THURSDAY, DECEMBER 20, 1906.

TWO HISTORIES OF CHEMISTRY.

A History of Chemistry from Earliest Times to the Present Day. By Ernst von Meyer. Translated by George McGowan. Third English edition, translated from the third German edition, with various additions and alterations. Pp. xxvii+691. (London: Macmillan and Co., Ltd.) Price 17*s.* net.

A History of Chemistry. By F. P. Armitage. Pp. xx+266. (London: Longmans, Green and Co., 1906.) Price 6*s.*

PROF. OSTWALD, who has done so much for the historical side of the literature of chemistry, has declared that "there is no more effective means of vivifying and deepening the study of a science than to saturate one's-self in its history." And perhaps of no science can this be more emphatically said than of chemistry. The story of its rise and development is one of the most astonishing and most deeply interesting chapters in the history of human progress. No one science can show such a splendid succession of material triumphs, or afford a more striking exemplification of the truth and wisdom of Bacon's aphorism that *Scientia est potentia*. It matters little that the desire to know may have had its origin in the lowest motives of self-interest. No doubt at all times in the history of the world there have been persons curious to know for the mere sake of knowing—persons, indeed, who deliberately preferred the risk of the possible unhappiness of wisdom to the apparently certain bliss of ignorance—but such persons have always been in a vast minority. But in the main the springs of human activity—intellectual no less than physical—have their origin in an enlightened self-interest. However "pure" a science may be to its votaries, there is a good deal of human nature in it after all, and when we come down to ultimate causes it is precisely this aspect of the matter that gives to the history of chemistry its strong human interest, and makes the personal story of its cultivators so fascinating.

Teachers of chemistry do wisely, therefore, in encouraging their pupils to make themselves familiar with the main outlines of the origin and growth of their science; and since it is impossible to separate this development from the human element which underlies it, to seek also to know something of the personal history and attributes of the men who have combined to make chemistry what it is. Luckily they have not far to seek for historical compilations worthy to be recommended for such a purpose. Practically every nation that zealously cultivates chemistry has furnished its contribution to the general stock of such compilations in obedience to, or in anticipation of, a demand which from the very nature of the case is inevitable. To a large extent the several histories may be said to reflect the popular estimation of the science in the countries which produced them. The monumental work of Kopp made its appearance at the period of, and possibly in consequence of, the national movement which originated with Liebig; and Höfer's "Histoire de la Chimie" was in like manner the probable outcome of the activity in France which had its rise with Lavoisier. No original systematic work of the same character, certainly none of commensurate importance, has been put together by any English historian. Certain of our larger manuals contain, by way of introduction, some historical account of the origin and development of the science, and a few monographs or biographies of the better known British chemists have appeared from time to time, but as regards systematic works we are dependent upon translations of foreign treatises.

Chief among these is the work of Ernst von Meyer, which made its first appearance in 1888, and of which an English translation by Dr. McGowan was published in 1891. The volume before us is the third English edition. It has been prepared from the third German edition, published in 1904, and, thanks to the various additions and alterations which Dr. McGowan has introduced with the sanction of the author, the history is, as the phrase goes, thoroughly up to date. The main divisions of the work remain very much as before, but some of the sections have been recast and much new matter has been added and old matter altered. For example, the author has not failed to take note of the results of recent inquiries into the life and work of that most remarkable man Paracelsus, who, as the researches of Mook, Schubert, Sudhoff, Aberle, and Strunz agree in showing, was by no means the bombastic charlatan he is commonly supposed to be. The mystery of Basil Valentine is submitted to a new examination, but the conclusion does not materially differ from that already arrived at by Kopp. But it is mainly in its account of the recent development of the science that the book differs from the works of Kopp and Höfer. Kopp, in his "Entwickelung der Chemie in der neueren Zeit," only carried his history down to the beginning of the last third of the nineteenth century—a time we can no longer consider new—and the generation that has followed has witnessed an astonishing expansion both in fundamental facts and in important and far-reaching dogmas, and it is in this period that the student of to-day probably finds his chief interest. Dr. von Meyer has himself lived through it, and he writes with a full and accurate knowledge of its achievements, and in the spirit of detachment, of impartiality and insight which characterise the true historian. The work is a perfect treasure-house in its wealth of bibliographical and biographical detail. Its literary charm lies in the simplicity and directness of its style, characteristics which Dr. McGowan has well preserved in his admirable rendering into English. We commend the work to all students of chemistry in the certain conviction that they will rise from its perusal with their interest in the science—to use Ostwald's words again—vivified and deepened.

The work of Mr. Armitage is of a different order, and, to the extent that it is original, is, we regret to say, a very immature production. It shows few traces of independent inquiry, but is obviously based in large measure on that of von Meyer, and in general treatment follows that work pretty closely. Now and again, however, Mr. Armitage seeks to be original rather in mode of expression than in the compilation of facts, but he only succeeds in being obscure, and his attempts at epigram and "fine writing" usually end in bathos. What, for example, is the precise meaning and value of the statement, "Even during that stage of transition which separated him from the brute creation, man must have appreciated the beneficial or harmful effect of many naturally occurring substances"? Quite true, no doubt, but the brute creation itself with equal certainty had this degree of appreciation of what was beneficial or harmful. But Mr. Armitage argues that in this appreciation we had the dawn of chemistry! What, too, is meant by saying that "Aristotle maintained the four elements earth, air, fire and water." Of the philosopher's stone it is said, "But it was not till later that its full powers, transmuting and medicinal, obtained recognition." Considering that the philosopher's stone was a myth, could its full powers ever obtain recognition? Again, "the sulphurous smell observed on the calcination of tin was very cogent evidence of the presence of sulphur." Is it quite certain that there is a sulphurous odour when tin is calcined? What, too, is meant by saying, "Hoffmann's attitude was not, however, maintained by any attempt at practical verification, and was, moreover, devoid of the unifying intent of Stahl"? Of Priestley and Cavendish it is said, "Their outward circumstances were as diverse as their inner consciousness." This is said of Lavoisier:—"The way of progress had been groped for long, the times were ripe for its discovery, and Lavoisier was their chosen agent."

We further read of Lavoisier:—"Complete success had awarded his efforts; and the weapons he had forged, of homage to experimental fact and scepticism of so-called established truths, were become the common property of scientific men."

Of Vauquelin we read:—"His work on the separation of the rare metals platinum, palladium, rhodium, indium, and osmium shows us how far the horizon had receded." The horizon must have receded very far indeed if it included indium in the time of Vauquelin. It has hitherto been supposed that indium was not discovered until 1863.

With respect to the attitude of Berzelius towards Dalton's hypothesis we read:—"Berzelius, in reviewing the whole subject, became oppressed with the unscientific slapdash manner in which it has been approached by his contemporaries." This is precisely the feeling with which we review Mr. Armitage's book; on reading it we too are oppressed with the unscientific slapdash manner in which the author has approached the whole subject of the history of chemistry.

MONASTICISM.

Essays upon the History of Meaux Abbey and Some Principles of Mediaeval Land Tenure. Based upon a Consideration of the Latin Chronicles of Meaux (A.D. 1150–1400.) By Rev. A. Earle. Pp. 192. (Hull and London: Brown and Sons, Ltd., 1906.)

THE author of this volume is, we apprehend, a curate of Nafferton-with-Wansford, in Yorkshire, who, having obtained an exhibition at St. John's College, Cambridge, for ecclesiastical history, has not neglected the subject in which he obtained distinction. We welcome all such additions to the skeleton army of genuine students of antiquity, but Mr. Earle has his spurs to win and his authority to establish, for it is not to be assumed that he learnt much about monastic chartularies and chronicles at Cambridge. We make this preliminary remark because Mr. Earle has not fortified his observations by marginal references to authority; he has written no preface, and has supplied no index. We presume these essays are intended for his neighbours, and are the result of notes for lectures on the subject of an interesting abbey to the chapter of which the author's church belonged.

The book is in two parts, the former containing eight chapters on the origin of the abbey and its influence on the surrounding country as imagined by the author, the latter containing six chapters on principles of land tenure. The essays are stated to be based on "a consideration of the Latin Chronicles of Meaux, 1150–1400, and in the margins are placed dates which are references to volume and page of the Chronicles as published by the Record Office." We presume the Master of the Rolls' series is meant. Having ascertained the scheme of the book we sought for a preface, in order to learn whether the author made an independent study of the chronicles and whether the observations and reasoning are his own. But there is no preface, and we are thus unable to satisfy a reasonable curiosity. The fact is that the Master of the Rolls published the chronicles of Melsa, or Meaux, in three large octavo volumes, 1866–8, the editor being Edward Bond, keeper of the manuscripts in the British Museum, and to each volume Mr. Bond contributed a long and very learned preface. Mr. Earle ought surely to have explained whether his interesting narrative is or is not entirely derived from Mr. Bond. In the absence of such explanation we must presume that it is, and we regard the volume before us as an excellent abstract of three long treatises by a learned author. We have, after much consideration, concluded that Mr. Earle's work, easy of perusal and rather colloquial in style, presents a fairly accurate picture of human society in Holderness, as affected by one of many great institutions, religious in their origin, but commercial in practice.

The abbey was founded by William le Gros, Earl of Albemarle, Lord of Holderness, in the year 1150, as the condition of being released from a vow to make a pilgrimage to Jerusalem. The monk who influenced the earl was Adam, of the Cistercian Abbey of Fountains, who had much to do with the foundation of that

great house, and he obtained the Papal dispensation vacating the vow from Eugenius III., then living in France, according to this chronicle.

The abbey being established and possessed of a fair estate—the original wooden buildings replaced by stone—Mr. Earle attempts to describe the state of the surrounding country and inhabitants. Although he occasionally uses a doubtful expression, such as "the rich riding in carriages," his description seems to us good. But when the relations of the rich and poor are summarised in such words as the poor man "could not resist the Lord in the Lord's own Manor Court," the impression is produced that the author has made little study of ancient courts. The appalling results of the Black Death are well indicated, and the more this terrible period is examined the more exalted do the monks, nuns, and priests of England appear.

The essays on mediæval land tenure contain much debatable matter, and many statements which, without reference to authority, we cannot accept, as, for example, that the right to "common of pasture" could be alienated.

We have not space to discuss such questions, and must limit our concluding remarks to the fifth chapter. Here Mr. Earle states his views on the nature of bondmen, and cites the curious case of Adam, son of Ivo Grise, drawing the inference that the descendants of a bondman could at any distance of time be claimed by the heirs of the original lord. The facts stated are hardly sufficient to support so large an inference, but it certainly does seem that when the abbey acquired land from a "nativus" or his son it was thought desirable to complete the title by purchasing the claim of the lord.

It is not, of course, possible to treat with perfect accuracy an antiquarian subject within the limits of a small volume of less than two hundred pages, but we can commend Mr. Earle's essays to the general public, as they are well written with proper sympathy with an old order now for ever passed away.

THE PLANTS OF KUMAON.

Catalogue of the Plants of Kumaon and of the Adjacent Portions of Garhwal and Tibet. By Lieut.-General Sir Richard Strachey, G.C.S.I., &c., revised and supplemented by J. F. Duthie. Pp. vii+271. (London: Lovell Reeve and Co., Ltd., 1906.)

THIS catalogue is based on the collections made between the years 1846 and 1849, in the province of Kumaon and the adjoining parts of Garhwal and Tibet, by Lieut. (now Sir Richard) Strachey and Mr. J. E. Winterbottom. The collection was principally made along a line extending through the province of Kumaon across the Himalaya in a south-westerly to north-easterly direction, over a distance of eighty or ninety miles, from the plain of Rohilkhand at about 1000 feet above sea-level, to the Tibetan plateau at an altitude of 14,000 feet to 15,000 feet on the upper course of the River Sutlej. The collection, generally known as the Strachey and Winterbottom Herbarium, included more than 2000 species, and sets of the plants were presented more than fifty years ago to the important herbaria in this country and abroad, together with a provisional catalogue. The present catalogue includes, besides the species represented in the original Strachey and Winterbottom herbarium, the results of previous and subsequent botanical exploration of the area from the time of Wallich, Royle, Falconer, Thomson, and others up to a comparatively recent period. Among the more important recent contributions to our knowledge of the Kumaon flora are the large collection made by the late Colonel Anderson, chiefly in the vicinity of Naini-tal, and the results of the extensive botanical explorations made by Mr. Duthie during his term of residence as Government botanist in the North-West Provinces.

Including a small number of cryptogams, the flora of Kumaon, as represented in the catalogue, contains 3043 species, representing 1084 genera. No fungi or algæ are included, and only fifty genera of lichens; hence much remains to be done to give an adequate idea of the flora so far as cellular cryptogams are concerned. On the other hand, we may regard the representation of the flowering plants as fairly complete. Mr. Duthie makes a comparison with the flora of China on the one hand and of Britain on the other. Of the 137 natural orders of flowering plants represented in Kumaon, 134 are found in China and 84 in Britain; of the 983 Kumaon genera, 812 occur in China and 287 in Britain; and of the 2672 Kumaon species, 1079 are Chinese and 226 British. The most predominant order in the area concerned, as estimated by number of species, is Gramineæ (226 species), followed by Compositæ (211 species), Leguminosæ (204 species), and Orchideæ (161 species). In the Eastern Himalaya and in British India as a whole, Orchideæ occupy the first place, with Gramineæ and Leguminosæ taking the second and third and third and second places respectively in the two areas concerned, while Compositæ stands fourth in the Eastern Himalayas, and seventh in the whole of British India. For the whole world Compositæ stands first, Leguminosæ second, Orchideæ third, and Gramineæ fifth.

The arrangement of the orders, genera, and species of the flowering plants is in accordance with that adopted in the "Flora of British India." The ferns were named and arranged by the late Mr. C. W. Hope; and the Bryophyta by Mr. C. H. Wright, following the plan adopted by Mr. Mitten in 1859. The method of the catalogue is a tabular one; for each species or variety, there are indicated in a series of parallel columns the habit of growth, colour of flower, time of flowering, locality, elevation, and occurrence respectively in the Himalayas (rainy or dry), Tibet, China, and Britain. The book as a whole forms a remarkably clear and concise review of the flora of an eminently interesting district of the Western Himalayas. A useful appendix is given in the form of a list comprising the determinations of the numbers in the Strachey and Winterbottom Herbarium according to the original catalogue and their equivalents in the present volume. Some of the changes are due to alterations of nomenclature, others to a more thorough investigation of the plants. A. B. R.

ENGINEERING DESIGN AND DRAWING.

(1) *Machine Design.* By Prof. Albert W. Smith and G. H. Marx. Pp. viii+369. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1905.) Price 12*s.* 6*d.* net.

(2) *Elements of Mechanical Drawing.* By A. A. Titsworth. Pp. v+130. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1906.) Price 5*s.* 6*d.* net.

(1) THE authors of this text-book have wisely departed somewhat from the usual practice followed in books on machine design, and have devoted the first five chapters to discussions of the general principles of kinematics which underlie the design of all classes of machinery. These chapters, in fact, deal with subjects such as constrainment of motion, relative motion, linkages, linear and angular velocity diagrams, &c., which the student usually finds only fully and clearly discussed in such works as Kennedy's "Mechanics of Machinery." In the sixth chapter the question of the proportions of machine parts as dictated by stress is taken up, and rules are given for the working stresses which must be adopted under any given set of conditions.

Fastenings, including rivets and bolts and nuts, are then considered. The authors rightly point out that the dimensions of the rivets which would be necessary in order to secure a joint of absolutely uniform strength are, in the case of lap joints, usually too large for practical convenience, and that, therefore, a compromise has to be effected; but surely the tables on pp. 94 and 95 are carried to an excess as regards thickness of plates, as no one would in practice think of using such joints for plates one inch or more in thickness. In dealing with bolts and nuts, naturally only the United States standard threads are employed, and in this chapter the results of some interesting experiments on the design of bolts for shock are given; it was shown that bolts with a hole drilled out in the centre through the unscrewed part, so as to give them a uniform cross-sectional area from end to end, were much stronger against shock than the original solid bolts.

The design of axles and shafts and of their bearings, including the modern ball and roller bearings, is very fully treated in several chapters; and then follow details of the design of couplings, both permanent and frictional, and a complete explanation of the theory of the transmission of power by belts and of the necessary calculations in order to settle the dimensions of belt required in any given case.

Fly-wheels and toothed wheel gearing are taken up in the next two chapters, the proper shape of gear teeth and their strength being dealt with in a very thorough manner. In the concluding chapter a branch of machine design usually much neglected in text-books is discussed, namely, the proportions and best shapes for machine frames.

The authors are to be congratulated on the fact that they have avoided crowding their illustrations with minute details, and, as a result, all the figures are clear, and the important points in the design which they are intended to illustrate are easily followed. The book should prove a useful text-book for engineering students in their first and second years' courses in machine design.

