the Mauritius continuously since. Thus we have now two tropical records, which, taken together, may be described as absolutely continuous, of solar changes sent to us in the most Imperial fashion by two observatories. Another appeal was made to Australia. For a time records were sent us, but I am sorry to say that after a time they ceased.

These records are sent regularly with every precaution against loss to the observatory at South Kensington, and for the days when no photographs have been taken at Greenwich the necessary photographs are transmitted there, where they are reduced in continuation of the record commenced in 1873 there, in succession to Kew.

What has been the result of this? The late Astronomer Royal took up this work at Greenwich in 1873. In 1874, 1875, 1876, 1877, 1878, the average number of days on which it was possible to obtain photographs in each year was a little more than 160, the exact figures being 159, 161, 167, 171, 149. This was Greenwich working alone, national work.

Next, we come to the Imperial work. Selecting years at random, and dealing with 1889 to 1893, I find that we obtained photographs of the sun in 1889 for every day in the year except five, in 1890 for every day except four, in 1891 for every day except two. It is easy to understand that with such a magnificently complete record as this the study of solar physics was enormously improved.

Very fortunately for science, even before these steps were being taken to secure a continuous record of the spotted area, Prof. Respighi (1869) and Prof. Tacchini (1872) had commenced at Rome a daily record of the solar prominences and of the latitudes at which they appeared at different times.

I pass on to some of the most important work done during the last quarter of a century, only referring to the results obtained which bear upon the connection between solar and terrestrial changes.

Many important advances were made in 1878.

Mr. F. Chambers, in continuing his studies on the Indian barometer, found (NATURE, vol. xviii. p. 567) a remarkable degree of resemblance in the progression of barometric pressure during summer, winter, and year, and sun-spots from year to year, but he noted that the barometric curve *lags* behind the sun-spot curve, particularly in the years of maxima of sun-spots. The winter curve is more regular than the summer one, probably because the weather generally in India is more settled in the winter than in the summer, but on the whole the two curves support each other in having a *low pressure* about the time of *sun-spot maximum*, and a high pressure about the time of sun-spot minimum. We may therefore conclude that the *sun is hottest* about the time when the *spots are at a maximum*. He added that these results appear to harmonise well with the decennial variations of the rainfall in India, and to throw light upon the inverse variation (compared with the sun-spots) of the winter rainfall of northern India.

Dr. Allan Broun also, in a discussion of Indian barometric readings, found that the years of greatest and least pressure are probably the same for all India, and that, therefore, the relation established by Mr. Chambers for Bombay holds for all India (NATURE, vol. xix. p. 6).

I next pass to rainfall. Dr. Meldrum, returning to his rainfall studies, found that (NATURE, vol. xviii. p. 565)

"There is a remarkable coincidence between the rainfall and sun-spot variation at Edinburgh, much more remarkable than that at Madras. The years of maximum and minimum rainfall, and sun-spots for the mean cycles, coincide, and on the whole there is a regular gradation from minimum to maximum, and from maximum to the next minimum."

The minimum rainfall occurred, on an average, in the year immediately preceding the year of maximum sun-spots.

The results of these investigations show that the rainfall of fifty-four stations in Great Britain from 1824–1867 was 0·75 inches *below mean* when sun-spots were at a minimum, and 0·90 inches *above mean* when sun-spots were at a maximum.

For the thirty-four stations in America, the corresponding numbers were 0·94 inch and 1·13 inch.

In the report of the Meteorological Department of the Government of India, published this year (1878), the following reference to solar action occurs:—

"The following are the main important inferences that the meteorology of India in the years 1877–1878 appears to suggest, if not to establish:—

"There is a tendency at the minimum sun-spot periods to prolonged excessive pressure over India, and to an unusual development of the winter rains, and to the occurrence of abnormally heavy snowfall over the Himalayan region. . . . This appears also to be accompanied by a weak south-west monsoon."

In 1880 the relation of Indian famines and the barometer was first fully treated by Mr. F. Chambers, the meteorological reporter for western India (NATURE, vol. xxiii. p. 109). He concluded from his inquiry that there is some intimate relation between the variations of *sun-spots, barometric pressure*, and *rainfall*, and as famines in general are induced by a deficiency of rain, it is probable that they also may be added to the above list of connected phenomena.

Commencing with the daily abnormal variations observed at several stations in western India, it was found that as the time over which an abnormal barometric fluctuation extended became longer and longer, the range of the fluctuation became more and more uniform at the various stations, thus leading to the conclusion that the "*abnormal variations of long duration affect a very wide area.*" For testing this, the conditions of Batavia were compared with those at Bombay, and the results showed a striking coincidence, the curves obtained for the two places being almost identical in form, but with this remarkable difference, the curve for Batavia was found *to lag* very persistently about one month *behind* the Bombay curve.

Similar results were then worked out for other stations, St. Helena, Mauritius, Madras, Calcutta, and Zi-ka-wei. On comparing the curves obtained for these various places, though a strong resemblance in form between all the curves is observed, there is also strong evidence of a want of simultaneity in the barometric movements at different stations, and as a rule the changes take place at the *more westerly stations* several months *earlier than* at the more *easterly ones*.

Thus on comparing the curves for St. Helena and Madras from 1841–1846, the latter sometimes lagged behind the former as much as six months, and for Bombay and Calcutta the corresponding difference was often upwards of six months.

The facts suggested to him long atmospheric waves (if such they may be called) travelling at a very slow and variable rate round the earth, from *west to east*, like the cyclones of the extra-tropical latitudes.