(2) This book is divided into two parts. In the first part, for beginners, the various drawing instruments in common use are described, and a series of exercises is given to illustrate the use of each of the instruments. The rest of this section is devoted to examples in simple projection, to intersections of solids, and development of surfaces. Part ii., for more advanced students, comprises problems in descriptive geometry, isometric projection, oblique projection, shadows, and perspective work, and concludes with a series of problems. The author has dealt with a branch of engineering drawing which is more commonly denoted by the name of geometrical drawing. The volume will form a useful text-book for students in engineering colleges during the first year of their course.

T. H. B.

OUR BOOK SHELF.

Das Kloster Kumbum in Tibet. By Wilhelm Filchner. Pp. vi+164; with maps, plans, and numerous plates. (Berlin: S. Mittler und Sohn, 1906.) Price 8 marks.

ONE of the most popular fanes of Lamaist pilgrimage is the great golden-roofed temple of Kumbum, about half-way between Lhasa and Pekin, in the neighbourhood of the Koko Nor Lake, on the border of Mongolia. It marks the sacred spot where was born in 1356 A.D. the reforming Lama and canonised saint Tsong-Khapa, who founded the now predominant yellow-cap sect which wields the temporal power. On the sacred spot itself, within the precincts of the temple, stands an old tree which is believed to have sprung miraculously from one of the saint's hairs. It is locally known as the "white sandalwood tree," and both its leaves and bark are held in great veneration as exhibiting on their surface images of the holy man. M. Huc, in his lively description of his visit to this sanctuary and his interview with its "Living Buddha," half a century ago, declared that he himself saw the images on the leaves, and he attributed this extraordinary phenomenon to the devilry of the priests. Since Huc's time the place has been many times visited and described by Europeans, lying as it does within that portion of eastern Tibet which has been annexed by China, and thus much more easily accessible than the "Forbidden Land" of the Lhasa Lamas.

By far the best and fullest of these descriptions has hitherto been that by Mr. Rockhill, the present United States Ambassador at Pekin. Mr. Rockhill found that the alleged images on the leaves and bark were a delusion, and that they only appeared to those votaries who had firm belief, whilst the faithless could distinguish nothing extraordinary on them. The specimens of the leaves and bark collected by Mr. Rockhill were identified by Mr. Hemsley, of Kew, as those of *Syringa villosa*, Vahl.; whilst Dr. Kanitz, of St. Petersburg, made the tree out to be *Ligustrina amurensis* (NATURE, April, 1896, pp. 534 and 556). Lieut. Filchner now gives us a handsome monograph on Kumbum, its temple, tree, and priests, as the result of his expedition there in 1903–1905, by way of Shanghai. Mr. Filchner started commendably equipped with an intimate knowledge of the literature of his subject, and has produced a record of permanent value, embodying a good deal of new re-

search about the temple and its large monastery of nearly 4000 priests. He devotes several pages to the sacred tree, which has been identified for him as *Syringa Giraldiana*, K. Schneider. A word of praise is due for the excellent illustrations, many of them from photographs by Frau Filchner, who accompanied her husband in his travels. Altogether the book forms a complete guide to the place, and is admirably produced at such a marvellously cheap price as is only possible on the Continent. L. A. WADDELL.

A Century's Progress in Astronomy. By Hector Macpherson, jun. Pp. xi+246. (London: W. Blackwood and Sons, 1906.) Price 6*s.* net.

IN attempting to crowd an account of a century's progress in one of the most progressive of sciences (during the last century) into 238 pages of well-displayed print we fear that Mr. Macpherson has attempted too much in too little space. The volume will certainly be found useful for reference as an astronomical "Who's Who," but we fear that the general reader will have but a hazy idea of the true meaning of the century's progress after perusing it.

The first two chapters, occupying more than one-sixth of the total reading matter, deal with Herschel, the "pioneer" and "discoverer," and are full of interest and information. The subsequent chapters (iii. to ix.) treat of the celestial bodies in the conventional order, and as completely as can be expected in so confined a space, the more important discoveries, *e.g.* those by Schwabe, Janssen, Lockyer, Tacchini, and others concerning the sun, receiving a fair amount of attention.

The concluding chapters (x. to xiv.) deal with the spectroscopic and variable-star work, stellar systems, stellar distribution, and celestial evolution, the various theories and researches in each branch being passed in rapid review.

Speaking generally, Mr. Macpherson's information is up-to-date, and includes most of the events in the century's work, but in some few cases this is not so. For example, we are surprised to find that although the names of some dozen foreign double-star observers are given (p. 201), no English name has been found worthy of inclusion, not even that of Thomas Lewis. Again, we believe that Sir Norman Lockyer's later researches have, by a natural order of progress, advanced his temperature classification beyond the stage where the Sirian stars were thought to illustrate the acme of temperature. A bibliography giving references to the original works so briefly epitomised in this volume would be of great value, but the book contains no references. W. E. R.

The World's Calendar. Invented by the Rev. J. P. Wiles. (London: G. Philip and Son.) Price 2*s.* net.

MR. WILES has devised a very ingenious toy which will exhibit the day of the week corresponding to any calendar date and also Easter-day for any year.

We do not think that any better mechanical method could have been constructed, but we are not much in sympathy with contriving any device of the kind. The information given is not often required by most of us, and those who do require it had far better work from a concise tabular statement.

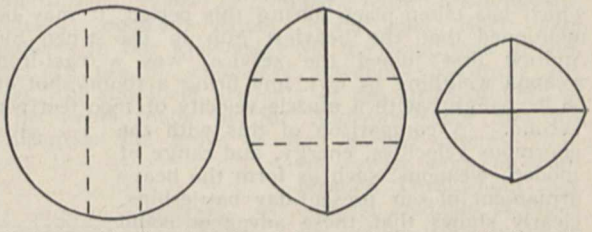
As a Christmas present it would probably give satisfaction. Perhaps Mr. Wiles contemplated this in bringing his calendar out in November. From this point of view it deserves success, and will prompt the curiosity of some to try thoroughly to understand the construction.

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.*]

Cutting a Round Cake on Scientific Principles.

CHRISTMAS suggests cakes, and these the wish on my part to describe a method of cutting them that I have recently devised to my own amusement and satisfaction. The problem to be solved was, "given a round tea-cake of some 5 inches across, and two persons of moderate appetite to eat it, in what way should it be cut so as to leave a minimum of exposed surface to become dry?" The ordinary method of cutting out a wedge is very faulty in this respect. The results to be aimed at are so to cut the cake that the remaining portions shall fit together. Consequently the chords (or the arcs) of the circumferences



Broken straight lines show intended cuts. Ordinary straight lines show the cuts that have been made. The segments are kept in apposition by a common elastic band that encloses the whole. In the above figures about one-third of the area of the original disc is removed by each of the two successive operations.

of these portions must be equal. The direction of the first two vertical planes of section is unimportant; they may be parallel, as in the first figure, or they may enclose a wedge. The cuts shown on the figures represent those made with the intention of letting the cake last for three days, each successive operation having removed about one-third of the area of the original disc. A common india-rubber band embraces the whole and keeps its segments together. F. G.

Anode Rays.

IN the *Deutsch. Phys. Gesell.* (Verh. 8, 21, pp. 559–566, November 15) there appears a paper by Gehrcke and Reichenheim under the title of "Anode Rays."

By means of a special construction a discharge is sent through a tube in which the anode consists of an inorganic salt placed on platinum foil and heated to a dull red heat by an auxiliary current. The salts used are mostly chlorides. In these circumstances a brilliant bundle of coloured rays is emitted by the anode, but this emission soon ceases. These rays the authors call "anode rays." Their positive charge is demonstrated by shooting them into a Faraday cylinder and by their magnetic deflection. These results appear to me to be attributable to the emission of positive ions by heated salts, which has already been investigated by Mr. Garrett and myself (*Phil. Mag.*, October, 1904). Mr. Garrett has continued the work described there, and finds that most halogen salts behave in a similar manner, and that this positive emission can readily be detected at ordinary temperatures. Both the number and velocity of the ions increase rapidly as the temperature is raised or pressure lowered, and in the paper mentioned we found that the emission ceased when the heating was continued. Allowing for the difference in temperature, Gehrcke and Reichenheim's results and ours appear to be different aspects of the same phenomenon. We are now seeking to determine what exactly the positive ions are, and in this connection the observation is of interest that the anode rays give very sharp lines of the metal involved, when coupled with J. Stark's discovery that the canal rays are the emitters of the hydrogen-line spectrum. R. S. WILLOWS.

Cass Institute, E.C., December 17.

THE DEVELOPMENT OF MODERN ARTILLERY AND EXPLOSIVES.[1]

THIS volume is a re-publication of the many valuable papers and lectures which Sir Andrew Noble has contributed on the subject of artillery and explosives. Everyone recognises that there is no greater authority on these subjects than the author, and certainly the marvellous development of heavy weapons within the last forty years would have been impossible but for the solid scientific foundations which Noble and his colleagues laid down. His has been a career of activity almost unequalled, his investigations extending from the period when he was secretary to the first Committee on Rifled Cannon (1858) down to the present time, when Sir Andrew Noble still serves on the Ordnance Research Board, and only last year contributed further valuable papers on the combustion of certain smokeless powders.

As illustrating the development in gun construction which has taken place during this period, it may be mentioned that the heaviest gun in use when Sir Andrew first joined the service was a cast-iron weapon weighing 95 cwt. and firing a round shot of 68 lb. weight, with a muzzle velocity of 1600 feet per second. A comparison of this with the enormous velocities, energy, and range of modern weapons, such as form the heavy armament of our present-day battleships, clearly shows that these advances could only have been made as the result of careful scientific experiment. Noble, together with his colleague the late Sir Frederick Abel, will ever be associated as the leading minds in this magnificent experimental work.

The apology which the author makes for this re-publication is therefore quite unnecessary, and all interested in the subject will gladly welcome this volume, for the papers and lectures were delivered before such various societies that it is often difficult to obtain access to the whole of them. Necessarily there arises a certain amount of repetition, but, as pointed out, the elimination of this would practically have meant re-writing the work, so that the papers appear precisely in their original form. Not only will the collection of them prove of value to the technical man, but several will appeal to the general reader, notably those on "The Rise and Progress of Rifled Naval Artillery," and "Mechanical Science in Relation to the Naval and Military Services."

The preface alone is most interesting, and might well be quoted at length. Two points only, however, which throw light on the objection to any change in the old days, may be noted. After the introduction of rifled artillery, a dinner was given by the Royal Artillery mess to the late Lord Armstrong. After eulogising the work done by the guest of the evening, the president concluded with the emphatic statement, "for myself I am radically opposed to any change." Again later, when Artillery officers were pressing for the introduction of a naval gun weighing seven tons, the naval officers "doubted whether so heavy a gun could be carried on board ship," and a compromise was effected by introducing a gun of 6½ tons. Yet we have had vessels, the *Sans Pareil* and *Benbow* (both long since obsolete), carrying two 110-ton guns!

[1] "Artillery and Explosives" By Sir Andrew Noble, Bart., K.C.B., F.R.S., &c. Pp. xvi+548. (London: John Murray, 1906.) Price 21*s.* net.

The first paper deals with the "Application of the Theory of Probabilities to Artillery Practice," and afforded valuable information as to the superiority of rifled ordnance. The paper is a mathematical one based on actual firing results, the object being to determine "for each gun, that area within which, if a given number of shots were fired, half of the number might be expected to fall." This paper is followed by one on "Experiments with Navez's Electroballistic Apparatus." Other papers of similar type are those "On the Ratio between the Forces tending to produce Translation and Rotation in the Bores of Rifled Guns" and "On the Pressures required to give Rotation to Rifled Projectiles," in which the relative behaviour with uniform and parabolic rifling is critically examined.

To the man of science, as distinct from the artillerist, undoubtedly the researches on the changes taking place during combustion of explosives, the measurement of temperatures, pressures, and velocities will be of the greatest interest. These researches may be said to commence with a paper "On the Tension of Fired Gunpowder" (1871), although part i. of the now classical "Researches on Explosives" did not appear until 1875. As already mentioned, only last year a further contribution under this title was published in the Proceedings of the Royal Society (followed later by a note making certain corrections on temperature estimations), which greatly extended our knowledge on the variation in the products, temperature, &c., when certain modern smokeless powders are fired under varying conditions. It is one of the few points on which we may offer criticism that these two papers are not included in the present volume, and unless some restrictions as to re-publication prevented, it is difficult to understand why they were omitted, for they are certainly not the least valuable of the series.

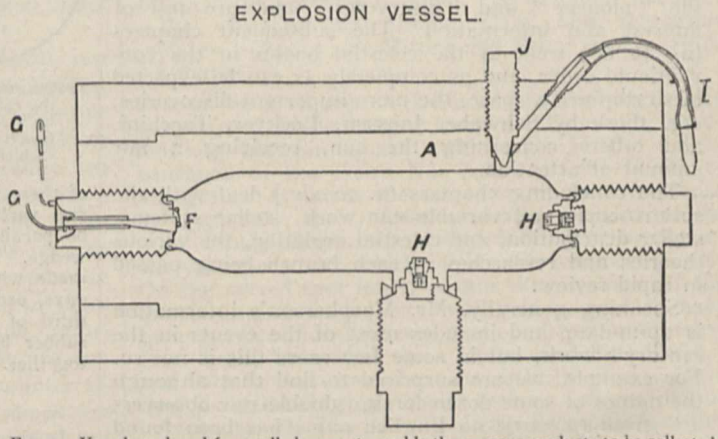


FIG. 1.—Vessel employed for small charges, to enable the gaseous products to be collected and examined. The firing plug is shown at F; the crusher gauges for determining the pressure at H, H; the escape valve for the gases at J.

When Noble and Abel first took up the examination of gunpowder, the knowledge on the subject was simply chaotic. Owing to faulty methods, unjustifiable assumptions, and other causes, the most diverse ideas as to the pressure and temperature developed on firing were held. Rodman, with his well-known "cutter gauge," had done valuable work, but here, as shown in an early paper in this volume, error arose from inertia of the cutter employed. For the examination of the products on firing, charges occupying but a small portion of the space in the experi-

mental vessel had been employed. Sir Andrew Noble and his colleagues fully appreciated the necessity of examining the products when the powder was fired as nearly as possible under like conditions to those existing in the gun, and it was not until they succeeded in retaining all the products when the charge was fired in a space which it completely filled that knowledge on the changes commenced to have any claim to scientific accuracy. Charges so large as 23 lb. of gunpowder and 5 lb. of guncotton have been fired in the author's explosion vessels, illustrations of which we reproduce.

We have become familiar with combustions under these conditions, but it is not difficult to appreciate the risks and troubles incidental to such work, and the patience required by the pioneers to overcome these difficulties. Interesting references will be found to some of these troubles in more than one paper. An account of one singular accident may be quoted:—

"The end of the vessel was placed against a wrought-iron beam. The screw—a half-inch pitch—being a very good fit, was screwed into its place with much difficulty, and with the use of a good deal of oil. On firing, the screw unscrewed . . . until the last two threads were reached. These were sheared. Owing to the wrought-iron beam . . . there was no motion of translation, but the motion of rotation was so high, that the screw first striking the ground and then an iron plate at an angle of 45°, went vertically into the air with a singular humming noise, descending in about 30 seconds a few feet from the place whence it rose."

EXPLOSION VESSEL.

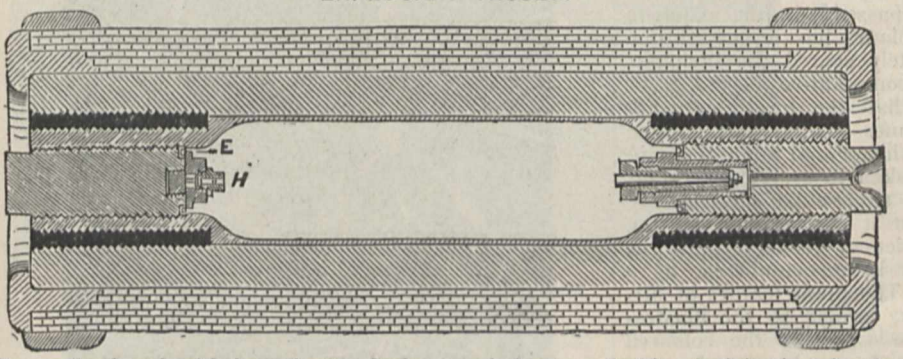


FIG. 2.—Vessel employed for heavy charges. Crusher gauge is shown at H, the firing plug being situated at the opposite end. The shell proper was strengthened by being wound with steel tape.

Only two points need be mentioned in connection with the researches on gunpowder. The author, adopting and relying on Bunsen and Schischkoff's method for estimating hyposulphites in the residues, regarded potassium hyposulphite as being formed as a primary product during combustion, a conclusion questioned by Berthelot, who regarded it "entirely as a product formed during the collection and analytical treatment of the solid residue." In a controversy which followed, Noble made out a good case for supposing no change to have been possible during the preparation of the material, but appears not to have considered the other possibility, faulty analytical methods. Later Debus showed that this was the case, and that actually the treatment produced hyposulphite, which necessitated a re-calculation of the composition of the residues. Attention might have been directed to this earlier in the book.

No practical method is available for determining the actual temperature of explosion, but making certain justifiable assumptions, calculated temperatures of approximate accuracy may be obtained. With Service gunpowder the author concluded the temperature to be about 2200° C., and regarded the signs of fusion of pieces of platinum in the charge as confirming this, Deville's value of "nearly 2000° C." being taken as the melting point of platinum. Holborn and Wein have more recently shown the melting point to be close to 1780° C., so that possibly the temperatures for gunpowder are somewhat high.

It may be noted that as a direct result of the researches on gunpowder, guns were constructed which advanced the velocities from 1600 to 2100 feet per second.

Although gunpowder held its own for centuries with but slight modification, it has now become a thing of the past as a military propellant explosive. The advantages of a smokeless powder are so great that as soon as the difficulty of "taming" guncotton had been overcome, its adoption, either gelatinised alone or mixed with nitroglycerin, quickly followed. Again Noble and Abel were pioneers in our knowledge of the conditions attending the use of smokeless powders. Naturally the very full and lucid accounts of the large number of experiments made by Sir Andrew Noble and his colleagues will prove of even greater interest than the earlier work on gunpowder. Throughout they enjoyed enviable facilities for actual trials in large experimental guns with full charges, and so were enabled to correlate the values in practice with laboratory experiments.

The changes involved during the combustion of smokeless explosives are less complicated than with gunpowder. Conditions, however, greatly modify the proportions in which the various permanent gases are found, hence the total gas volume is also affected. The influence of increasing amounts of nitroglycerin to nitrocellulose in cordites was first fully worked out by Noble, and has proved of the greatest practical value, since it has a close connection with the important question of erosion. With the introduction of the old form of cordite for large guns, the loss of accuracy and short life of the gun became serious matters for consideration. Noble showed erosion to be due to two causes, (*a*) high temperature of the products, (*b*) the motion of these hot gases. Further, a series of elaborate experiments with specially prepared cordites containing increasing percentages of nitroglycerin showed that increase of temperature went hand in hand with increase of nitroglycerin, and consequently also the erosion.

The logical step, therefore, was to reduce the percentage of nitroglycerin, and, as is now common knowledge, the new M.D. cordite contains only 30 per cent. of nitroglycerin instead of 58 per cent. as in the earlier form. Powder of this composition will, for the same charge and size of cord, give less energy in the gun, but this may be overcome by suitable modification of the charge and size of cord. These points are all made beautifully clear by some excellent coloured plates in the last paper, which was delivered in 1900 at the Royal Institution. Other instructive plates in the same paper are those dealing with velocities and pressures derived from them, in

a series of experiments with numerous modern smokeless powders, carried out in a 100-calibre 6-inch gun.

We still employ M.D. cordite in spite of the almost universal adoption by our European neighbours and the Americans of simple nitrocellulose powders, which they experience considerable trouble in keeping in a stable condition, and we may therefore assume that no great advance has been made since Noble's experiments clearly indicated the right path to be followed in the production of a trustworthy smokeless powder which shall give minimum erosion, whilst possessing the essential quality of stability.

J. S. S. B.

A HALF-DOZEN ILLUSTRATED NATURE BOOKS.[1]

IF the lover of natural history and country life whose tastes incline to the study of the higher animals, and who may also possess an appetite for a spice of philosophy, cannot find matter to his liking in at least one of this excellent half-dozen of popular books, he must indeed be hard to please. The first five are charming examples of the modern style of nature-study and popular natural history works, and the general excellence of the style of the text is only equalled (or shall we say surpassed?) by the exquisite illustrations. Since each volume has a special line of its own, we are fortunately spared the invidious task of deciding as to their comparative merits.

The first volume in the list—the forerunner, apparently, of a series of volumes written on the same general lines—is a natural history of mammals, in which, while the group is taken in systematic order, the method of treatment is so popular (and at the same time so accurate) that it can scarcely fail to appeal to a very large series of readers, many of whom will be glad to find it unencumbered, as a rule, with scientific names. The great feature of Mr. Ingersoll's book is, however, formed by the illustrations, many of which—more especially the coloured plates and the reproductions from photographs—are beyond praise. Among the best may be reckoned several of the twelve coloured plates drawn by the author's daughter. Those of the fallow-deer and the jaguar are reproductions from German works, and in the case of these, as well as in that of the water-chevrotain on p. 342, which is copied from an encyclopædia article by Sir W. H. Flower, we fail to notice any acknowledgment of the source. Special attention may be directed to the photo. of the Himalayan tahr on p. 262, as showing the shaggy character of the coat, which is so completely lost in all museum specimens we have seen. On the other hand, it may be noticed that on p. 240 the author gives a figure of the head of an African buffalo to do duty for that of the Indian wild ox or gaur; while the cut of an urial's head on p. 251 is a ludicrous caricature.

In general the text is well up to date, including, for instance, an account of the pedigree of the elephant; but it is rather behindhand in the matter of giraffes, and likewise in classing all antelopes as members of a single subfamily. Moreover, in definitely asserting that the latter animals are recent immigrants into Africa, the author ignores the recent suggestion of Mr. Madison Grant as to the Bovidæ being an endemic Ethiopian group. As instances of error we may refer to an evident mistake in regard to the colour of Pembroke cattle (p. 240), and to the reference of the name "ravine-deer" to the blackbuck (p. 277). These are, however, but trifling slips, and scarcely detract from the general excellence of a most attractive volume.

A Christmas bird-book from the pen and camera of Mr. Kearton is a standing dish to which all young bird-lovers look forward with delight, and we can

FIG. 1.—Chiffchaff and Nest. From "Nature's Carol-Singers."

assure them that they will not be disappointed at the fare their favourite author and artist has provided for the present season. This time Mr. Kearton has taken up his subject from a more definitely systematic point of view than usual, dealing "in a concise and popular manner with the appearance, haunts, habits, nests, eggs, songs, and call-notes of the winged melodists that breed in various parts of the British Islands. I have endeavoured," he continues, "to describe them in such a way that the reader may be able to identify them for himself or herself in wood and field, and where two species bear a similarity of appearance or song, to emphasise the points wherein they differ."

In this aim the author appears to have been successful, condensing the necessary technical descriptions

[1] (1) "The Life of Animals—the Mammals." By E. Ingersoll. Pp. xi+555; illustrated (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) Price 8*s*. 6*d*. net.

(2) "Nature's Carol-Singers." By R. Kearton. Pp. 251; illustrated. London: Cassell and Co., Ltd.) Price 6*s*.

(3) "An Idler in the Wilds." By T. Edwardes. Pp. viii+109; illustrated. (London: John Murray.) Price 6*s*. net.

(4) "I Go A-Walking through the Woods and o'er the Moor." Compiled from the works of the late Rev. C. A. Johns and others. Pp. 79; illustrated. (Edinburgh and London: T. N. Foulis.) Price 2*s*. 6*d*. net.

(5) "Brier Patch Philosophy." By "Peter Rabbit." Interpreted by W. J. Long Pp. xvii+296; illustrated. (London: Ginn and Co.) Price 6*s*. net.

(6) "Birds Shown to the Children." By M. K. C. Scott, described by J. A. Henderson. Pp. 112; illustrated. (London and Edinburgh: T. C. and C. E. Jack.) Price 2*s*. 6*d*. net.

of colouring into as small a space as possible, and afterwards elaborating the more interesting details of habits and distribution. As in all Mr. Kearton's books, the great attraction is, however, the illustrations, which are from photographs by himself and his brother; and in this volume, were we not afraid of libelling their earlier efforts, we should be tempted to say that the artists have surpassed themselves. Be this as it may, the charming illustrations in this volume would be hard to beat, as our readers may judge for themselves from the sample here reproduced (Fig. 1), which was selected almost at random, as where all are excellent it is difficult to make a choice. A more attractive gift-book for young people fond of birds—as all of them should be, and probably are, when they have the proper opportunities—would be difficult to find.

The third volume in the list is, as implied by its title, less of a purely natural history than either of the two preceding ones, dealing largely with country scenery and country life; the frontispiece depicts a beautiful scene from an old-fashioned English hamlet with thatched cottages, while other illustrations show no less exquisite glimpses of shore and river landscape. Certain chapters, such as the one on the flight of the swift and another on the song of the skylark, are, however, vivid sketches of phases in the habits and life-history of birds possessing a peculiar interest and charm of their own; and it is only lack of space that prevents our dwelling on these at some length. Both those mentioned are illustrated with photographs of the species to which they are respectively devoted, and many readers will be specially interested in the author's observations with regard to the nocturnal flight of the swift. In saying that Mr. Tickner Edwardes's little volume, although written on different lines, vies in interest with Sir Herbert Maxwell's "Memories of the Months" we are bestowing a very high meed of praise.

"I Go A-Walking," which is dated 1907, although it was previously issued in parts, and the first of these noted in our columns on its first appearance, is a series of brief illustrated biographies of certain selected birds and animals. These are, no doubt, excellent in their way, but the charm of the book lies in the illustrations; and since these are reproductions from photographs by Mr. C. Reid, of Wishaw, it would be waste of words to add anything in the way of commendation. A special feature of the work is the number of illustrations of groups of young birds, and that our readers may judge for themselves as to the excellence of these (and the illustrations generally) we reproduce, by the courtesy of the publisher, one showing a trio of young rooks.

FIG. 2.—Young Rooks. From "I Go A-Walking."

The fifth book on our list is on a higher plane and of a type totally different from any of the others, dealing mainly with animal psychology, and revealing the thoughtful and speculative mind of the talented author. To do justice to Mr. Long's ideas and theories in the space of a few lines is a manifest impossibility, and we must be content to refer to his belief that the lower animals "possess a rudimentary mind," and may therefore be accorded "some small chance for immortality." With these sentiments we have no cavil, but when we read the statement that "death to the animal is but a sleep, and the only thought in his head when he lies down for the last time is nature's whisper that he will waken as usual when the right time comes," we would ask the author how many wild animals die, so to speak, in their beds? With this brief notice we must leave (and commend) a thoughtful work to the best attention of earnest and thoughtful readers.

Last, and likewise least, is the little volume on birds in Miss Chisholm's "Shown to the Children" series. In works of this nature the necessity for abundant illustration over-rides all other considerations, and if in this instance quantity somewhat exceeds quality, it must be borne in mind that forty-eight full-page coloured plates form a very liberal allowance in a half-crown book, and that the style of execution will probably pass muster among the readers of the book. If we except a few sentences, such as the statement that blackbirds eat snails, the letterpress appears in the main to be just what should be provided for very juvenile readers. R. L.

THE TREATMENT OF CANCER.

IT is an appropriate coincidence that the sensational statements made in the daily Press last week respecting the cure of cancer should have as their antidote the scientific discourse "On the Treatment of Cancer by Modern Methods," which was delivered at the Royal College of Surgeons, as the Bradshaw lecture, by Mr. Edmund Owen on December 12. In an article in the *Pall Mall Gazette* Dr. Saleeby went so far as to assert that the conquest of cancer is within measurable distance, the means of cure being trypsin, a digestive ferment formed by the pancreas and passed in its secretion into the duodenum—the upper part of the small intestine.

The use of trypsin as a cure for cancer seems to have suggested itself independently to two observers, Mr. J. Beard and Dr. Shaw-Mackenzie, the former apparently on embryological grounds, and the latter because of the comparative immunity of the small intestine from cancer. Thus, in 105,374 cases of cancer of the digestive tract, the small intestine was affected in only twenty.[1] Beard found that in mice, the subjects of experimental cancer (the Jensen

[1] Shaw-Mackenzie, *Brit. Med. Journ.*, 1906, i., p. 715.

tumour), injections of trypsin caused shrinkage and degeneration of the tumours,[1] a not unlikely event considering the active digestive properties of trypsin, and his method is stated to have been carried out with success in the human subject by Prof. Morton in America.

The full report of the work of Prof. Morton will be awaited with interest, but, in the meantime, the premature publication of details cannot be too strongly condemned. It is well known that trypsin has been tried in this country by many without any startling success; it is possible that it may be valuable in certain localised growths, just as radium and the X-rays are in selected cases, but, on the data available, to assert that the conquest of cancer is near at hand is unreasonable, and does infinite mischief to science as well as increasing the suffering of the unfortunate victims of this dire malady by hopes that are destined not to be realised.

With reference to Mr. Beard's experiments on mouse cancer, it is to be noted that this so-called experimental cancer is an implantation of the disease into an animal, and not a cancerous metamorphosis of the animal's own tissues, a thing very different from spontaneous cancer. Chian turpentine, violet leaves, Doyen's serum, and a host of other remedies have all at some time or other been vaunted as specifics for cancer, but none has stood the test of rigorous trial.

In conclusion, an extract from the Bradshaw lecture may be quoted:—

"Surgery must not go in advance of facts, or she will assuredly be overtaken and tripped up, as she has learnt from sad experience. At present it is beyond her power to promise to *cure* cancer, whether by a cutting operation, by X-rays, by Finsen's light, or by any drug or nostrum injected into the blood, taken internally, or applied locally. Treatment is, unfortunately, not the same thing as cure, and the most effectual treatment for cancer—no matter how small it may be—is still removal by the knife."[2]

NUBIAN ANTIQUITIES.

AN important philological discovery is announced from Berlin. Profs. Karl Schmidt and H. Schäfer, who are well known for their work in connection with Coptic literature and Nubian antiquities respectively, have succeeded in making out something of the meaning of some religious documents of the eighth century A.D., written in Coptic characters, but in the Nubian language. The three Nubian dialects of to-day, Kenûs, Mahass, and Danakil, are not written. We have, of course, considerable knowledge of the grammar, &c., of these modern dialects, but of the earlier history of the language but little is known. Hence the interest of Prof. Schmidt's discovery. If the two savants concerned succeed in making out more of the language, we may be able to decipher some of the *few* Nubian inscriptions written in Coptic characters which still exist.

In the description of the rock-cut grottoes of Gebel Adda, near Abu Simbel, in Murray's "Handbook for Egypt" (1896, p. 977), we find the following passage:—"On the walls are some Coptic inscriptions, and on the S. wall of the adytum is a long text of 14 lines, in what Lepsius calls 'Christian Ethiopic,' of which another example exists on a rock (now partly broken) at the foot of the cliff on which Qasr Ibrîm stands. The letters are those of the Coptic alphabet, but the language is unknown." This is the kind of inscription referred to. Such records are very rare, and we fear that even when read they will prove to be of religious character, and will not throw the "light on the history of the earliest Nubian races" which the sanguine Berlin correspondent of the *Globe* (December 11) anticipates. The discovery referred to is published in the *Abhandlungen* of the Royal Prussian Academy of Sciences under the title "First Fragments of Christian Literature in the Old-Nubian Language."

The Old-Nubian inscriptions of Qasr Ibrîm and Gebel Adda are not referred to in Prof. Breasted's recently published report on the "Temples of Lower Nubia" (Chicago, 1906). We hope they have not suffered of late years. With regard to the grottoes of Gebel Adda, we note that on p. 18 of his report Prof. Breasted claims to have discovered a fact that has in reality been known for at least ten years, namely, that the ancient Egyptian Viceroy of Nubia, Paser, who cut a "memorial niche" for himself in this rock, lived in the reign of Eye (Ai) as well as in that of Harmhab (Horemheb). Prof. Breasted errs in his statement that Paser was "heretofore [? hitherto: *heretofore* can only refer to matter comprised in Prof. Breasted's previous pages] supposed to have been in office only under Harmhab." He will find the fact noted in the 1896 edition of Murray's "Egypt," probably by that indefatigable collector of Egyptian epigraphic material, Prof. Sayce.

Murray's book is especially useful for rock-tombs and inscriptions, and has far more detail of sites not usually visited by tourists than Baedeker has; but Prof. Breasted has religiously followed his German guide, and so has fallen into Baedeker's error of calling the temple of Serret el-Gharb, south of Gebel Adda, "the temple of Aksheh" (p. 17). This mistake was pointed out by Prof. Sayce in the "Recueil de Travaux" for 1895, but still remains uncorrected. Aksheh, Aksha, or Akasheh, is many miles away, south of Wadi Halfa; there is a village called *Eshka*, however, not far off, which may be the origin of Baedeker's mistake.

NOTES.

THE following presidents of sections have accepted office for the meeting of the British Association to be held at Leicester next year:—A (Mathematics and Physics), Prof. A. E. H. Love, F.R.S.; B (Chemistry), Prof. A. Smithells, F.R.S.; C (Geology), Prof. J. W. Gregory, F.R.S.; D (Zoology), Dr. W. E. Hoyle; E (Geography), Mr. George G. Chisholm; F (Economics), Prof. W. J. Ashley; G (Engineering), Prof. Silvanus P. Thompson, F.R.S.; H (Anthropology), Mr. D. G. Hogarth; I (Physiology), Dr. A. D. Waller, F.R.S.; K (Botany), Prof. J. B. Farmer, F.R.S.; and L (Educational Science), Sir Philip Magnus, M.P.