With special reference to famines, he remarked that, on comparing the dates of all the severe famines which have occurred in India since 1841, widespread and severe famines are generally accompanied or immediately preceded by waves of high barometric pressure. He suggested, therefore, that intimation of the approach of famines might be obtained in two ways:—

(*a*) By regular observations of the solar spotted area and early reductions of the observations, so as to obtain early information of current changes going on in the sun.

(*b*) By barometric observations at stations differing widely in longitude, and the early communications of the results to stations situated to the eastward.

In the same year, Dr. H. F. Blanford discovered that (NATURE, vol. xxi. p. 480)

"Between Russia and Western Siberia on the one hand, and the Indo-Malayan region on the other, there is a reciprocating and cyclical oscillation of barometric pressure, of such a character that the pressure is at a maximum in *Western Siberia* and *Russia* about the epoch of maximum sun-spots, and in the *Indo-Malayan area* at that of minimum sun-spots."

Up to 1881, the general idea had been that there was a great difference between the meteorological conditions at the maximum and minimum of the sun-spot curve, but the more numerous and more accurate series of observations available in the year in question revealed to Meldrum "extreme oscillations of weather changes in different places at the turning points of the curves representing the increase and decrease of solar activity."

This was a most important change of front. Not the maximum only, but both the maximum and minimum had to be considered ("Relations of Weather and Mortality, and in the Climatic Effect of Forests").

In relation to these pressure changes Blanford wrote as follows (NATURE, vol. xxi. p. 482):—

"Among the best established variations in terrestrial meteorology which conform to the sun-spot cycle, are those of tropical cyclones, and the general rainfall of the globe, both of which imply a corresponding variation in evaporation and the condensation of vapour. Now the variation of pressure with which we have to deal evidently has its seat in the higher (probably the cloud-forming) strata of the atmosphere. This is not only illustrated in the present instance by the observed relative excess of pressure at the hill stations as compared with the plains, but also follows as a general law from the fact established by Gautier and Köppen, viz., that the temperature of the lowest stratum varies in a manner antagonistic to the observed variation of pressure. It is then a reasonable inference that the principal agency in producing the observed reduction of pressure at the epoch of sun-spot maximum is the more copious production and ascent of vapour, which may operate in three different ways. First, by displacing air the density of which is three-eighths greater; second, by evolving latent heat in its condensation; and thirdly, by causing ascending currents, and thus reducing dynamically the pressure of the atmosphere as a whole. The first and second of these processes do not indeed directly reduce the pressure but only the density of the air stratum while they increase its volume. In order, therefore, that the observed effect may follow, a portion of the higher atmosphere must be removed, and this will necessarily flow away to regions where the production of vapour is at a minimum, viz., the polar and cooler portions of the temperature zones, and more especially those where a cold dry land surface radiates rapidly under a winter sky. Such an expanse is the great northern plain of European Russia and Western Siberia north of the Altai."

In 1886 we got the first fruits of the observations of the widened lines in sun-spots, which had been obtained on a definite plan, since 1879. The changes which occurred from a spot-minimum to a spot-maximum, and some distance beyond, had therefore been recorded. The changes were most marked, showing a great change in the chemistry of the spots at these times. At minimum the lines chiefly widened were those of iron and some other metals, but at the maximum the lines widened were classed as "unknown," because they had not been recorded in the spectra of the terrestrial elements. It was reasonable to suppose, therefore, that the sun was not only hotter at maximum, but hot enough to dissociate iron vapours (*Proc.* Roy. Soc., 1886, p. 353).

In 1891 Janssen's suggestion of 1869 was brought into a practical shape for observatory work by Hale and Deslandres (*Comptes rendus*, August 17, 1891), and the prominences on the sun's disc and surrounding it were photographed in full daylight by using only the light radiated by the calcium vapour, which they always contain.

By the year 1900 we had accumulated at South Kensington observations of the widened lines for a period of more than twenty years. There was a curious break in the regularity of the results obtained after 1894, and the Indian meteorologists reported contemporaneous irregularities in the Indian rainfall.

I determined, therefore, to make a connected inquiry into both these classes of phenomena. Thanks to the establishment of the Indian Meteorological Department in 1875, we had rainfall tables extending over a quarter of a century, and in the tropics, where the problems might be taken as of the simplest, to compare with the new solar data.

I have already stated that in the preliminary discussion of the most widened lines observed in the sun-spots up to the year 1885 a most remarkable difference was observed in the lines observed at sun-spot maximum and minimum. This continued until about 1895, another ten years. As the curve of iron lines went up, the curve of "unknown" lines came down; there were therefore *crossings* of the curves which might, on the hypothesis before referred to, be taken as the times at which the temperature of the sun had a mean value. These crossings turned out to be about half-way between the maxima and minima of the spotted area which had to be considered as the times at which the sun was hotter and colder than the mean.

We were then brought into the presence of three well-marked stages of solar temperature—it was no longer a question merely of spots and no spots, but of heat pulses.

The next point was to study these heat pulses in relation to the Indian rainfall, and it was found that in many parts of India the plus and minus heat pulses on the sun, which, of course, occurred immediately after the time of mean temperature, when the sun was getting either hotter or colder, were accompanied by pulses of rain in the Indian Ocean and the surrounding land. It was next found, from a study of the Indian Famine Committee's reports, that the famines which have devastated India during the last half century have occurred in the intervals between the pulses.

In 1902, with the view of getting more light on the important issues raised by the comparison of the solar heat pulses and the Indian rainfall, I determined to reduce the observations of prominences made by Tacchini at the Observatory of the Collegio Romano since 1874, and to compare the Indian meteorological conditions with them. The reason for this step was that the admirable photographs of the prominences on the solar disc, published by Hale and Deslandres, showed the extensive area over which they were distributed. An argument which has been used against the possible connection between solar and terrestrial changes was based upon the small area covered by spots. In 1877 Eliot wrote as follows (Report on the Meteorology of India, 1877, p. 2):—

"So far as can be judged from the magnitude of the sun-spots, the cyclical variation of the magnitude of the sun's face free from spots is very small compared with the surface itself; and consequently, according to mathematical principle, the effect on the elements of meteorological observations for the whole earth ought to be small."

Now the photographs to which I have referred exhibited broad bands of prominences extending almost across the whole disc, and if we assume two belts of prominences, north and south, 10° wide, with their centres over latitude 16°, a sixth of the sun's hemisphere would be in a state of disturbance. Hence it followed that the prominence effect, when fully studied, might be much more striking and important than that produced by spots.

The prior work in connection with the Indian rainfall had shown not only that there was a close connection between pressure and rainfall, but that the pressure was much the more constant element over the different areas. The comparison with the prominences obtained from the discussion of Tacchini's results was in the first instance compared with the Indian pressure curve.

The result was magnificent. In addition to the well-marked prominence maximum at the maximum of the spotted area, there were others corresponding approximately with the "crossings" of the widened lines, and all were re-echoed by the Indian barometers!

The sun-spot cycle of eleven years gave way to a prominence cycle of about 3·7 years, and by this interval, as a rule, are the Indian pressures separated.

To see whether such a striking and important result as this was limited to Indian ground, the important series of pressure observations obtained at Cordoba in South America were studied. Here the same effect was also most marked, but with the important difference that the curves were inverted, that is, high pressure years in India were represented by low pressure years in Cordoba.

In order to extend the Indian and Cordoba areas and to see how far these conditions prevailed, the pressure variations of stations as widely distributed as possible were examined. The result of this inquiry showed that the world might be divided roughly into two portions. The Indian area was found to extend to Australia, East Indies, Asiatic Russia, Mauritius, Egypt, East Africa, and Europe, while the Cordoba region might be said to include not only South and Central America, but the United States and Canada, extending further west than Honolulu.

The discovery of this barometric surge, which has been corroborated since by Prof. Bigelow, was an important advance, and will enable the investigator to connect up regions that undergo similar pressure changes.

In addition to the two periods, namely, 11 and 3·7 years, mentioned above, Brückner ("Klimaschwankungen," Eduard Brückner, Vienna, 1890) has pointed out that there is a long period weather variation. His discussion of all the available data of pressure, rainfall, temperature, &c., led him to conclude that there is a periodical variation in the climates over the whole earth, the mean length of this period being about thirty-five years.

Since this work, a recent discussion of the sun-spot data by Dr. W. J. S. Lockyer (*Proc.* Roy. Soc., vol. lxviii. pp. 285–300) has brought to light a similar long period, and this has taught us that each eleven-year cycle is different from the one immediately preceding and that following it.

A further inquiry into the distribution of the solar prominences, as observed by Respighi, Secchi Tacchini, Ricco, and Mascari (*Memorie* della Societa degli Spettroscopisti Italiani), has resulted in increasing our knowledge of the circulation of the solar atmosphere. The centres of prominence action, or the centres of the prominence belts, have a tendency to move from low to high latitudes, the opposite of spots; generally speaking, two belts in each hemisphere exist for some time, then they couple up and move towards the solar poles, while in the meantime a new belt begins to form in low latitudes (*Proc.* Roy. Soc., vol. lxxi. pp. 446–452).

The existence of prominences in the polar regions is coincident with great magnetic disturbances on the earth just previous to or about the time of sun-spot maxima (*ibid.*, pp. 244–250). Further, these polar prominences are responsible for the existence of large coronal streamers near the solar poles, as seen during solar eclipses about the time of sun-spot maximum. In fact, recent research seems to indicate that this prominence circulation is intimately associated with all the different forms of the corona (*Monthly Notices* R.A.S., vol. lxiii., 1903).

There seems little doubt, therefore, that we must look to the study of the solar prominences not only as the primary factors in the magnetic and atmospheric changes in our sun, but as the instigators of the terrestrial variations.

In dealing with solar phenomena, especially from a meteorological point of view, it is of great importance that the solar disc be treated in zones and not as a whole.

Just as it has been shown that the prominences sometimes exist in three zones in one hemisphere at one time, so is this the case with spots, but unfortunately it is only very recently that the phenomena occurring in each hemisphere have been treated in this manner.

It has already been pointed out that a possible connection existed between changes in the spotted area of the sun and terrestrial temperatures. Quite recently this question has been studied by Charles Nordmann (*Comptes rendus*, No. 18, May 4, 1903, vol. cxxxvi.), who finds that

"The mean terrestrial temperature exhibits a period sensibly equal to that of solar spots; the effect of spots is to diminish the mean terrestrial temperature, that is to say, the curve which represents the variations of this is parallel to the inverse curve of the frequency of solar spots."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—Four resolutions referring to compulsory Greek were submitted to Congregation on Tuesday. The resolution permitting candidates intending to read for the honour school of natural science to offer a substitute for Greek was carried by a majority of 2, the voting being 164 in favour and 162 against. The second resolution, giving the same option to honours students in mathematics, was approved by a majority of 29—the voting being 131 and 102. The two remaining resolutions providing alternative subjects for Greek in the examination in Holy Scripture, and in Responsions, were agreed to without a division. The resolutions will now be embodied in a Statute by Council, and will be submitted to Congregation and Convocation in due form.