THE Royal Irish Academy held a very successful conversazione in the Academy House on December 4. Their Excellencies the Lord Lieutenant (visitor of the academy) and the Countess of Aberdeen were present, and a large and distinguished company accepted the invitation of the president and council. Some of the rare manuscripts in the possession of the academy were on exhibition, and attracted much attention; and interesting demonstrations were given in connection with recent scientific developments. There were shown by the fisheries branch of the Department of Agriculture and Technical Instruction for Ireland a number of important additions to the marine fauna of Ireland. Some new scientific instruments were

[1] *Brit. Med. Journ.*, 1906, i., p. 140.
[2] *Brit. Med. Journ.*, 1906, ii., p. 1681.

exhibited and explained, and there was a notable series of large photographs of Vesuvius taken during the recent eruption.

IN the speech of the Secretary for Scotland on December 14, during the debate in committee of the House of Commons on the National Galleries of Scotland Bill, the following passage describes his final proposals regarding the accommodation and grant to the Royal Society of Edinburgh:—"He had now to mention the arrangements proposed for the housing of the Royal Society. For that purpose it was proposed to expend 28,000*l.* of the capital in the hands of the Board of Manufactures. A sum of 25,000*l.* would go to the purchase of a building, and 3000*l.* would cover the expenses of fitting up, re-decorating the new premises, and transferring the library and other effects of the Royal Society from the Royal Institution. The Treasury were giving the Royal Society a grant of not more than 600*l.* a year. At present the Royal Society received a grant of 300*l.* a year, which grant was paid by them as rent for the part of the Royal Institution which they now occupied. In future the Royal Society would be placed in occupation of their new premises, and they would also have the grant of 600*l.* a year for scientific purposes, and would be free from any obligation to pay rent. He thought it would be conceded that the Treasury had been, not extravagant in this matter, but generous."

BY permission of the Lord Mayor, the annual meeting of the British Science Guild will be held at the Mansion House on January 28 at 4 p.m. Mr. Haldane, the president of the Guild, and others to be announced later, will speak. The Lord Mayor will preside.

TO celebrate the fiftieth anniversary of its foundation the Geographical Society of Vienna held a meeting on December 15 under the presidency of the Archduke Rainer, patron of the society.

THE gold medal offered by the National Geographic Society, Washington, for extraordinary achievements, was presented to Commander Peary by the President of the United States at a banquet on December 15.

THE Berlin correspondent of the *Times* states that on December 14 the German Wireless Telegraphy Company succeeded in establishing wireless telephonic communication between its offices in Berlin and the wireless telegraph station at Nauen, a distance of about twenty-five miles. It is claimed that the apparatus can be adapted to any wireless telegraph installation.

IN the House of Commons on Tuesday a discussion took place on the wireless telegraphy convention signed at the recent conference in Berlin, an account of which was given in NATURE of November 15 (p. 59). Sir E. Sassoon moved:—"That, in view of the experimental and undeveloped condition of radio-telegraphy, this House regards with apprehension any engagements hampering the complete freedom of action of the State, and asks His Majesty's Government to grant a Select Committee to inquire into the proposals embodied in the Berlin Convention previous to ratification." The resolution was withdrawn after Mr. Buxton, Postmaster-General, had announced, in the course of a detailed reply to the criticisms passed upon the convention, that a select committee of inquiry would be appointed by the Government at an early period of next session.

ON Friday last, December 14, there was opened in the Alexandra Park, in Manchester, a range of houses erected by the Manchester City Council for the unique collection of cacti made by the late Mr. Charles Darrah, of Heaton Mersey, and presented to the town of Manchester by his widow and sons. The houses, which were erected at the cost of 2500*l.*, are admirably suited for the purpose, and provide a suitable building for this splendid collection, which comprises about 1200 species and varieties of Cactaceæ, and about 400 specimens of other succulent plants.

A CORRESPONDENT in Osaka sends us a cutting from the *Japan Chronicle* of October 20 in which it is reported that "a remarkable piece of crystal has been discovered on a hill at Masutomi-mura, Kita-Koma district, Yamanashi Prefecture. It is 4½ feet long and 1½ feet thick, weighing more than 10,000 lb." The information is not definite enough to be of much value, but it may be pointed out that a quartz crystal of the size mentioned (4½ feet by 1½ feet) would weigh about 1000 lb., not 10,000 lb. In the collection at the British Museum (Natural History) there is a crystal from Madagascar which is 3 feet long and more than 1 foot thick. A crystal in Milan, 3¼ feet in length and 5½ feet in circumference, is estimated to weigh 870 lb.

SPEAKING at the eighth annual dinner of the members of the Medical Graduates' College and Polyclinic, held in London on December 12, Prof. Clifford Allbutt, who presided, said it is quite impossible for teachers, however eminent they may be, to teach undergraduates and post-graduates at the same time, hence the necessity for a post-graduate society of this kind. The science of medicine is living, and the sciences on which medicine was founded are living, and post-graduates must move forward with the rest. Prof. Allbutt suggested that the institution should not rest until it has succeeded in bringing about in this country the establishment of a Ministry of Health.

THE report and balance-sheet for 1906 of the Armstrong College Marine Laboratory, Cullercoats, shows that the sum of 2048*l.* has been received as donations in aid of the scheme to provide a completely equipped laboratory. A marine laboratory is to be erected forthwith at a cost of 3000*l.*, and Mr. Hudleston, the owner, has agreed to let the laboratory to Armstrong College at a yearly rental of 3 per cent. on his outlay. An appeal is made for funds to furnish and equip the laboratory when erected, and these may be sent either to Mr. A. Meek at Armstrong College, Newcastle-upon-Tyne, or to Mr. George Wilkinson, 1 Mosley Street, Newcastle-upon-Tyne.

ON December 6 Mr. Alfred Hands delivered a lecture before the Royal Engineers at Chatham on "The Protection of Buildings from Lightning." He showed the extent of damage by lightning by means of a chart of England and Wales on which the positions and nature of objects damaged during a period of about nine years were indicated by coloured spots. This included 2485 buildings, of which 148 were churches. Mr. Hands showed that it is impossible to protect buildings efficiently by means of set rules; each case has to be studied separately, and the system of protection applied which the complications of metal in and about the structure show to be necessary. Hitherto too much importance has been attached to the form and composition of the conductor, and too little to the fact that its efficiency depends almost entirely on the way in which it is applied, and very little on what it is. As regards the relative value of iron and copper for conductors, so far as the matter concerns conductivity and the dissipation of energy, Mr. Hands holds it to be of such trifling importance that it sinks into insignificance

in comparison with considerations of durability. A lightning conductor is expected to last for a long time, and iron is, unfortunately, too perishable for the purpose. As regards cost, an iron system, if of sufficient size to be fairly lasting, is more costly than an ordinary copper tape one.

A LETTER in the *Times* reports the return of Dr. Stein from his second exploration of Chinese Turkestan. As before, he has combined careful surveys of the Chinese-Indian frontier with archæological work. His former surveys of the farther side of the Kuen-lun have been largely supplemented, and he has explored more ancient sites, revisiting also the Rawak Stupa, from which he obtained before such important archæological material. More ancient documents have been secured, and we await with interest his report, and hope that he will bring out another book describing his travels. This, though it will not possess the charm of novelty which distinguished his "Sand-buried Ruins of Khotan" (see NATURE, vol. lxx., p. 275), and made it one of the most important archæological publications of a decade, will still be most interesting as a sequel to his first work, and is sure to contain matter of the greatest importance. We greatly desire to hear more of the mighty Muztagh-ata, "Ice-mountain Father," and of the other Muztagh in the Kuen-lun, with the extraordinary eroded ranges of Yagan-dawan and the impassable gorges of the Yurung-kash, as well as of the ancient cities of Khotan with their sand-buried treasures of former civilisation.

RARE birds observed at Rositten form the subject of notes by Dr. J. Thienemann in the June and October issues of Reichenow's *Ornithol. Monatsberichte*. The most noteworthy is the Indian greenish tree-warbler, *Phylloscopus* (*Acanthopneuste*) *viridans*.

THE articles in the November issue of *Naturen* include one by Mr. N. J. Føyn on the *Gjøa* expedition under Amundsen for polar magnetic observation; a second, by Mr. C. F. Kolderup, on the San Francisco earthquake; and a third, by Mr. J. A. Grieg, on animal groups in the Bergen Museum. The latter institution, it appears, has been endeavouring to imitate the *régime* inaugurated by Sir W. H. Flower in our own Natural History Museum, and the article contains reproductions from photographs of groups of birds and mammals amid their natural surroundings, which have been recently set up at Bergen.

A MEMOIR by Prof. F. Toula on the dentition of *Rhinoceros* (*Ceratorhinus*) *hundseimensis* forms article 2 of vol. xx. of the *Abhandlungen der k.k. geol. Reichsanstalt*, Vienna. This rhinoceros, which is regarded as a relative of the living *R. sumatrensis*, was first described in 1901 on the evidence of remains from Hundsheim, Altenburg, since which date additional material has been obtained. In describing the dentition in detail, the author refers to that of other European Tertiary species, several of which he splits up into new species and subspecies. The *Rhinoceros etruscus* described by Prof. W. B. Dawkins from the forest-bed of Pakefield he makes, for example, the type of a subspecies, *R. e. pakefieldensis*. In giving the designation *R. megarhinus brachycephala* to a Continental form, Prof. Toula seems to be unaware that, according to the rule adopted by zoologists, this name is preoccupied by *R. mercki brachycephala*, Schröder.

WE have to acknowledge the receipt of vol. v., part iii., and vol. vi., part i., of the Proceedings of the Rhodesia Scientific Association, published at Bulawayo. In addition to Mr. F. White's presidential address delivered on November 7, 1905, the former contains notes, by Mr. H. Marshall, on birds of the Zambezi valley; geological notes on Rhodesia, by Mr. C. E. Parsons; and petrographical notes on the oldest rocks of South Africa, by Mr. F. P. Mennell. The grasses of Rhodesia, by Mr. C. F. H. Monro, and the Amantabele and other tribes of Matabeleland, by Mr. H. J. Taylor, Chief Native Commissioner, form the chief subjects of the later issue. The "black peril" looms large in Mr. Taylor's paper. The native, according to the author, has recently made rapid strides towards civilisation, and superstition is fast dying out. "His mind is becoming more expansive, and his object is to place himself by his own efforts, if possible, on an equal footing with that of the white man. There is a new era in the life of the native, and we are at the present time faced with the greatest political question of the day; all other questions sink into insignificance in comparison."

THE Journal of the Quekett Microscopical Club for November (ix., No. 59), among others, contains a suggestive paper by Mr. J. Rheinberg on stereoscopic effect and the improvement of the binocular microscope, and a very useful non-technical summary of the Mendelian hypothesis, with bibliography and suggestions for experiments with microscopic organisms.

DR. H. G. GAYLORD, of Buffalo, details some remarkable facts suggestive of contagion among mice and rats arising from tumours believed to be cancerous (*Brit. Med. Journ.*, December 1, p. 1555). A cage was discovered in which upwards of sixty cases of spontaneous tumours occurred among rats and mice kept in it in the course of three years. The fact that the location of the cage was frequently changed, and that the stock was entirely renewed without permanent cessation in the occurrence of tumours, indicate that the cage itself was the source of infection.

DURING the last three or four years the view has been gaining ground that the spirillar microorganisms met with in certain diseases, and known as "spirochætes," are protozoan, and not bacterial, in nature, and Schaudinn stated that they were probably a stage in the development of trypanosomes. Novy and Knapp, however, again reassert the bacterial nature of these spirochætes on the following grounds:—(1) they do not seem to divide longitudinally as do trypanosomes; (2) they multiply much more rapidly than protozoa usually do; (3) unlike trypanosomes, they are unaltered by dialysis against water; (4) they are less affected by heat, and have less avidity for air than trypanosomes; and (5) with spirochætes a well-marked active immunity may be induced on inoculation (*Brit. Med. Journ.*, December 1, p. 1573).

IN the Bulletin of the Imperial Botanic Gardens at St. Petersburg, vol. vi., part iv., Mr. N. Busch continues his letters from the Crimea describing the plants collected *en route*. Mr. W. I. Taliew, writing on the flora around Ssergatsch, a town in the Government of Nischny-Novgorod, notes the gradual immigration of *steppe* plants, and another ecological paper is contributed by Mr. B. Fedtschenko on the plant associations of the lake near Borowsk, indicating that it is an outlier of the more northern lakes.

THE importance of forests in connection with the water supply of a country, inasmuch as they regulate the flow of rivers, prevent erosion, and help to conserve moisture, is now generally admitted. This subject is touched upon in

the editorial of the *Indian Forester* (September), and is discussed in a letter from Mr. A. M. Lushington, who draws his arguments from a consideration of the sources of the Cauvery. Mr. Lushington emphasises the necessity of duly conserving the forests at the river sources, and suggests that the help of Government should be invoked to provide the necessary funds, more particularly where the river runs through different States.

MUCH attention is paid in various parts of India by the forest departments to the planting of avenues along the roadsides. An article describing the trees suitable for the Salem district in Madras, by Mr. F. A. Lodge, is published in the same number of the *Indian Forester*. Figs, the wild mango, the tamarind, and the margosa tree, *Melia azedirachta*, are recommended as a first choice, but a more extensive list is given of trees less generally suitable although adapted to special soils. Cultural directions are added with regard to setting out nurseries, transplanting and pruning.

THE *Bulletin de la Société d'Encouragement* (vol. cviii., No. 9) contains the oration delivered by Mr. Gruner at the funeral of Mr. Huet, the eminent civil engineer, president of the society.

THE report of the judges on the trials of suction gas producers organised by the Royal Agricultural Society has been drawn up by Captain Sankey, and summaries of it are published in the *Engineer* and in *Engineering* of December 14. It forms a valuable contribution to the literature of the subject, and shows conclusively that the suction plant is well adapted for agricultural purposes. Although less manual labour is required than with a steam engine, more intelligence is required on the part of the attendant to ensure the production of gas of good quality. In the eleven plants of which complete figures are given, the fuel consumption per brake horse-power at full load varied between 1·04 lb. and 1·48 lb. The winners of the awards priced their plants at almost the same figure, 11·65*l*. and 11·77*l*. per brake horse-power.

RECENT developments in aërial navigation form the subject of an article by Major Baden-Powell in *Knowledge* for December. Commenting on the prevalent view that Santos Dumont's experiments constitute the first case of actual human flight, the author refers to the previous reported records of the Brothers Wilbur and Orville Wright. He also expresses doubt as to how far the recent experiments in Paris have effectively disposed of the stability question. From Major Baden-Powell's article we further learn that experiments with mechanically-propelled balloons are still receiving considerable attention. In particular, the Zeppelin airship has again been making trips, and a speed of thirty miles an hour has been recorded, though it would appear that the estimate was made by theodolite measurements, and further information would therefore have to be placed at the disposal of a reader before any conclusions could be drawn as to the velocity relative to the wind. A new Lebaudy balloon called *La Patrie* has been built for the French Government. Since the appearance of Major Baden-Powell's article it has been reported in the Press that a new explosive has been prepared by the United States Government for use in aëroplane machines constructed by the Brothers Wright.

THE Journal of the Franklin Institute (vol. clxii., No. 5) contains a striking illustration of the historical collection of more than a thousand incandescent lamps, for which the Elliott Cresson gold medal was awarded to Mr. William J. Hammer, of New York. The collection, made during a period covering more than a quarter of a century, embodies a history that could not have been recorded in words, and could not be reproduced if destroyed. In the same issue Prof. Carl Hering describes the Decker battery, a new form of primary battery for large outputs. It is the usual bichromate cell, the feature of novelty being the construction of the cell and its parts. Prof. A. E. Outerbridge reviews recent progress in metallurgy, dealing specially with high-speed tool steels, ferro-alloys, steel-hardening metals, nickel-vanadium steel alloys, blast-furnace slag cement, aluminium, copper, the great increase in the production of gold, and the declining production of silver.

IN the *Century Magazine* for December is an article by the Hon. W. H. Taft, Secretary of War, U.S.A., explaining why the lock system was adopted for the Panama Canal. This question had been referred to a commission of thirteen of the most experienced ship-canal engineers both in the United States and abroad. The majority of this commission, eight in number, advised a sea-level canal, while the minority, consisting principally of the American engineers, advised a canal with locks at a summit-level of 85 feet above the sea. The final decision of the American Government and Congress has been accorded to the adoption of the lock system. The reason for this may be briefly summarised as follows:—The canal without locks would require a deep cutting, a great deal of which would be rock, through the summit-level at Cuelebra involving the removal of 250 millions of cubic yards. The waterway through this cutting would only be 150 feet wide and 40 feet deep. It was estimated that it would take sixteen years to complete the work, and that the total cost, including interest on the outlay, would amount to about 63 millions of pounds. The lock canal, on the other hand, is estimated to cost half the above sum, and to occupy only half the time in constructing. The waterway will vary from 45 feet to 75 feet in depth, and the width from 1000 feet over half the length, 500 feet to 800 feet over a third, and for about five miles 200 feet. The locks are to be in three flights, with a rise of 85 feet, or a total lift of 255 feet. Next to the locks, the most important work will be the enormous dam that is to be constructed to hold the water from the Chagres River, which will form a lake covering an area of 118 square miles, and in places eight miles wide, the depth varying from 45 feet to 75 feet. The dam will, in fact, be a small artificial mountain about 1½ miles long, half a mile wide at the bottom, and 135 feet high, the depth of the impounded water being 85 feet at the dam, the top of which is to be 50 feet above water-level.