The 255th meeting of the Oxford University Junior Scientific Club was held at the museum on Wednesday, February 3. Mr. J. F. Hornsey, Wadham, read a paper on "Photographic Films," with numerous exhibits. The following are the officers elected for this term:—President, Mr. W. E. Smith, Balliol; biological secretary, Mr. P. T. Spencer-Phillips, New College; chemical secretary, Mr. B. M. Jones, Balliol; treasurer, Mr. C. P. D. A. Pereira, Keble; editor, Mr. G. P. Poulton, Balliol.

CAMBRIDGE.—It is announced that when His Majesty the King visits the university on March 1 for the purpose of opening the new museums and medical school, he will be accompanied by the Queen and by Princess Victoria.

Mr. C. E. Inglis, King's, and Mr. A. H. Peake, St. John's, have been reappointed demonstrators in mechanism and applied mechanics.

Recent donations to the benefaction fund have raised the total to 71,658*l.* A number are specially ear-marked for various scientific departments.

The Balfour studentship, vacant by the untimely death of Mr. J. S. Budgett, will be filled up in the Easter term. The studentship is of the value of 200*l.* a year; the student need not necessarily be a member of the university, and he must devote himself to original research in animal morphology. Application is to be made to the registrary, Mr. J. W. Clark.

Dr. Guillemard, Prof. Darwin, Dr. Marr, Prof. Bury, and Dr. A. W. Ward have been appointed members of the newly created Board of Geographical Studies.

The following have been appointed electors to the chairs respectively named:—Prof. Thomson, F.R.S. (chemistry), Prof. Larmor, Sec.R.S. (Plumian of astronomy), Sir M. Foster, F.R.S. (anatomy and Downing of medicine), Prof. Allbutt, F.R.S. (botany and physiology), Mr. A. C. Seward, F.R.S. (geology), Sir William Ramsay, F.R.S. (Jacksonian of chemistry), Prof. Liveing, F.R.S. (mineralogy and agriculture), Mr. J. W. Clark (zoology), Prof. R. B. Clifton, F.R.S. (Cavendish of physics), H. Darwin, F.R.S. (mechanism), Sir Frederick Treves, Bart. (surgery), Prof. Muir (pathology).

Prof. Marshall Ward, Prof. Hughes, Mr. R. H. Adie, Mr. T. B. Wood, Prof. Middleton, Mr. A. E. Shipley, Mr. J. H. Widdicombe, and Mr. W. McCracken have been appointed examiners for the diploma in agriculture.

DR. H. KENWOOD has been appointed professor of hygiene at University College, London, in succession to the late Prof. W. H. Corfield.

IT is stated by *Science* that by the will of the late Mr. Charles F. Doe, of San Francisco, more than 100,000*l.* is bequeathed to the University of California for a library.

AMONG the names of those upon whom the Senatus Academicus of the University of St. Andrews has resolved to confer the honorary LL.D. at its annual graduation ceremony in March next are those of Prof. A. H. Keane and Prof. J. N. Langley, F.R.S.

MR. FREDERICK PURSER, fellow of Trinity College, Dublin, has, says the *Lancet*, presented a sum of 2000*l.* to the equipment fund of Queen's College, Belfast, to found a studentship in mathematics in memory of his brother, the late Prof. John Purser, of Queen's College, Belfast.

IN a pamphlet published by Messrs. Ginn and Co., Prof. J. W. Adamson, professor of education in King's College, London, deals with what he calls our defective system of training teachers. He argues that "professional training is a post-graduate business. The general, as distinct from technical, studies of the teacher are admittedly part of his professional equipment, since he cannot teach what he does not know, and mental gymnastic is at least as necessary for him as for the layman. Nevertheless, it remains true that purely technical instruction is also requisite, while the teacher's general culture, whether of the university or other type, should not be inferior in range or depth to that of the layman of similar intellectual status." He consequently urges that the general education of the teacher should be separated from technical instruction, the first being more or less completed before the second is begun.

THE following appointments are announced in the current number of the *Physikalische Zeitschrift*:—Dr. Ludwig Berend, professor of chemistry at the University of Kiel; Dr. Paul Spies, professor of physics at the Royal Academy of Posen; Prof. H. Berg, professor of mechanical engineering at the Stuttgart Technical School; Dr. Eberhard Rimbach and Dr. Georg Frerichs, professors of chemistry at Bonn; W. Wendelin, of Vienna, professor of electrotechnics and applied mechanics at Leoben; and Dr. Frederik Carl Mulertz Strömer, professor of mathematics at Christiania in succession to the late Prof. C. A. Bjerknes. Prof. Herrmann Struve is to succeed Prof. Wilhelm Förster as professor of astronomy at the University of Berlin, and Dr. Robert Freiherr Daublebsky von Sterneck has been transferred from Vienna to the chair of mathematics in the University of Czernowitz. The course of lectures at Bonn on chemistry of foodstuffs has been placed in the hands of Prof. Karl Kippenberger. The following teachers in technical high schools have been raised to the standing of professor:—R. Lutz, professor of mechanical engineering at Aachen; Dr. Carl Frenzel, professor of electrochemistry at Brünn; and Dr. Bernhard Neumann, professor of chemistry at Darmstadt.