THE frequently observed fact that the spontaneous ionisation of the air when measured in leaden vessels appears to be greater than when observed in a chamber of any other metal suggests the presence of some radio-active impurity in ordinary lead. An attempt to identify this constituent is described by Messrs. Elster and Geitel in No. 23 of the *Physikalische Zeitschrift*. The fact that a solution of ordinary lead does not give an emanation proves that the radio-active element is neither radium, actinium, nor radio-thorium. The active constituent remains in solution when the lead is precipitated as chloride, and in this respect resembles radium E and radium F; the fact that it shows an α radiation exclusively would suggest that it is probably radium F (polonium). Before this point can be settled measurements will have to be made of the range of its α radiation

In a communication to the Royal Academy of Belgium (Bulletin No. 7, p. 452) Prof. Walthère Spring shows that the material obtained by decomposing a solution of hydrogen sulphide with sulphur dioxide, and formerly described as δ sulphur by Debus, who considered it to be an allotropic form of the element, is in reality a hydrate having the composition S_8,H_2O. The hydrate has at the ordinary temperature a vapour pressure much smaller than that characterising most hydrates. When, however, it is exposed for a long period in a vacuum it gradually loses water, a form of sulphur being produced which differs from the known forms in its regenerating the hydrate when left in contact with water. It is interesting to note that the composition of the hydrate corresponds with the molecular weight S_8, which has been found by physical methods to characterise sulphur in solution.

Mr. W. B. Clive has published a second edition of "Graphs: or the Graphical Representation of Algebraic Functions," by Messrs. C. H. French and G. Osborn. The book has been expanded, chapters having been added on harder graphs and on the slope of a graph.

A second popular edition of Mr. Oliver Pike's "In Bird-land with Field-glass and Camera" has been published by Mr. T. Fisher Unwin. The first edition of this attractive volume was reviewed in our issue of August 30, 1900 (vol. lxii., p. 417), and it is unnecessary to add anything to the favourable opinion then expressed.

We have received tickets for Mr. Otho Stuart's revival of *A Midsummer Night's Dream* at the Adelphi Theatre. We are glad to know that the management is presenting this delightful comedy, which, unlike many of the modern plays, is not based upon impurity or inanity, but provides all who see it, whether children or adults, with innocent enjoyment and real delight. An arrangement has been made by which schools and parties of students may receive special terms of admittance, for particulars of which application should be sent to Mr. C. F. Leyel at the Adelphi Theatre.

A second edition of Mr. J. H. Stansbie's "Introduction to Metallurgical Chemistry for Technical Students" has been published by Mr. Edward Arnold. The book assumes that those who use it are practically interested in the common metals, but have only the knowledge of their properties gained by every-day observation in the workshop or foundry. The scientific study of the subject consequently starts at the beginning. The text is practical in character, and will be useful to the technical students for whom it is intended.

OUR ASTRONOMICAL COLUMN.

Systematic Stellar Motions.—In a paper submitted to the Royal Astronomical Society Mr. A. S. Eddington discusses the proper motions of the stars contained in the Greenwich-Groombridge catalogue from the point of view that they are not haphazard, but may be considered as belonging to two defined systems.

It has been generally assumed that these proper motions were proper to the individual stars only, but Prof. Kapteyn recently concluded that this assumption was erroneous, and that they might be classified into two "drifts," which are in relative motion, the one to the other. Mr. Eddington's results confirm this theory quantitatively. In each drift the velocities relative to the system of axes of the drift are quite haphazard, but this system of axes has a velocity which is defined as the velocity of that drift.

On analysing the figures obtained for the regions discussed, in order to find the directions of the two drifts in each region, Mr. Eddington found that the stars of drift i. have a common velocity, relative to the sun, away from a point near to R.A. 18h., dec. +18°, and that the best point for the apex of drift ii. is about the position R.A. 7h. 30m., dec. +58°. The velocity of the first drift relative to the sun is much larger than that of the second, the ratio being about 17 : 5, and from an investigation of the *magnitudes* of the proper motions there appears to be no appreciable difference in the mean distances of the stars of the two drifts (the *Observatory*, No. 377).

The Spectrocomparator.—An extremely interesting instrument, devised for the measurement of the spectral displacements in the determination of stellar radial velocities, is described by Dr. J. Hartmann in No. 4, vol. xxiv., of the *Astrophysical Journal*.

The usual method employed in measuring the "Doppler" displacement has been to measure the displacement of each individual stellar line in regard to the corresponding line in a terrestrial spectrum, but in Dr. Hartmann's instrument a large number of lines are compared with those of a standard solar spectrum at one time, so that a stellar spectrum rich in lines, which would, by the older method, have taken days to measure, may now be measured in an hour or two. Details, too numerous to mention here, are given in Dr. Hartmann's paper, and are well illustrated by diagrams and worked examples.

Measurements of the Effective Wave-lengths in Stellar Spectra.—The position of the "effective" wave-lengths in stellar spectra, that is, the position of the radiations which, in the combined radiations of a complete spectrum, appeal most strongly to the eye, is of great importance in double-star observations. For this reason Dr. H. E. Lau has determined this position in seventy stars, by Prof. Comstock's interference method, and publishes the results in No. 4134 of the *Astronomische Nachrichten*.

The stars which have been examined are arranged in groups according to the Harvard classification, and the distance between the conjugate spectra of the first order is given for each object. This quantity may be converted into wave-lengths by the application of a known factor.

Early Observations of Jupiter's Sixth Satellite.—On examining the Harvard photographs of Jupiter, Miss Leavitt found the image of the sixth satellite on two taken in 1894 and on nine taken in 1899. These plates were measured, and the results of the measures and their reduction are given and discussed in No. ii., vol. lx., of the Annals of Harvard College Observatory. It appears that Miss Leavitt marked and measured this satellite when examining some of these plates on December 10, 1904, but concluded that it was probably an asteroid near to its stationary point.

Observations of the August Meteors.—In No. 4132 of the *Astronomische Nachrichten* Prof. von Konkoly records the results of some meteor observations made at the O-Gyalla Observatory in July and August last. These results show that the maximum of the shower occurred on August 12, on the night of which 158 meteors were observed at O'Gyalla and 251 at the subsidiary station at Nagy-Tagyos. On August 13 the corresponding numbers were 111 and 175.

GEOLOGY IN THE UNITED STATES AND CANADA.

Glacialists will be interested in the short sketch of the drumlins of south-eastern Wisconsin contained in Bulletin No. 273 of the U.S. Geological Survey.[1] It is a preliminary record of a detailed study of the post-Pleistocene deposits of the district which embraces part of the ground moraine of the Green Bay glacier—in which most of the drumlins lie—and part of that of the Lake Michigan glacier, as well as an earlier Iowan or Illinoian glaciation. The relations of the drumlins to eskers and to the terminal moraines and rock mounds were investigated. The map shows most clearly the arrangement of the drumlins to correspond with the lines of flow of the deploying glacier.

Bulletin No. 265[2] contains a short account of the struc-

[1] Bulletin No. 273. "The Drumlins of South-eastern Wisconsin." (Preliminary Paper.) By W. C. Aldin. (1905.)

[2] Bulletin No. 265 "Geology of the Boulder District of Colorado." By N. M. Fenneman. (1905.)

ture and stratigraphy of the district, and such features as mesas, slip faults, and lake basins are incidentally described. The well-known Wyoming beds are still tentatively retained in the Triassic system on very poor evidence, and notwithstanding the different interpretation placed upon them by Mr. Darton. The main purpose of the paper is to explain the position of the oil-bearing beds at Boulder. These are shown to be irregular sandstones in the Pierre shales (Cretaceous). The paying beds are limited to a narrow line over the crest of a shallow anticline and over one or two subsidiary folds. Much time and money appear to have been wasted through carelessness in keeping the journals of bore-holes, and by the reckless "shooting" of the wells.

Not long ago we had occasion to notice a bulletin by Mr. T. N. Dale dealing with the much-discussed Taconic area. The same author has now (Bulletin No. 272 [1]) called upon his long experience of the region to produce in a pamphlet, of no more than fifty pages, a charmingly lucid exposition of its physical geography. With the maps, sketches, and photographs, this will be an ideal guide-book to the district for intelligent students.

In Professional Paper No. 43 [2] Mr. Lindgren gives a detailed description of one of the largest copper-producing districts in the United States. The oldest rocks are pre-Cambrian granites and schists; over them lie Palæozoic formations, comprising Cambrian quartzites, Ordovician limestones, shales possibly of Devonian age, and pure limestones of the Carboniferous. Resting unconformably upon the Palæozoic strata are Cretaceous shales and sandstones. After the deposition of the latter formation, a second granitic intrusion, with dioritic porphyries, penetrated the rocks in sheets, laccolites, and dykes. Then there followed a period of uplift and faulting, succeeded by great volcanic effusions of basalt, rhyolite, and some andesite. A remarkable Quaternary deposit, the Gila conglomerate, at the foot of the mountains bears witness to the erosion that has exposed the older rocks in the centre of the district.

The ore deposits are primarily dependent upon the intrusions of porphyry; where it came in contact with the limestones and shales of the Palæozoic series extensive contact metamorphism resulted, not only near the main mass, but within the range of influence of the numerous dykes. The limestone has suffered most, in some cases being converted into an almost solid mass of garnet. Magnetite, pyrite, chalcopyrite, and zinc blende appear to have been intruded into the altered rock from the porphyry magma. Subsequently, oxidising waters have converted the sulphides into carbonates; malachite and azurite are the most common ores. The zinc blende has been carried away as zinc sulphate. The magnetite and garnet have been much decomposed, yielding silica and limonite.

These ore bodies, though somewhat irregular, are mostly worked along the bedding, frequently by tunnels, since they lie at no great depth. In addition to the above ore bodies, there are numerous veins of pyrite, chalcopyrite, and zinc blende; these have been greatly enriched by the secondary deposition of chalcocite on the pyrites, both in the veins themselves and in the adjoining impregnated porphyry. Some interesting observations are made on the action of sulphuric acid solutions, and on the influence exerted by kaolin in enriching the ore. A new mineral species, coronadite, a lead-bearing manganite, is described on pp. 103–5.

This paper contains a good deal of interesting matter, and is illustrated by good maps and a series of capital photomicrographs of the ores within the rocks.

The thoroughness with which the U.S. Geological Survey tackles problems of local water supply could not be better exemplified than by Professional Paper No. 44.[1] Naturally the greater part of this bulky volume is occupied by material of purely local interest, that is, with detailed descriptions of well sections, but the brief outline of the geology of Long Island and an account of the elaborate procedure adopted for determining the rate of flow in underground water are capable of more general application.

British geologists will be interested to note the suggestion to use the terms "wold" and "vale" in a restricted sense to replace the rather loose use of escarpment and cuesta, which are here more precisely defined; but of more importance, and quite opportune, are Mr. Veatch's conclusions as to the cause of the folding of strata at Gay Head; this he unhesitatingly ascribes to the thrust or drag of a continental ice-sheet. The volume is liberally supplied with maps.

The fifth volume of the General Reports of the Maryland Geological Survey [2] is, as usual, a businesslike and well-finished production. It contains the second report on the magnetic work in Maryland, by L. A. Bauer; the third report on the highways of Maryland, by A. N. Johnson; and an elaborate report on the coal deposits of the State, by Prof. W. B. Clark and others.

Bulletin No. 268 [3] contains a descriptive account of

FIG. 1.—Bald of Big Yellow Mountain, Mitchell County, N.C. From "Southern Appalachian Forests."

Foraminifera collected by Prof. J. C. Branner from the Monterey shale on Rancho del Encinal, near Asuncion Station, in San Luis Obispo County, California. The reader is left in some confusion after studying the brief prelude to the detailed descriptions of Foraminifera, for Prof. Branner, who writes the geological introduction, makes it clear that the shaly series is very frequently sandy, and definite interbedded sandstones are not uncommon. On the other hand, Mr. Blagg (p. 11) makes the statement that "The absence of the arenaceous genera undoubtedly shows the purity of the waters in oceanic circulation during the Miocene, and this evidence is still further substantiated by the fine argillaceous and silt character of the deposit in which the Foraminifera are deposited (*sic*). The Foraminifera, in fact, constitute a large portion of the entire mass of the marl itself." On the previous page (p. 10), however, Prof. Branner says, "the bulk of this shale is made of diatom skeletons." Plate i., representing a sandstone intrusion in the Monterey shale, is by no means a convincing illustration.

The fossils described in Bulletin No. 266 [4] were all collected from the Malone Mountain and the immediate

[1] Bulletin No. 272. "Taconic Physiography." By T. N. Dale. (1905.
[2] Professional Paper No. 43. "The Copper Deposits of the Clifton-Morenci District, Arizona." By W. Lindgren. (1905.)

[1] Professional Paper No. 44. "Underground Water Resources of Long Island, New York." By A. C. Veatch, C. S. Slichter, I. Bowman, W. O. Crosby, and R. E. Horton. (1906.)
[2] Vol. v. Maryland Geological Survey. (1905.)
[3] Bulletin No. 268. "Miocene Foraminifera from the Monterey Shale of California." By R. M. Bagg, jun. (1905.)
[4] Bulletin No. 266. "Paleontology of the Malone Jurassic Formation of Texas." By F. W. Cragin, with notes by T. W. Stanton. (1905.)

neighbourhood. Notwithstanding the presence of the genus Ptychomya, the affinities of its fauna clearly refer the Malone formation to the Jurassic system. New species of Perisphinctes, Olcostephanus, Nautilus, Trigonia, Natica, Nerinea, Nerinella, Martesia, Pholadomya, and others are figured and described.

Bulletin No. 270[1] contains records of borings and shallow excavations, with notes on the nature of the rock. From these data sectional elevations have been prepared traversing the district in many directions. Information of this kind, in the same handy form, would be of great value to engineers and contractors in the London area, as it is no doubt in New York.

Bulletin No. 267[2] contains a short discussion of the problem of the classification and nomenclature of the great series of alternating magnesian limestones and sandstones known as the "magnesian series" or "Ozark series" (Cambrian and Ordovician). The ore deposits do not appear to possess any striking features.

A short description of the stratigraphy of the region (mainly Carboniferous), with particulars of the mineral resources, is given in Bulletin No. 256.[3] There is a coloured map.

Taken together, Bulletins Nos. 247, 251, 263[4] give an

FIG. 2.—Land Erosion near Marion, N.C. Showing rapid erosion of soil by heavy rains when the forest cover is reduced or destroyed. From "Southern Appalachian Forests."

excellent survey of the conditions of gold mining in Alaska. Nos. 247 and 251 deal with the geology of their respective districts; No. 263 contains a wealth of information upon all the subjects that fall within the scope of the title, and no miner should venture to Alaska without a copy. All three bulletins are well illustrated.

A more generalised account of the same region is contained in "The Geography and Geology of Alaska," by A. H. Brooks (Professional Paper No. 45, 1906[5]). This well-illustrated volume deals with the climate, the drainage, the history of explorations and surveys, and the geology. In the last-named section an elaborate table is provided giving the correlation of the strata in the western United States and Canada. A bibliography is appended.

Professional Paper No. 41[1] contains a good deal of useful information upon the mineral resources of the central copper region. There is also a short account of the volcanic rocks of Mount Wrangell and of the glaciation of the Copper River basin. There are numerous interesting illustrations.

"The purpose of Mr. Alden's paper[2] is to throw, if possible, some fresh light on the relations which existed during the later stages of the Glacial epoch between the glaciers of south-eastern Wisconsin." It is an interesting study of the phases of glaciation and deglaciation in an area of moderate size. The principal facts are graphically illustrated in a series of admirable maps, prepared by the author to show the relations of the several glacial deposits at different stages.

Professional Paper No. 30. Parts of this volume[3] are excellent, but we are constrained to ask, For whom is it intended? Is it for the West Kentucky miner? Then why burden him with a dissertation on Carboniferous stratigraphy and palæontology? On the other hand, if it was meant for the help of palæontologists, why should their troubles be increased by recording new species under the title "Lead, Zinc, and Fluorspar Deposits"? As for the new species themselves, they may be found beautifully figured, but the diagnoses are very meagre.