THE first volume of the report for 1902 of the Commissioner of Education of the United States Bureau of

Education has now been published. The subjects included in the volume of 1176 pages relate to educational problems in all parts of the world, and prominence is given to the needs and condition of higher education in various countries. Among chapters likely to interest men of science may be mentioned the first instalment of a compilation of the general laws relating to colleges in the United States founded, under Acts of Congress, for the establishment and for the more complete endowment and support of colleges for the benefit of agriculture and the mechanic arts. An account of education in British South Africa reviews the facts with reference to Cape Colony, and enumerates the efforts being made in the Transvaal and the Orange River Colony to supply efficient education. Interesting particulars concerning university work in France are given in an article on education in France. It appears that the number of students in the French State universities rose from 17,605 in 1887–88 to 29,931 in 1901, of whom 3910 were registered in the faculty of sciences. It should be added that there are also in France 3500 students in State technical schools of a high order. A chapter on Italian education reveals evidence of the increasing favour in which technical instruction is held in Italy. In 1899–1900 there were 37,900 students attending the Government and private technical high schools, and of these 3900 were women. In Russia, according to an article by E. Kovalevsky, there are thirteen superior technical institutions with 8000 students. It is impossible even to enumerate the complete contents of this valuable report; it will provide students of education with material for much study and thought.

A SPECIAL subcommittee on technical instruction for women, appointed by the Technical Education Board of the London County Council, has issued a report. The subcommittee found that it could get little help from the study of foreign institutions, as the women's technical schools in Continental countries are day schools in which general education and technical training are given together. Technical classes like those carried on at London polytechnics, and work-girl students like those who attend such classes, are practically unknown on the Continent. The report first reviews the opportunities for technical instruction now open to women, and then proceeds to make suggestions for promoting further developments in such technical instruction. It is urged that, wherever possible, women teachers should be appointed for those trade classes which are reserved exclusively for women; that the attention of leading employers be directed to the action which has already been taken by certain firms in arranging for their apprentices to attend technical classes; and that the attention of girls in the elementary schools be directed to the opportunities for industrial training, and that every encouragement be offered to them to attend technical classes. Among the proposals—which number twenty-six—made by the subcommittee, a few seem of special importance. For instance, that classes be established for the training of women in hygiene and sanitation with the view of their taking up the occupation of sanitary, workshop, or public health inspectors, or of rent collectors; that in domestic economy schools more thorough instruction be given in the care and management of young children; that day classes for the training of daily servants or charwomen be conducted; and that technical day schools for girls, with a course planned to cover three years, be opened as opportunity offers.

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, January 6.—Sir Archibald Geikie, Sec.R.S., vice-president, in the chair.—On a Palæolithic floor at Prah Sands, in Cornwall: Clement **Reid,** F.R.S., and Eleanor M. **Reid.** Prah Sands lie about 7 miles east of Penzance, and have long been known as exhibiting a good section of "head" or rubble-drift, over raised beach, which rests on a wave-worn rocky platform. Recent storms have cleared away the talus at the foot of the cliff, and have exposed, between the "head" and the raised beach, a Palæolithic land-surface, consisting of loamy soil penetrated by small roots. In and above this occur black seams full of small fragments of charcoal and bone; these are particularly abundant round groups of large flat stones, which seem to have formed ancient hearths. The black seams contain implements made of vein-quartz. For a few feet above this land-surface the angular "head" consists mainly of loam with fragments of vein-quartz, some of which are worked. This seems to be the first record of Palæolithic man in Cornwall.—Implementiferous sections at Wolvercote (Oxfordshire): A. M. **Bell.** This section shows the following beds:—(1) Oxford Clay; (2) old surface, in which are pits or troughs chiefly filled with gravel and enveloped in weathered clay; (3) a large river-bed, containing gravel at the base, and layers of clay above; (4) Neolithic surface-layer, 2 feet thick. The gravel of the river-bed contains quartzite-pebbles, some of exceptional size, and is covered by a thin lenticular layer of peat and sand, yielding thirty flowering plants and many mosses; the clays over this have probably been formed in a lake, possibly due to a beaver-dam. In the gravel-bed are found implements formed of flint quarried from the Chalk, or of quartzite from pebbles of the Northern Drift, all remarkable for their size, beauty, and freshness, together with the remains of large mammals, including the mammoth. The old surface, from which the river-bed has been eroded, has also yielded implements associated with quartzites, quartz-pebbles, and lydianstone, gravel from the Thames Valley, limestone-pebbles, Oolitic fossils, and sand.

Zoological Society, January 19.—G. A. Boulenger, F.R.S. vice-president, in the chair.—A communication from Mr. Guy A. K. **Marshall,** entitled "A Monograph of the Coleoptera of the Genus Hipporhinus, Schh.," was read. It contained an enumeration of 138 known species of the genus, of which 50 were described as new.—Dr. Walter **Kidd** proposed the use of two additional characters in the description of genera and species of certain mammals. These were the arrangement of the hair on the naso-frontal region and the distribution of hair-whorls.—Dr. W. G. **Ridewood** read a paper on the skull of the giraffe, based on sections made in five different places through a skull of that animal.—Mr. F. E. **Beddard,** F.R.S., read a note on the brains of the potto (*Perodicticus potto*) and the slow loris (*Nycticebus tardigradus*), and made some observations upon the arteries of the brain in certain primates that had died in the society's menagerie.—Dr. C. W. **Andrews** read a paper on the pelvis and hind-limb of the ratite bird *Mullerornis betsilei*, and described a new struthious bird, from the Upper Eocene beds of the Fayum, Egypt.

Royal Meteorological Society, January 20.—Annual general meeting, Captain D. Wilson-Barker, president, in the chair.—The Symons gold medal for 1904, awarded to Hofrath Dr. Julius Hann, of Vienna, in consideration of his eminent services to the science of meteorology, was received by Count L. Széchenyi, First Secretary to the Austro-Hungarian Embassy, on behalf of Dr. Hann.—The **President** in his address dealt with the present condition of ocean meteorology, and began by referring to the early workers in meteorological science, Lieut. M. F. Maury in America and Admiral R. FitzRoy in England, also to the address on the same subject delivered to the society by Dr. R. H. Scott, F.R.S., in 1886. He then sketched the present state of our knowledge, illustrating his remarks by numerous maps. He reviewed the meteorological work of different nations, pointing out the energetic action of the United States in particular, and of Germany and England. He regretted the want of liberality shown by the Government in affording financial aid for the development of this important science, and in conclusion he urged the necessity of interesting the youth of the country in the matter by making it a special subject of school and college curricula.

Royal Microscopical Society, January 20.—Annual meeting, Dr. Hy. Woodward, F.R.S., president, in the chair.—The curator, Mr. C. **Rousselet,** exhibited an old microscope by Plössl, of Vienna, which had been sent on approval.—Dr. **Woodward,** the retiring president, gave his annual address, taking as his subject "The Evolution of Vertebrate Animals in Time."

Linnean Society, January 21.—Prof. S. H. Vines, F.R.S., president, in the chair.—Dr. Eric **Drabble** exhibited a lantern-slide showing diagrams of bicarpellary fruits of the French bean. The specimens of *Phaseolus vulgaris*, Savi, were obtained from a garden on the Middle Coal-measures of north Derbyshire.—The Rev. R. Ashington **Bullen** exhibited a finely preserved female specimen of the northern stone-crab, *Lithodes maia* (Linn.), from Aberdeen, and directed attention to the various organisms securely settled upon its carapace.—Biscayan plankton, part i., methods and data: Dr. G. H. **Fowler.** This formed the introduction to a series of reports from different hands dealing with the collections made by Dr. Fowler in the Bay of Biscay during a cruise of H.M.S. *Research*, and set out the objects of the cruise, the gear employed, and the records of weather, light, temperature, &c., kept in the naturalist's log.—The Crustacea obtained during the operations described in the preceding paper, entitled "Biscayan Plankton Collected on H.M.S. *Research* in July, 1900. Part ii. The Amphipoda and Cladocera, with Notes on a Larval Thyrostracan": Rev. T. R. R. **Stebbing,** F.R.S.—Dr. **Fowler** added some notes on the distribution of these Amphipoda, particularly in relation to the special points which the cruise was designed to study. No species, nor the Hyperiidea as a whole, showed any signs of the nocturnal rise and diurnal fall alleged to affect the epiplankton. Evidence was adduced to show that *Cyphocaris anonyx* and *Scina borealis* were Arctic and Subarctic forms, seeking the deep cold water of the mesoplankton at the lower latitudes of the Bay of Biscay.

PARIS.