The bulk of Professional Paper No. 37[4] is a dreary mass of statistics relating to the forest conditions of southern Appalachia, but it contains a number of illustrations which will appeal to all who are interested in problems of afforestation and water supply. The forest suffers from ill-regulated lumbering and from fires, but far more damage is done, not to the forest alone, but to the water supply, the scenery, and the agriculture of large districts by the clearing of land for farm purposes on high ground and steep slopes. The rainfall on the north-western slopes ranges from 40 inches to 50 inches, on the south-eastern slopes from 60 inches to 70 inches, and heavy downpours are common. The two figures here reproduced bring out very clearly the cause of the trouble and one of its effects.

In Professional Paper No. 38[5] is a careful description of the Bingham mining district, where low-grade copper and rich silver-lead ores occur in Carboniferous strata and in the later monzonite intrusions.

Professional Papers Nos. 40 and 47[6] are two important palæontological works; both are illustrated with a large number of beautiful plates.

It is not every mineral district that boasts of so elaborate a memoir as Professional Paper No. 42[7] within five years of its discovery. This paper deals with the geology, petrology, faults, and veins, and gives details of each of the mines. The temperature in the Tonopah mines shows an abnormally rapid increase with depth, comparable to that in the Comstock.

In Professional Paper No. 49[8] a general account is given of the Cumberland Gap coalfield, Kentucky. All the rocks of this basin are of the age of the Pottsville group of the Pennsylvanian coalfield. The field has only been exploited since 1892; eight seams are mined at present; their thickness ranges from 4 feet to 6 feet.

The Annual Report of the Geological Survey of Canada

[1] Bulletin No. 270. "The Configuration of the Rock Floor of Greater New York." By W. H. Hobbs. (1905.)

[2] Bulletin No. 267. "The Copper Deposits of Missouri." By H. O. Foster Bain and E. O. Ulrich. (1905.)

[3] Bulletin No. 256. "Mineral Resources of Elders Ridge Quadrangle, Pennsylvania." By R. W. Stone. (1905.)

[4] Bulletin No. 247. "The Fairhaven Gold Placers, Seward Peninsula, Alaska." By F. H. Moffit. (1905.) Bulletin No. 251. "The Gold Placers of Forty-mile, Birch Creek and Fairbanks Regions, Alaska." By L. M. Prindle. (1905.) Bulletin No. 263. "Methods and Costs of Gravel and Placer Mining in Alaska." By C. W. Purington. (1905.)

[5] Professional Paper No. 45. "The Geography and Geology of Alaska." By A. H. Brooks. (1906.)

[1] Professional Paper No. 41. "Geology of the Central Copper River Region, Alaska." By W. C. Mendenhall. (1905.)

[2] Professional Paper No. 34. "The Delavan Lobe of the Lake Michigan Glacier." By W. C. Alden. (1904.)

[3] Professional Paper No. 30. "The Lead, Zinc, and Fluorspar Deposits of Western Kentucky." By E. O. Ulrich and W. S. Tangier Smith. (1905.)

[4] Professional Paper No. 37. "The Southern Appalachian Forests." By H. B. Ayres and W. W. Ashe. (1905.)

[5] Professional Paper No. 38. "Economic Geology of the Bingham Mining District, Utah." By J. M. Boutwell and others. (1905.)

[6] Professional Paper No. 40. "The Triassic Cephalopod Genera of America." By A. Hyatt and J. P. Smith. (1905.) Professional Paper No. 47. "The Tertiary and Quaternary Pectens of California." By R. Arnold. (1906.)

[7] Professional Paper No. 42. "Geology of the Tonopah Mining District, Nevada." By J. E. Spurr. (1905.)

[8] Professional Paper No. 49. "Geology and Mineral Resources of Part of the Cumberland Gap Coalfield, Kentucky." By G. H. Ashley and L. C. Glenn.

for 1901 [1] (published 1905) contains, in addition to the summary report (published in 1902), a report on the Klondike goldfields, by R. G. McConnell, 1905; a report on an exploration of Ekwan River, Sutton Mill Lakes, by D. B. Dowling, 1904; Dr. Barlow's elaborate report on the nickel and copper deposits of the Sudbury mining district, 1904; and other papers. Both volumes are illustrated and accompanied by separate portfolios of maps. The volume for 1902–3 contains the summary reports for 1902 (published in 1903) and for 1903 (published in 1904). There is also a report on the coalfield of the Souris River, East Assiniboia, by D. B. Dowling, and the "Section of Mines" annual report for 1902.

SCIENTIFIC FISHERY INVESTIGATIONS.

IN the unavoidable absence of the Chancellor of the Exchequer, Mr. R. M'Kenna received a deputation at the Treasury on December 18 in support of the application of the Marine Biological Association for a grant to continue the scientific fishery investigations which are at present being conducted in the North Sea and English Channel. The deputation was introduced by the Right Hon. Austen Chamberlain, M.P., ex-Chancellor of the Exchequer, and among those present were Prof. E. Ray Lankester (president of the Marine Biological Association), Sir Michael Foster, Sir William Ramsay, Mr. A. E. Shipley (chairman of the council), Sir Charles Eliot, Mr. Chas. Hellyer, Mr. J. A. Travers, Dr. Chalmers Mitchell, Prof. E. A. Minchin, and Dr. H. R. Mill.

In introducing the deputation, Mr. Austen Chamberlain stated that, as a former Chancellor of the Exchequer, it had been his duty to review the work which had been done by the Marine Biological Association, and he had come to the conclusion that it was most necessary, and that it had been efficiently performed. He considered that British Governments of both parties should do more to support both science and art. Prof. Lankester gave a brief account of the history of the Marine Biological Association, and explained the circumstances in which the association undertook, at the request of His Majesty's Government, to carry out the English portion of the international scheme of fishery investigations. He directed attention to the fact that the present application of the association for funds to continue their researches had received the special support of the Royal Society, which recorded in a strong minute its appreciation of the value and efficiency of the work being done.

Mr. A. E. Shipley said the Government has gained directly and in money by entrusting the North Sea work to the Marine Biological Association. He referred to the importance of extending over a sufficient period of years the kind of investigation which the association is making. Only so can the effects of secondary causes and exceptional fluctuations be eliminated from the essential, primary, normal factors. While time advances in an arithmetical progression so does the value of the results increase in a geometrical ratio. Mr. Shipley gave a short *résumé* of the work accomplished, and because it has furnished the problems of most pressing importance he confined his remarks chiefly to the plaice. During the last four years the association has devoted much hard work to tracing the life-history and the distribution of this species throughout the North Sea, with the result that many important facts concerning it have been established. Similar investigations have been carried on, but not yet so thoroughly, into the life-histories, the distribution, the migrations, and rate of growth of many of the other food fishes, the cod, the haddock, the sole, the turbot, and others. Special experiments have been made on the *Huxley* to determine the vitality and the extent of injury inflicted upon trawl-caught fish by the operations of trawling. The hydrographic observations and the investigations into the minute organisms which crowd the surface of the waters and form the ultimate food of fish have been efficiently carried on in accordance with the programme laid down by the international conferences. In this work especially, the Plymouth steamer, the *Oithona*, has supplemented and helped the *Huxley*. The association asked for a continuation of the grant which for the last five years the Government has made towards the expense of carrying on the English part of the North Sea international investigations. A grant of 6000*l*. a year is needed to continue the international work, and a grant of 2000*l*. for the work on the south coast, making a total grant asked for of 8000*l*. Next spring, for the first time, the International Congress has been invited to meet in England. There will be gathered together in London some thirty or forty of the leading men of science from Russia, Finland, Sweden, Norway, Denmark, Germany, Holland, and Belgium. It will be a pitiful thing, and also a deep humiliation, if we have to greet these gentlemen with the tidings that England, who takes from the North Sea far more than all the other eight countries together, more, in fact, than 90 per cent. of the total yield, is too impoverished to continue to do her share of this important work.

Sir Michael Foster, speaking on behalf of the British Science Guild, considered that the money asked for ought to be regarded as of the nature of an investment, and not as expenditure. He believed that scientific investigation was the only sound foundation upon which fishery legislation could be framed, and that experimental legislation, which was the only possible alternative to experimental research, would involve the country in far greater expenditure than the small sum required by the Marine Biological Association.

Mr. Charles Hellyer, chairman of committees of the National Sea Fisheries Protection Association, speaking as a practical man connected with the fishing industry, emphasised the importance to the industry of the knowledge being accumulated by the scientific investigations now in progress.

Mr. J. A. Travers, in the absence of the Prime-Warden, referred to the support which the Fishmongers' Company had always given to the work of the Marine Biological Association in the belief that an increase of scientific knowledge was bound to be advantageous to the best interests of the fishing industry.

Dr. H. R. Mill spoke of the very valuable results which had been obtained from the hydrographical work carried out in the North Sea and adjacent waters during recent years, and expressed the view that the time was not far distant when it would be possible to predict the movements of the migratory fishes from a knowledge of the hydrographical conditions of the sea.

Mr. M'Kenna, in reply to the deputation, stated that after what had been said there could be no question as to the value of the work upon which the Marine Biological Association was engaged. But the demands upon the national Exchequer were very heavy, and as a matter of experience they found that the satisfaction of one demand led to a number of others being brought forward. He promised to lay the views expressed by the deputation before the Chancellor of the Exchequer, who would, he had no doubt, give them his most careful consideration.

AGRICULTURAL RESEARCH.

IN concluding a course of Cantor lectures at the Society of Arts on Monday, on the subject of "Artificial Fertilisers," Mr. A. D. Hall, director of the Rothamsted Experiment Station, pointed out that only by continued investigation and experiment can a knowledge be obtained of the conditions necessary to make the maximum profit out of the land, crops, and stock. The teacher can only hand on what is already known; and much yet remains unknown about the growth of our commonest crops and the action of standard fertilisers. Adequate provision for scientific investigation of agricultural matters is of national importance, as the following remarks made by Mr. Hall show; but though a few counties and other local bodies are carrying out demonstrations, Rothamsted, with its comparatively small endowment, remains practically our only experiment station where problems in agricultural science are studied with the object of making new knowledge, and State aid for research amounts only to a few hundred pounds a year for the whole country.

The grants of our Board of Agriculture for agricultural

[1] "The Annual Report of the Geological Survey of Canada for 1901." (1905.) With separate folio of maps. The Annual Report of the Geological Survey of Canada, vol. xv., 1902–3. (1906.)

research during the past year amounted to 425*l.*, while the corresponding grant in the United States of America (salaries and administration expenses being excluded in each case) was more than 150,000*l.* It is true that in both countries the local authorities also spend some money on agricultural experiments, but the same disproportion would probably be found between the respective amounts if the figures could be arrived at.

Are we to take it, then, that these figures represent the relative importance of the agriculture of the two countries, or does the larger figure indicate the greater need of the American farmer for experiment and investigation? The exact contrary is the case; in the British Isles we have to farm with dear land, dear labour, and a number of charges due to the proximity of a high civilisation. Farming in consequence can only pay when there is a considerable monetary return per acre, and the bigger yield necessary involves intensive cultivation, the purchase of fertilisers, and the employment of skill, which are all needless to our competitors on a virgin soil. But each increase in the expenditure and skill necessary for the crop means a greater opening for knowledge and investigation; science can do little to save money for the man who merely stirs the surface of a virgin prairie, scattering in the seed meanwhile, and then leaves it to take its chance until harvest. Compare with such a farmer the highly technical routine of the hop-grower who spends 50*l.* per acre before he harvests his crop, his repeated cultivations, his manurings, his sprayings for various ends; it is with this kind of crops that science can find profitable employment.

Looking at the average yields of the various countries of the world, we find that Great Britain is the most intensively farmed country; it obtains the biggest crops per acre, it has to spend the most to obtain them. Furthermore, the biggest crop the greater are the risks of disease and blight, the greater are the difficulties in securing high quality. Here, then, in Great Britain exists the greatest need for knowledge and investigation; we cannot even always beg knowledge from wiser countries, for many of our problems are special, and brought about by the very conditions of high farming which prevail here. England was the first country to start an experimental station, yet Rothamsted still remains the only institution solely devoted to agricultural research in the British Isles, if we except the farm of the Royal Agricultural Society at Woburn. The income of the Rothamsted station, derived solely from private benefaction, is about 2600*l.* a year; in the United States each of the fifty-three States possesses a station receiving 3000*l.* a year from the Federal Government, besides what the State itself may contribute, in addition to the great central department of agriculture to which reference has already been made.

SOME NEW METHODS IN METEOROLOGY.[1]

PROF. BIGELOW has here collected six studies. The first four deal with diurnal periods:—(i.) of temperature; (ii.) of barometric pressure; (iii.) of vapour tension, electric potential, and coefficient of dissipation; (iv.) of terrestrial magnetism; (v.) treats of the variable action of the sun and its effects upon terrestrial weather conditions; whilst (vi.) is a general review of the status of cosmical meteorology.

The immediate occasion, the author tells us, for these studies was the necessity of deciding upon the best lines of work for the new "Mount Weather" Observatory, at Bluemont, Va., which is intended to serve as a centre for research in connection with the U.S. Weather Bureau. This observatory is to have on its staff experts in various departments, and there is to be an advisory committee, of which Prof. Bigelow is described elsewhere as chairman.

Several of Prof. Bigelow's views as to the prosecution of the higher meteorology have much to recommend them, as, for example, the following:—"If cosmical meteorology is to be established then all rough and ready methods must be abandoned, and the work of computing and discussing the data must be placed in the hands of physicists and astro-physicists who possess scientific instincts and training" (p. 48); or again:—"We must waste nothing by using bad methods of work and unskilled men" (p. 51).

But Prof. Bigelow possesses, apparently, a duality in his nature, and the following are examples of his second self:—"In the midst of this concatenation of forces the terrestrial magnetic field stands out as the best unifier or integrator. It is the most sensitive and delicate pulse which we possess, having one throb in the solar mass, and the other in its synchronism with the earth's meteorological elements" (p. 48). This seems not unworthy of Colonel Starbottle addressing a jury, but what exactly does it mean? Here, again, is what we are told of the sun:—"Recent computations indicate that at the centre . . . there is a nucleus which . . . is nearly as solid as the interior of the earth, with a temperature of about 10,000° C.; the average density . . . is 1·43 times that of water, and this is located at half the distance from the centre to the surface" (p. 39).

Feeling doubts of our capacity to follow with advantage Prof. Bigelow's highest flights, we have devoted more attention to his studies on the diurnal variations. The view to be taken of these must depend on whether they are intended as examples of the methods to be followed by the Mount Weather Observatory, or whether they are simply illustrations of the "rough-and-ready" methods the abandonment of which the author elsewhere recommends. Study i. deduces from continuous temperature records at Blue Hill Observatory, and from observations made during or in connection with kite ascents there, the diurnal variation of temperature at a series of heights for every month of the year. The final results are embodied in Figs. 14 to 25, the diurnal variation being assumed negligible at the height of 3400 metres the whole year round. The original data are not given, and the methods of manipulating them are only indicated generally. Of the probable value of the results no estimate seems possible. Study ii. gives some general, but not very lucid, information about the diurnal variation of barometric pressure. Of the amplitude of the 24-hour term it says, not incorrectly, "it is very different at neighbouring stations." Yet Prof. Bigelow obtains Fourier coefficients for a composite diurnal inequality based on data from Boston, New York, Washington, Buffalo, and Cleveland. Again, we are told in the general remarks that the amplitude of the 24-hour term is from one-fourth to one-half that of the 12-hour term. But in the composite case treated by Prof. Bigelow the 24-hour term is larger than the 12-hour term in the summer months, and the arithmetic means from the twelve monthly values of the amplitudes seem closely alike for the two waves.

In the calculations, the diurnal variation is assumed to be *completely* accounted for by three waves of periods 24, 12, and 8 hours. If $[n]$ denote the departure at hour n from the mean for the day, then the contributions to $[n]$ from the 12- and 8-hour waves are respectively

$$\tfrac{1}{2}\{[n]+[n+12]\} \text{ and } \tfrac{1}{4}\{[n]+[n+8]+[n+16]\},$$

and what remains after subtracting these two contributions from $[n]$ is *assumed* to represent the contribution of the 24-hour wave. This method cannot be recommended even for rough preliminary work, unless the 24-hour term is largely dominant and the Fourier series is known to converge very rapidly. In the present instance the amplitude of the 8-hour wave is, according to Prof. Bigelow's figures, about half that of the 24-hour wave from November to February. In these months the observational data would certainly give an appreciable 6-hour term. The same method is then applied to the diurnal variation of temperature (with sign reversed) as deduced in Study i. for heights of 195, 400, and 1000 metres at Blue Hill. The results for the 8-hour wave at 195 metres during the summer months at once arrest attention. In July, for instance, no hourly value assigned to this wave is positive. This seems to be due, not to misprints—though these are somewhat numerous in the tables—but to error in the figures for the diurnal inequality itself. If the *twenty-four* hourly differences from the mean are summed algebraically, there is in most months a substantial remainder, showing that the mean value for the day has not been correctly taken.