Academy of Sciences, February 1.—M. Mascart in the chair.—Presentation of the atlas of solar photography carried out at the Observatory of Meudon: J. **Janssen.** The accumulation of the material summarised in this work has occupied twenty-seven years, upwards of 6000 photographs having been taken. The lenses of the telescope, made by Prazmowski, were constructed of a flint glass specially chosen to give a maximum in the HH′ violet region, and the time of exposure was reduced to about 1/3000 second.—The action of carbon upon quicklime at the temperature of molten platinum: Henri **Moissan.** The experiment was carried out in a quartz tube, heated by the oxyhydrogen blowpipe, the material being placed in a graphite boat. It was found that an intimate mixture of finely divided quicklime and sugar charcoal was not attacked at the temperature of melting platinum, no trace of calcium carbide being formed. It was also proved experimentally that at its point of fusion calcium carbide is at a higher temperature than the melting point of platinum.—The direct reduction of aromatic halogen derivatives by finely divided nickel and hydrogen: Paul **Sabatier** and Alph. **Mailhe.** At a suitable temperature, chlorine derivatives of benzene are reduced by hydrogen to benzene in the presence of finely divided nickel. Thus at 270° C. chlorobenzene gives a good yield of benzene, with small quantities of diphenyl. Hexachlorobenzene gives a mixture containing trichloro-, dichloro-, and monochlorobenzene, together with benzene. Bromo-compounds undergo a similar reduction, but with greater difficulty, on account of the formation of nickel bromide, which is not readily reduced at the temperature of the experiment. Iodo-compounds behave in a like manner; the reaction stops after a short time on account of the accumulation of nickel iodide, but if a mixture of hydrogen and iodobenzene and pure hydrogen are sent alternately over reduced nickel at 270° C. a good yield of benzene is obtained.—Observations on the preceding note: M. **Berthelot.** The relation between the foregoing experiments and those made by the author in 1868 by means of hydriodic acid is pointed out, and the precautions necessary in the repetition of this work insisted on.—On the scapular and pelvic hands of the holocephalous fishes and in the Dipneustæ: Armand **Sabatier.**—Observations on the sun made at the Observatory of Lyons with the 16 cm. Brunner equatorial during the third quarter of 1903: J. **Guillaume.** Tables are given showing the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—On the diminution in the intensity of the solar radiation during the years 1902 and 1903: Ladislas **Gorczynski.** The variations in the intensity of the solar radiation, previously noted at Lausanne, Clarens, Heidelberg, and at Washington, are confirmed by the author's observations at Warsaw. The first marked diminution commenced in May, 1902, the lowest point being noted in the spring of 1903. Towards the end of the year the progress of this diminution of intensity, compared with that of 1902, appeared to be arrested, although the absolute values still continue low when compared with the values for 1901. The eruptions of Martinique have been suggested as a possible cause of this diminution, but so far positive proof of this is wanting.—On systems of two surfaces the lines of curvature of which project on a plane following the same curves: M. **Guichard.**—On entire functions: A. **Pellet.**—On monodrome functions and transcendental numbers: Edmond **Maillet.**—On the principle of construction of an optical apparatus for obtaining very high magnifications: C. **Chabrié.** Instead of obtaining a geometrically similar image, as is the case with the usual optical systems, the suggestion is put forward that deformed, magnified images may be used, reducing these images to their proper shape by a geometrical construction. The case of the magnification produced by a transparent cone is worked out.—The action of magnetic fields on feebly luminous sources: C. **Gutton.** Whenever phosphorescent calcium sulphide is placed in a non-uniform magnetic field it becomes more luminous, but there is no action in a uniform field. The bearing of these experiments on work with the Blondlot rays is discussed.—On the physiological action of the *n*-rays and conducted radiations: Augustin **Charpentier.** A piece of tempered steel, moved about the side of the head, the room being in semi-darkness, produces a distinct increase in the clearness with which the surrounding objects are seen, and this effect was proved not to be due to changes of refraction in the eye.—The emission of *n*-rays by plants maintained in the dark: Édouard **Meyer.**—An attempt at an experimental determination of rational clothing: J. **Bergonié.**—On manganese salts acting as oxydases in the presence of a colloid: A. **Trillat.** Colloidal solutions of manganese obtained in the presence of albumen possess the properties of an oxydase, oxidising hydroquinone to quinone, pyrogallic acid to purpurogallic acid; the oxidising properties are removed by boiling.—On mixtures of antimony and its trisulphide: H. **Pélabon.**—On an isomer of borneol, campholenic alcohol, and some campholenic derivatives: A. **Béhal.**—Some new dinaphthopyranic phenols: R. **Fosse.**—On the alkyl-allyl-ketones: E. E. **Blaise.** The general method for the preparation of ketones by the use of the magnesium alkyl compounds fails with allyl iodide, the reaction being abnormal. The author has now found that the condensation of nitriles with allyl iodide proceeds in a normal manner in the presence of zinc, and has prepared a number of allyl ketones in this way.—Oxyalkyl ethylenic hydrocarbons and acids: Charles **Moureu.** The author has isolated in the pure state a series of oxyalkyl ethylenic acids of the type $RC(OR):CH.CO_2H$ and of the corresponding hydrocarbons, and has studied the modes of decomposition of these compounds.—Researches on azo-compounds; the reduction of acetals and nitrobenzoic acids: P. **Freundler.**—The influence of the carbonic acid emitted by the soil on vegetation: E. **Demoussy.** From earlier work the author had been led to the conclusion that the rapid growth of plants under glass is not only due to the high temperature caused by the fermentation of the manure, but is largely due to the large amount of carbon dioxide given off. In confirmation of this view, further experimental evidence of the effect of an excess of carbon dioxide is now given.—On the culture of divers species of higher plants in the presence of a mixture of algæ and bacteria: MM. **Bouilhac** and **Giustiniani.** Several non-leguminous plants may profit by atmospheric nitrogen fixed by certain lower organisms, algæ and bacteria.—Organisation and morphogeny of the Tridacnæ: M. **Anthony.**—On the selection of polytaxic characters in the case of Mendelian growths: G. **Coutagne.**—Report on the development of the tracheal apparatus and metamorphoses in insects: Jules **Anglas.**—The application of the X-rays to the examination of fine pearls: Raphael **Dubois.** It is possible by means of the X-rays to examine the living oyster, and, without in any way injuring it, to see whether it contains a pearl or not. If the pearl is too small, the oyster can be returned alive for further growth.—Pollinisation experiments in *Poly-*

gonum Fagopyrum: Pierre Paul **Richer**.—On the growth in weight of plants: Mlle. M. **Stefanowska**.—On the culture of black rot: P. **Viala** and P. **Pacottet**.—On the *rôle* of phosphorus in mineral layers: L. **De Launay**.—On the presence of the Oligocene in Madagascar: Paul **Lemoine**.—On the earthquakes felt in Portugal during 1903: Paul **Choffat**. Slight earthquake shocks are frequent in Portugal, but on August 9 and September 14, 1903, that country was visited with two shocks of unusual force. The first of these affected nearly the whole of Portugal; the second was more limited in range, and it is shown that the seismic centres of both these earthquakes were in deep sea.

NEW SOUTH WALES.

Royal Society, December 2, 1903.—Mr. F. B. Guthrie, president, in the chair.—A comparison of the periods of the electrical vibrations associated with simple circuits: J. A. **Pollock**, with an appendix by J. C. **Close**. The periods of the electrical vibrations connected with narrow rectangular closed circuits have been compared with those of the oscillations associated with straight wires, with open and closed circles, and with closed ellipses. Definite numerical results have been obtained for circuits varying in length from 3 to 9 metres.—A contribution to the study of the dielectric constant of water at low temperatures: O. U. **Vonwiller**. The object of the experiments was to ascertain whether the dielectric constant of water had a maximum value at 4° C. or not. First an air condenser was used, readings being taken as its capacity was given different known values, and then a condenser having water as its dielectric, readings being taken as the temperature rose from 0° C. The capacity of the water condenser invariably decreased as the temperature rose, there being no indication whatever of a critical value at 4° C.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 11.

ROYAL SOCIETY, at 4.30.—On the Compressibilities of Oxygen, Hydrogen, Nitrogen, and Carbonic Oxide between One Atmosphere and Half an Atmosphere of Pressure; and on the Atomic Weights of the Elements concerned. Preliminary Notice: Lord Rayleigh, O.M., F.R.S.—A New Method of Detecting Electrical Oscillations: Dr. J. A. Ewing, F.R.S., and L. H. Walter.—On the High-Temperature Standards of the National Physical Laboratory. An Account of a Comparison of Platinum Thermometers and Thermojunctions with the Gas-thermometer: Dr. J. A. Harker.—Constant Standard Silver Trial-Plates: Edward Matthey.—On Certain Properties of the Alloys of Silver and Cadmium: Dr. T. Kirke Rose.—Sun-spot Variation in Latitude, 1861-1902: Dr. W. J. S. Lockyer.

ROYAL INSTITUTION, at 5.—Recent Research in Agriculture: A. D. Hall.

SOCIETY OF ARTS, at 4.30.—Our Commercial Relations with Afghanistan: Col. Sir Thomas H. Holdich, K.C.M.G., K.C.I.E.

MATHEMATICAL SOCIETY, at 5.30.—On the Roots of the Equation $\frac{1}{\Gamma(x+1)}=c$: G. H. Hardy.—On a Certain Double Integral: Prof. A. C. Dixon.—On an Appropriate Form of Conductor for a Moving Point-Singularity: Prof. A. W. Conway.—On Group-Velocity: Prof. H. Lamb.—On Point-Wise Discontinuous Functions of a Real Variable: Dr. E. W. Hobson.—Some Extensions of Abel's Theorem on Power Series on the Circle of Convergence: G. H. Hardy.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Transatlantic Engineering Schools and Engineering: Prof. R. M. Walmsley.

FRIDAY, FEBRUARY 12.

ROYAL INSTITUTION, at 9.—Some Aspects of Modern Weather Forecasting: W. N Shaw, F.R.S.

PHYSICAL SOCIETY, at 8.—Annual General Meeting. Address by the president, Dr. R. T. Glazebrook, F.R.S., on the Theories of Microscopic Vision.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Anniversary Meeting.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Electricity and Destructor Station at Plumstead: T. S. Nash.

MALACOLOGICAL SOCIETY, at 8.—Annual Meeting: President's Address.

SATURDAY, FEBRUARY 13.

ROYAL INSTITUTION, at 3.—Culture and Sculpture: Dr. C. Waldstein.

ESSEX FIELD CLUB, at 6.30 (Essex Museum of Natural History, Stratford).—Nature's Protection of Insect Life, with Natural-colour Photographs: Mr. F. Enock.

MONDAY, FEBRUARY 15.

SOCIETY OF ARTS, at 8.—Oils and Fats—their Uses and Applications: Dr. J. Lewkowitsch. (Cantor Lectures, IV.).

TUESDAY, FEBRUARY 16.

ROYAL INSTITUTION, at 5.—The Development of Animals: Prof. L. C. Miall, F.R.S.

ZOOLOGICAL SOCIETY, at 8.30.—(1) On the Marine Fauna of Zanzibar and British East Africa—Polychæta, Part iii.; (2) The Polychæta of the Maldive Archipelago from the Collections made by J. Stanley Gardiner in 1899: Cyril Crossland.—On some Nudibranchs from Zanzibar and East Africa—No. IV. Dorididæ Cryptobranchiatæ: Sir Charles Eliot, K.C.M.G.

ROYAL STATISTICAL SOCIETY, at 5.—Trade Union Expenditure on Unemployed Benefit: E. L. Hartley.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Forms of Turbines most Suitable for Low Falls: A. Steiger.

WEDNESDAY, FEBRUARY 17.

SOCIETY OF ARTS, at 8.—Garden Cities in their Relation to Industries and Agriculture: A. R. Sennett.

ROYAL MICROSCOPICAL SOCIETY, at 8.—On the Vertical Illuminator; the Influence of the Antipoint on the Microscopic Image shown Graphically: E. M. Nelson.—A Microscope with Geometric Slides: Keith Lucas.—Mr. C. L. Curties will exhibit Specimens of Marine Objects mounted by Mr. H. J. Waddington.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Report on the Phenological Observations for 1903: E. Mawley.—Observations by Means of Kites at Crinan in the Summer of 1903: W. H. Dines.

CHEMICAL SOCIETY, at 5.30.—Observations on some Continuous Intramolecular and at First Reversible Changes extending over Prolonged Periods of Time: R. J. Friswell.—The Esterification of *r*-Mandelic Acid by Menthol and Borneol: A. McKenzie.

THURSDAY, FEBRUARY 18.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Further Researches on the Temperature Classification of Stars: Sir J. Norman Lockyer, K.C.B., F.R.S.—Theory of Amphoteric Electrolytes: Prof. James Walker, F.R.S.—Note on the Formation of Solids at Low Temperatures, particularly with regard to Solid Hydrogen: Prof. Morris W. Travers.—Atmospherical Radio-activity in High Latitudes: George C. Simpson.

ROYAL INSTITUTION, at 5.—Recent Research in Agriculture: A. D. Hall.

LINNEAN SOCIETY, at 8.—Mendel's Laws as Illustrated by Wheat Hybrids: R. H. Biffen.—Heredity and Variation as seen in *Primula sinensis*: W. Bateson, F.R.S.—Formation of Secondary Wood in Psilotum: L. A. Boodle.

FRIDAY, FEBRUARY 19.

ROYAL INSTITUTION, at 9.—Condensation Nuclei: C. T. R. Wilson, F.R.S.

GEOLOGICAL SOCIETY, at 8.—Anniversary Meeting.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Annual General Meeting; followed by Discussion on Heat Treatment of Steel.—The Motion of Gases in Pipes, and the Use of Gauges to Determine the Delivery: R. Threlfall, F.R.S.

EPIDEMIOLOGICAL SOCIETY, at 8.30.—The Etiology of Scurvy: Dr. Myer Coplans.

SATURDAY, FEBRUARY 20.

ROYAL INSTITUTION, at 3.—The Life and Work of Stokes: Lord Rayleigh.

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