Limits of space allow only of brief reference to other

[1] "Studies on the Diurnal Periods in the Lower Strata of the Atmosphere." Reprints from the *Monthly Weather Review*, 1905. By Prof. Frank Hagar Bigelow. (Washington: Weather Bureau, 1905.)

matters. Tables iii. to vi., p. 23, and numerous curves deal with diurnal variation of vapour pressure at Parc St. Maur, and at Blue Hill at several levels. Tables vii. and viii. and Chart xii. deal with electric potential at Greenwich for each month of the year, and with seasonal data at Perpignan and Paris. From a study of these the author advances in Chart xiii., sect. ii., as the representative curve of the diurnal inequality one possessing *five* maxima! A very similar curve—based on results by Zölss and Gockel—is given for electric dissipation. The conclusions embodied in these curves cannot be recommended for general acceptance. The same remark applies to the conclusion, on p. 21, that "the (earth's) electrostatic field varies inversely to that of the solar energy." The sole basis for this view seems to be Table ix., p. 24, and Fig. 53, which are regarded as proving a parallel variation from year to year between the number of solar prominences and the reciprocal of a quantity supposed to represent the mean annual potential gradient at Greenwich.

The diurnal variation of the magnetic field seems to be ascribed to up and down movements of positive ions in the atmosphere; these are supposed to indulge a preference for cold air during the day. As to magnetic storms, the author's theory is even less clearly stated, but he apparently regards it as supported by the rapid rise towards 1 p.m. in the frequency figures given by Mr. Maunder for the hour of commencement of magnetic storms at Greenwich from 1882 to 1903. The author is presumably unaware that Mr. Maunder has since attributed this sudden rise to a cause having nothing to do with terrestrial magnetism, and that it is not shown in figures he has given for the epoch 1848 to 1881 (*cf. Phil. Mag.*, September, 1905, p. 306). In opposition to the theory advanced by Prof. Schuster and others, that the magnetic diurnal inequality is due to electric currents in the *upper* atmosphere, the author contends that the source is more directly thermal and confined to the lowest two miles of the atmosphere. A comparatively short series of simultaneous observations at suitably chosen high- and low-level stations should be fairly decisive for or against Prof. Bigelow's contention.

In the above criticisms the author has been regarded as a scientific man whose aim is to convey scientific ideas to other scientific men. If his aim is simply to convey to an unscientific public a general idea of the problems which present themselves in cosmical physics, with the view of impressing the imagination rather than of appealing to the intelligence, the case is no doubt different. But on either hypothesis, what useful purpose is likely to be served by the indiscriminate collection of statistics and the enunciation of vague, hasty theories? A sparing use of theory may serve as a lubricant, but theory when heaped upon theory is simply dust clogging the wheels of science.

CHARLES CHREE.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

MR. J. J. WELCH has been appointed to the newly-established chair of naval architecture at the Armstrong College, Newcastle.

IT is announced in the *Lancet* that the late Dr. Gustave Schorstein bequeathed 500*l.* to the regius professor of medicine at the University of Oxford for the pathological department of the medical school, 500*l.* to the London Hospital, and a sum, which will probably amount to some 10,000*l.*, in trust to the University of Oxford, subject to certain life interests. When these are expired the capital is to be at the disposal of the University for use as the University may think fit.

THE following courses of lectures for teachers have been arranged, among others, at University College, London, in conjunction with the education committee of the London County Council:—"The Teaching of Geography to Children," Prof. Lyde; "Some Types of Vegetation and the Conditions under which they Exist," Dr. Fritsch, both courses beginning on January 17; and "The Principles of Electrical Science during the Past 150 Years," Prof. Trouton, beginning on January 19.

THE preliminary programme of the second International Congress on School Hygiene, to be held on August 5–10, 1907, at the University of London, South Kensington, has been issued. The work of the congress will be divided into eleven sections, each presided over by an authority on the subject dealt with. The organising committee is inviting educational and public health authorities, universities, colleges, schools, societies, and others to appoint delegates to the meeting, and is appealing for donations to meet the large expenditure involved in organising the congress, which it is estimated will be not less than 3000*l.* The president of the congress is Sir Lauder Brunton, F.R.S., and the hon. secretaries are Dr. James Kerr and Mr. E. White Wallis.

THE report of the Board of Education for the year 1905–6 is of an encouraging nature. There is plenty of evidence provided that our national system of technical education continues steadily to improve. The report points out that much attention has been paid throughout the country to the extension and improvement of the facilities provided for continuative education. There has been marked activity in the establishment of courses of instruction affording special technical training, and the effective character of the many courses organised under varied conditions shows that local circumstances have received the consideration necessary for success in this kind of educational work. Technical institutions affording whole-time training for those who can give two or more years to study after completing a secondary-school course have improved and multiplied their courses of technical instruction. The multiplication of courses requiring the whole time of students is a gratifying indication of the growing appreciation of the value of the work of the technical school; but this appreciation is not confined to whole-time instruction. The improved organisation of the varied institutions engaged in supplementing the training which a youth receives in the office or workshop has borne fruit in many practical developments, demonstrating the extent to which such further education may become a recognised element in the lives of our youths. The report, which runs to 106 pages, deals fully with every department of elementary, secondary, and technical education, and shows conclusively that, political controversy notwithstanding, valuable work is being accomplished in the schools.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society November 22.—"The Structure of Nerve Fibres." By J. S. **Macdonald.** Communicated by Prof. C. S. Sherrington, F.R.S.

Nerve fibres teased in harmless saline solutions and examined under the microscope exhibit a series of varied appearances which are distributed in a constant order in the length of the fibre. This orderly distribution is explained as due to the electrical current which traverses the fibre inwards from each injured point, and which leaves the fibre to traverse the salt solution at certain definite "kathodal" points.

At each injured point, the source of the current, the colloid material is precipitated and is surrounded by an aqueous solution. By the use of definite reagents the solution is found to be a concentrated solution of a potassium salt, probably potassium chloride. The author in a previous paper has directed attention to the importance of this fact, when injury is considered as the fatal consequence of a violent "excitation," and to the probability that "excitation" is the outcome of such a desolution of colloid material and liberation of inorganic salt to diffuse and give rise to electrical change. At kathodal points a similar set of conditions is observed, in origin secondary to those already described at the current source.

The injury region is abruptly limited by an adjacent "anodal region," where the material of the nerve fibre has an exceptionally fluid appearance, except in so far as this fluidity is disturbed by secondary acid formation and diffusion.

The anodal region passes into the kathodal region through a graduated series of coagulative change, attended

by an increasing density of granule formations (precipitated proteid).

The distribution of potassium salt in the solutions within the fibre can be mapped out, not only by definite potassium precipitants, but also by dyes which are "salted out" by potassium salts. This fact is held to be of importance where in other recorded instances the "staining" effects of these dyes have been observed in nerve cells and in cells of secretory glands, since in these cases also the staining effects observed may be due to intracellular solutions of inorganic salts.

The author has also made observations upon the form in which the proteid matter is precipitated in regions of the fibre of different coagulation intensity. These observations have resulted in the opinion that the "neurofibrils," which are commonly described as structural elements of nerve fibres, are precipitates of proteid making an appearance only when the conditions determining coagulation have a certain low value.

November 22.—"On Opsonins in Relation to Red Blood-cells." By Dr. J. O. Wakelin **Barratt**. Communicated by Dr. C. J. Martin, F.R.S.

It is shown that—

(1) By employing phagocytosis as a test of the presence of red blood-cell opsonin, and avoiding spontaneous phagocytosis by suitable conditions of experiment, quantitative determinations of the opsonic content of serum may be made.

(2) In the experiments made, the interaction of opsonin and red blood-cell proceeded at a rate corresponding to that exhibited in a bimolecular stoichiometric reaction.

Royal Microscopical Society, November 21.—Mr. A. N. Disney, vice-president, in the chair.—The use of a top stop for developing latent powers of the microscope: J. W. **Gordon**. The author exhibited his apparatus, which had previously been shown to the society, and pointed out that a top stop enables the microscopist to vary the proportion between the refracted and the unrefracted light which passes the instrument, and thus to render conspicuous a particular feature of the object. In illustration of the results thus reached, he exhibited photographs taken with an achromatic oil-immersion objective of N.A. 1·0 to demonstrate how, by means of a top stop, the objective in question could be made to equal the performance of an objective of much wider aperture.

Physical Society, November 23.—Prof. J. Perry, F.R.S., president, in the chair.—Electric radiation from bent antennæ: Prof. J. A. **Fleming**. An account of experiments at University College, London, with radiating antennæ consisting of bent wires having the property of radiating electric waves more strongly in some directions than others. The receiving arrangement consisted of a thermoelectric oscillation-detector contained in a double test-tube like a Dewar vacuum-vessel. Four copper strips pass down the inner tube, and platinum wires soldered to them are sealed through the glass. One pair of these are connected by a fine constantan wire, and the other pair by a tellurium-bismuth thermojunction. A high vacuum is made between the test-tubes. If electric oscillations are sent through the constantan wire and a galvanometer connected to the thermojunction, this receiver can measure the root-mean-square value of the oscillations induced in any receiving antenna when the fine wire is inserted between the antenna and the earth. The receiver used gave deflections almost exactly proportional to the square of the current passing through the fine wire. This receiver was inserted between an earth-plate and a vertical receiving antenna. The transmitting antenna consisted of a similar wire and plate. Readings were taken of the current in the receiving antenna, and plotted out as polar curves corresponding to the various directions of the free end of the transmitter. Curves show that the intensity of radiation in various azimuths for constant distance between receiver and transmitter becomes more unequal as the ratio of horizontal to vertical part of the transmitter increases. Also all the polar curves show a minimum radiation corresponding to a direction of the free end of the transmitter such that it makes an angle of 70° to 75° with the line joining the earthed points of the transmitter and receiver. The form of the polar curve observed for the same sending antenna, but with different distances between sender and receiver, varies as it should do by theory. A large number of forms of antenna were examined. Similar effects observed by Mr. Marconi in the case of bent receiving antennæ are explained, and it is shown that these effects cannot be explained without admitting three sources of electromotive force in the bent receiving antennæ:—(1) that due to the magnetic force of the incident wave; (2) that due to the electric force; and (3) an electromotive force due to the periodic insertion and removal of lines of magnetic force from the nearly closed loop formed by the bent antennæ.—Auroral and sun-spot frequencies contrasted: Dr. C. **Chree**. The author has already investigated the relationships between certain phenomena of terrestrial magnetism and sun-spot frequency. The present paper makes similar comparisons between sun-spot frequency and the frequency of auroras. The sun-spot data utilised are from the big table of Wolf and Wolfer, covering the long period 1749 to 1901. Mean values have been calculated from this table for each month of the year. One object was to see whether there was appreciable variation in the mean sun-spot frequencies for individual months of the year. The differences between the means for individual months proved to be by no means negligible when calculated from thirty-three consecutive years, or from groups of thirty-three or thirty-nine years selected as representing sun-spot maximum and minimum. A comparison is instituted between mean sun-spot frequencies and mean auroral frequencies calculated for the same group of years. During the periods dealt with there seemed reason to believe that variation occurred in the unit of auroral frequency. To eliminate such uncertainties as far as possible, a period, say, poor in sun-spots, is contrasted with two equal periods rich in sun-spots, one preceding and the other following it. An investigation is made as to whether the annual variation of auroral frequency is the same in years of many as in years of few sun-spots. The evidence is not perhaps altogether decisive, but, so far as it goes, it points to the conclusion that, *relatively* considered, the annual variation is more pronounced when sun-spots are few than when they are numerous. There seems, however, to be a conspicuous difference between the variation in the annual auroral frequencies derived from the south and the north of Scandinavia. At first sight the much greater length of time for which records exist suggests that aurora lends itself more readily than terrestrial magnetism to a comparison with sun-spots.—The electrical resistances of alloys: Dr. R. S. **Willows**. Lord Rayleigh has given a theory intended to account for the high resistance of alloys compared with that of the constituent metals. The author attempts to put this theory in evidence by measuring the resistance of an alloy with direct and also alternating currents. At the instant of reversal of the latter the back E.M.F. will assist the external E.M.F., and hence more current will pass, *i.e.* the resistance will apparently be reduced. No spurious resistance could be detected. A minimum accuracy of 0·02 per cent. is attained.

Mathematical Society, December 13.—Prof. W. Burnside, president, in the chair.—The form of the surface of a searchlight reflector: C. S. **Jackson**. The light from a source must be reflected so as to pass horizontally through a narrow vertical slit. The equation of the surface is found to be of the form $r+\rho=\text{const.}$, where r is the distance of a point on the surface from the source, treated as a point, and ρ is the perpendicular distance of the same point of the surface from the slit, treated as a vertical line. The practical construction of the surface is explained.—The Diophantine equation $x^n - Ny^n = z$: Major P. A. **MacMahon**. A method is explained for obtaining the arithmetically independent solutions of the Diophantine inequality $\lambda x \geqslant \mu y$ by forming the descending intermediate series of convergents to the continued fraction μ/λ. The forms of the arithmetically independent solutions of the Diophantine inequality $x \geqslant N^m y$ are deduced, and the properties of the number z, which can have the form $x^n - Ny^n$, are determined.—Asymptotic expansion of integral functions defined by generalised hypergeometric series: Dr. E. W. **Barnes**. The series in question satisfy

a linear differential equation which is a generalised form of that satisfied by the ordinary hypergeometric series, and the asymptotic expansions are related to the form of the differential equation. In the most important cases the asymptotic expansions become exponentially infinite at infinite distances.—The potential equation and others with function given on the boundary: L. F. **Richardson.** The paper suggests a tentative method for arriving at an approximate solution of the problem of steady flow of heat in a homogeneous solid with given surface temperature by beginning with the problem of variable flow in a solid of variable diffusivity which tends to zero on the boundary.—The limits of real variants: J. **Mercer.** The paper is occupied with generalisations of Cauchy's theorem which is expressed by the formula

$$\lim_{n=\infty}(X_{n+1}-X_n)=\lim_{n=\infty}(n^{-1}X_n).$$

Royal Astronomical Society, December 14.—Mr. W. H. Maw, president, in the chair.—Solar parallax papers, No. 5: examination of the photographic places of stars published in the Paris Eros Circular: A. R. **Hinks.** Comparisons had been made of the photographic places of stars obtained at Paris, Bordeaux, Catania, San Fernando, Toulouse, and Algiers, showing many discordances, some of considerable amount. The Algiers places were specially affected by "magnitude equation," the cause of which was very obscure. It appeared that many of the star places are affected by errors much larger than those considered permissible in the Astrographic Catalogue.—Account of the Oxford Astrographic Catalogue, vol. i.: H. H. **Turner.** The volume in question, which has just been published, contains measures of rectangular coordinates and diameters of star images on plates with centres in dec. +31°. The complete catalogue will consist of eight volumes, one of which will be devoted to discussions.—Notes on some spectroscopic observations of the sun: H. F. **Newall.** The observations were first made with the 25-inch equatorial at Cambridge (the Newall telescope), and later with a fixed horizontal telescope, a cœlostat, and auxiliary mirror; the latter equipment appeared to possess considerable advantages. An account was given of the preliminary experiments; the instrumental arrangements were described, and some results were given of the photographic study of the bands and flutings in the spectra of sun-spots.—Note on the approaching return of Halley's comet: A. C. D. **Crommelin.** The author directed attention to a paper by Dr. A. J. Ångström published in 1862, in which a mean period for the comet of 76·93 years was deduced, with inequalities due to the action of Jupiter and Saturn. Dr. Ångström's results give 1913·08 for the time of the next perihelion passage, while that given by the Count de Pontécoulant is 1910·37. In view of this large discrepancy of 2·7 years, it is most desirable that the perturbations should be independently computed. Before the last return, in 1835, there were at least five independent determinations of the orbit, and it would be a great misfortune if there is a serious error in the prediction of this return after the great success achieved in 1759 and 1835.—Photographs of Mira Ceti in 1897 and 1906, by Father **Sidgreaves,** were shown. There were marked differences in the relative intensities of the hydrogen lines.—Dr. **Lockyer** also showed photographs of the star taken at its present maximum.

MANCHESTER.

Literary and Philosophical Society, November 13.—Mr. C. Bailey in the chair.—Luminosity produced by the rubbing or knocking together of various forms of silica: R. L. **Taylor.** The luminosity is connected in some way with the breaking away of small particles, mostly in the form of dust. Mr. Joseph Burton finds that whereas ordinary felspar only shows this property in a very small degree, the same substance previously heated almost to fusion shows it nearly as well as quartz. Common glass does not show it, but a specimen of glass "frit," rich in lead and very hard, does to a slight extent. The luminosity may be partly due to the hardness of the material, but that it is not entirely so is shown by the fact that whereas a slight luminosity is shown when a piece of corundum or a piece of native emery is rubbed against a piece of silica, there is none whatever when two pieces of corundum or two pieces of native emery are knocked together. There is a curious odour produced by the impact of any of these bodies which become luminous, an odour which has been compared to that of ozone, but Mr. Taylor has not been able to verify that observation. Mr. F. Jones and Mr. Burton also made careful tests for ozone, and both failed to obtain any evidence of its presence.—The proembryo and bulbils of *Lamprothamnus alopecuroides* (Braun): Miss M. **McNicol.** This plant, which occurs in various countries of Europe and also in Africa, is characterised by the possession of unicellular bulbils or tubercles, formed by the transformation of rhizoids.

CAMBRIDGE.

Philosophical Society, November 12.—Dr. Hobson, president, in the chair.—(1) Electrification produced by heating salts; (2) secondary Röntgen rays: Prof. **Thomson.**—The specific heat of gases at constant volume and high pressure: W. A. D. **Rudge.** The author has determined the specific heat of carbonic acid by heating the gas in small steel bulbs immersed in a calorimeter containing paraffin. The value obtained was about 0·45 for a temperature range of from 36° to 60°, when the gas was under a pressure of about 480 atmospheres.—The radio-activity of the alkali metals: N. R. **Campbell** and A. **Wood.** It is found that potassium salts show a greater radio-activity than any substance examined which does not contain a "radio-active element." The activity is an atomic property, and is not due to any impurity. The rays from potassium vary in penetrating power; the most penetrating rays are similar to the β rays from uranium. An activity of the same nature is observed in rubidium, but could not be detected in cæsium, sodium, or lithium. The rays from rubidium are far less penetrating than those from potassium. The ionisation caused by the rays from potassium is about 1/1000 of that caused by the β rays from a similar quantity of uranium. An apparently successful attempt has been made to obtain a photographic impression caused by the rays from potassium.—A relation between the ionic velocity and the volume of organic ions in aqueous solutions: G. A. **Carse** and T. H. **Laby.** This is a continuation of a previous paper (Proc. Camb. Phil. Soc., xiii., p. 287, 1906). It is found that the product ionic velocity × linear dimension of the ion, or va, is sensibly constant for the ions of twenty-two amines, the mean value being 20·2, for seven homologues of aniline 18·8, for thirteen pyridines and quinolines 20·3, for five phosphines 17·6, &c. The linear dimension of an ion is taken as proportional to the cube root of the ionic volume, which is deduced from molecular and atomic volumes. It is shown from hydrodynamical considerations that $va=$ const. × (term depending on ionic shape).

November 26.—Dr. Fenton, vice-president, in the chair.—A delicate reaction for carbohydrates: Dr. **Fenton.** When bromo- or chloro-methylfurfural reacts with sodio-malonic ester in alcoholic solution, a product is obtained solutions of which exhibit an intense blue fluorescence. The reaction is extremely delicate, and serves to detect the most minute trace of the above-named derivatives of methylfurfural. It is further shown that all hexoses and polysaccharides, glucosides, &c., which contain a hexose residue yield bromo-methylfurfural when acted upon by hydrogen bromide under appropriate conditions, and they may therefore be readily identified by the formation of this fluorescent product.—Xanthoxalanil and its analogues: S. **Ruhemann.** The author has studied the action of ethyl oxalate on acetanilide in the presence of sodium ethoxide, and has found that the compound thus formed, which is called xanthoxalanil, has the formula $C_{28}H_{12}O_5N_2$.—The influence of a strong magnetic field on the spark spectra of titanium, chromium, and manganese: J. E. **Purvis.** The strength of the field was 40,000 units, and Prof. Liveing's 21-feet concave grating spectroscope was used. The general results showed that most of the lines were divided into triplets of which the middle constituent was at least twice as strong as the two outside ones, although the three constituents of several lines appeared to be more nearly equal. A number of lines were divided into four, and the two outside constituents of some were weaker and more diffuse than the two middle ones, whilst in several they appeared to be equally strong.

Chromium λ 2866·80 appeared to divide into eight, only seen separately when analysed by a calcite prism; 3147·23, 2855·73, 2757·75 were divided into six, also only seen separated on analysis; and 2861 is divided into five. The titanium line 3252·03 is divided into six. The distances of the constituents of the divided lines were measured for a considerable number of the strongest lines, and the values of $d\lambda/\lambda^2$ calculated from them. It appeared that amongst the lines which had more than three constituents, the values for several were simple multiples of one another, and in several instances the constituents of different lines had the same values, the same general appearance and polarisation. Also the values of $d\lambda/\lambda^2$ for some lines appeared to be simple multiples of those of other lines.—The solubility of stereoisomerides in optically active solvents: H. O. **Jones.** The statement, found in certain text-books, that the solubility of two optical antimers *must* be different in an optically active solvent has been put to the test of experiment, and it has been found untrue. In the cases of *d*- and *l*-camphoroximes and of *d*- and *l*-camphors in *l*-amylbromide and in dextrorotatory turpentine as solvents, the solubility of the *d* and *l* compounds was found to be the same.—Estimation of copper: W. H. **Foster.** An attempt to employ the method of Wood and Berry for the estimation of sugar, and that of Jones and Carpenter for the estimation of hydroxylamine, to the determination of copper, especially in mixtures. The method was found to be simple and accurate with copper solutions, using grape-sugar as reducing agent. With mixtures of copper and other metals the results were generally unsatisfactory, being high when sugar was the reducing agent employed, and low when hydroxylamine was used. Phenylhydrazine gave better results than hydroxylamine, but these were also below those required by theory. The method, which is really a modification of that of Schwarz, can be recommended for solutions of copper salts alone, or for solutions containing only small quantities of other metals.—The maturation of the germ-cells in the saw-fly, *Nematus ribesii* (third note): L. **Doncaster.**

DUBLIN.

Royal Dublin Society, November 20.—Sir Howard Grubb, F.R.S., vice-president, in the chair.—Some injurious fungi found in Ireland: Prof. T. **Johnson.** The author dealt with certain fungal diseases, mainly from the economic aspect, such as yellow-blight and scab in the potato, "Phoma" rot in mangel and turnip; onion rot, and barley leaf-streak. The paper ended with an account of the author's discovery of the American gooseberry mildew on the red currant in co. Kilkenny, and of the steps taken by the Irish Government to check the spread of this mildew in Ireland.—A contribution to the study of evaporation from water surfaces: J. R. **Sutton.** The observations and experiments were made at Kimberley, South Africa, and under meteorological conditions, *i.e.* in the open air. It is provisionally concluded that while differences between the vapour tensions at the water surface and in the open air are competent to influence the rate of evaporation to a large extent, the intensity of the effect of vapour-tension differences is profoundly modified by the relation the temperature of the dew point bears to the temperature of the air, or, in other words, is profoundly modified by the relative humidity. The water temperatures are, as such, probably of no great importance, initially, at any rate; but when considered in conjunction with the temperature and relative humidity of the air, an influence becomes apparent which, so far as is known, has not hitherto received due recognition. It seems to be extremely probable that after the relative humidity of the open air and the difference of vapour tension have been allowed for, much of the observed evaporation, from whatsoever form of water surface or type of gauge, is due to convection currents. The effects of insolation are discussed, both as regards evaporation at sea and from land surfaces, and the conclusion is drawn that too much importance has hitherto been attributed to this source of energy. In a series of experiments on the effects of electrification, no difference was detected between the evaporation from insulated and uninsulated copper evaporating vessels, other than trifling differences which may be due to experimental error.

EDINBURGH.

Royal Society, November 19.—Dr. R. H. Traquair in the chair.—A new Siphonogorgid genus, with descriptions of three new species: J. J. **Simpson.** These organisms were obtained from the shallow waters of the Indian Ocean, and presented features which quite differentiated them from the other known genera of the same family.—Craniometric observations on the skull of *Equus prejvalskii* and other horses: Prof. O. Charnock **Bradley.** The general conclusions were that the wild horse had a long, narrow face, the Iceland or forest type a short, broad face, while the Celtic type occupied an intermediate position; that the orbit of the wild horse was elongated and placed far back as compared with the rounded orbits of the two other types.—Skulls of horses from the Roman fort at Newstead, near Melrose, with observations on the origin of domestic horses: Prof. J. C. **Ewart.** From a careful study of these skulls, thirteen in all, the author obtained fresh evidence in support of his theory that the present domesticated horses are descended from three distinct types, namely, the wild horse of the Gobi Desert, the Celtic type, and the forest type. The evidence from length and shape of skull, and from the estimated heights of the horses of which the skulls had been found near Melrose, was thoroughly examined, and there seemed little doubt that the Romans possessed horses of from twelve to fifteen hands in height belonging to the three types named. A remarkable feature which seemed to have hitherto escaped notice was the manner in which the forward part of the skull was bent with reference to the base, giving to some types a Roman-nose aspect, to others a straight form of face. An interesting point was that the amount of bending varied with the age of the animal, being (for example) bent at birth in the case of the wild horse, then becoming straight at sixteen months, and, finally, bent again in the adult.—The inversion of cane sugar by optically active acids: Theodore **Rettie** and Dr. W. W. **Taylor.**

December 3.—Prof. Crum Brown, vice-president, in the chair.—The sporulation of *Amoeba proteus*: Prof. J. Y. **Simpson.** The paper gave an account of the sporulation in *Amoeba proteus* without encystment, describing certain specific nuclear changes, and raising some questions in connection with the nuclear changes in the allied species *Pelomyxa palustris*.—Results of removal and transplantation of ovaries: Dr. F. H. A. **Marshall** and W. A. **Jolly.**—The influence of an excessive meat diet on the osseous system: Dr. Chalmers **Watson.**—The effects of a meat diet on fertility and lactation: Dr. B. P. **Watson.**—The effects of a meat diet on the minute structure of the uterus: Drs. Malcolm **Campbell** and Chalmers **Watson.** These three papers treated of different aspects of the same general question. In the first it was shown that in the offspring of rats fed on an excessive meat diet the osseous system was defective. The bones were invariably too soft and vascular, and frequently showed structural changes like those of rickets in the human subject. The blood-forming cells in the bone marrow were also affected, being at first increased in number and later diminished. In the second paper it was demonstrated that the reproductive power of rats fed on an excessive meat diet was much below that of rats fed on a bread-and-milk diet. Further, when the meat-fed rats had litters they were less able to feed their young owing to smaller development of mammary tissue. The third paper contained a description of the minute structure of the lining membranes of the uterus in rats fed on different diets. The prolonged use of an unphysiological diet, such as an excessive meat diet, induced structural changes in the mucous membrane of the uterus, and these changes were most pronounced in animals in which the faulty feeding was begun when the animals were weaned. Such animals were invariably sterile.—The minors of a product determinant: Dr. Thomas **Muir.**

PARIS.

Academy of Sciences, December 10.—M. H. Poincaré in the chair.—The division of labour amongst bees: Gaston **Bonnier.** The author's experiments during last summer show that the division of labour is carried out to a surprising extent among bees. Bees which are seeking for

pollen or nectar do not carry it, but merely carry the news to the hive. A number of bees are sent out to strip the flowers, a number carrying pollen only, others nectar only, others again water only, when water is needed. The number sent out is proportional to the number of flowers to be stripped, and by marking the bees with coloured talc it was proved that each bee confined itself for the time being to one class of work. The same bee might be seeking for flowers in the morning and collecting in the afternoon, but did not change the nature of its work without returning to the hive. There seemed to be something in the nature of a working arrangement between the bees of different hives, as when the work of clearing a certain area of flowers had once been commenced by a few bees from one hive, these collectors were not interfered with by bees from other hives.—Some scientific discoveries of Leonardo da Vinci: P. **Duhem.** A study of the effect of the scientific writings of Leonardo da Vinci on the work of Mersenne, Roberval, Descartes, Fabry, and Huygens.—Glycosuria without hyperglycemia: R. **Lépine** and M. **Boulud.**—The theory of ensembles: Félix **Bernstein.**—The power of orthogonal systems of continuous functions: Erhard **Schmidt.**—The calculation of limits: L. **Fejér.**—A class of differential equations reducible to linear equations: M. **Rivereau.**—The phenomena of magnetic rotatory polarisation in crystals: Jean **Becquerel.**—The motor effects of high frequency currents: H. **Guilleminot.**—A colour reaction given by reducing sugars by *m*-dinitrobenzene in alkaline solution: MM. **Chavassieu** and **Morel.** A violet colouring matter is produced. It is neither more nor less characteristic than other colour reactions of aldoses and ketoses, but has the advantage of being very easy to carry out.—A tetrabromo-derivative of methylethylketone: M. **Pastureau.** The ketone is converted into a peroxide by the action of hydrogen peroxide in acid solution, and this submitted to the action of bromine. The tetrabromide thus formed has been shown to have the constitution $CH_2Br—CO—CH_2—CBr_3$, since when heated with potassium carbonate it gives acetol.—The distribution of phosphorus in foods: M. **Balland.**—The distribution of vicianine and of its diastase in the seeds of Leguminosæ: Gabriel **Bertrand** and Mlle. L. **Rivkind.** About forty species were examined, and most of them were found to contain a diastase capable of hydrolysing vivianine. The glucoside was only found in plants of the genus Vicia, and the distribution of the two substances was very irregular even in this one genus. *Vicia narbonensis*, for example, contains neither diastase nor vicianine.—The composition of vegetable juices extracted from roots: G. **André.**—The respiration of seeds in the state of latent life: Paul **Becquerel.** It has been found that light, the teguments of the seed, and the state of hydration are all important factors in the respiration of the seed, and the effect of these may be sufficient to explain the variable results obtained by different workers on this subject.—Pollen, its origin and transformation: Germand **Vert.**—A tumour in an invertebrate, *Sipunculus nudus*: Marcel A. **Hérubel.**—A new order of dinoflagellated parasites, Blastodiniæ: Edouard **Chatton.**—The interpretation of some results in radiotherapy and an attempt at fixing a rational technique: J. **Bergonié** and L. **Tribondeau.**—The conglomerates of Messina and those of the Glokova-Varassova synclinal in Greece: Ph. **Négris.**

CALCUTTA.

Asiatic Society of Bengal, November 7.—Latitude of the Presidency College Observatory: Babu Phanindra Lal **Ganguli.** A simplified method of making approximate calculations in recording observations at the Presidency College Observatory.—Further notes on earwigs (Dermaptera) in the Indian Museum, with the description of a new species: M. **Burr.** Records of new localities and the description of a new species of the genus Anisolabis.—Notes on the habits of the earwig, *Labidura lividipes*, Dufour: Dr. N. **Annandale.** This earwig is sometimes very common at light during the hot weather and rains. It uses its forceps in opening and folding its wings.—Cirrhipèdes Operculés de l'Indian Museum, de Calcutta: M. A. **Gruvel.** An account of the sessile barnacles of the Indian Museum collection, with descriptions of a new genus, Pyrgopsis, and of new species, four of the genus Verruca and one of Balanus. The genus Pyrgopsis is allied to Pyrgoma.—Note on the Houbara or bastard bustard (*Houbara macqueenii*): Lieut.-Colonel D. C. **Phillott.** An account of the habits of this bird, its food, way of hiding, &c.—Descriptions of two new Indian frogs: G. A. **Boulenger.** The species are *Rhacophorus taeniatus* from the plains of Bengal, and *Ixalus annandalii* from the Sikkim Himalaya.—Notes on pollination of flowers in India, Nos. 1–3: I. H. **Burkill.** The author describes (1) the pollination of *Thunbergia grandiflora* in Calcutta by the boring bees, *Xylocapa latipes* and *X. aestuans*; (2) the pollination of *Corchorus capsularis* and *C. olitorius*—the two jute plants—in many places in Bengal and Assam; (3) the pollination, as observed in the Simla Hills, of the flowers of *Adhatoda vasica, Dicliptera bupleuroides, Morina persica, Salvia lanata, Scutellaria linearis*, and *Teucrium royleanum.*—*Ascaris lobulata*, Schneider, ein Parasit aus des Darms von *Platanista gangetica*: Dr. v. **Linstow.** A brief note upon the features of this parasitic worm.—Notes on the fresh-water fauna of India, No. ix., descriptions of new fresh-water sponges from Calcutta, with a record of two known species from the Himalayas and a list of the Indian forms: Dr. N. **Annandale.** Two new species and a new variety of Spongilla, a new species of Ephydatia, and two of Trochospongilla are described from a tank in Calcutta. *Spongilla carteri*, Bowerbank, and *Ephydatia robusta*, Potts, are recorded from a lake situated at the height of 4500 feet above sea-level in the Central Himalayas, on the evidence of floating gemmules. The list of Indian fresh-water sponges now includes nine species and varieties of Spongilla, four of Ephydatia, and two of Trochospongilla. The species recorded from Bombay are mostly different from those occurring in Calcutta.—Notes on fresh-water fauna of India, No. x., *Hydra orientalis* during the rains: Dr. N. **Annandale.** Four-tentacled individuals of the polyp have been found during the rains bearing four-tentacled buds, but without sexual organs. At this season they confine themselves to deep and densely shaded parts of the tank, and are small and colourless.

NEW SOUTH WALES.

Royal Society, September 5.—Mr. H. A. Lenehan, vice-president, in the chair.—Port Sydney: L. **Hargrave.** The paper showed how Port Jackson might be made an up-to-date port without tampering with vested interests, present traffic, or riparian rights. The accommodation shown was 8000 yards of quay, with 40 feet of water; six miles from Redfern.—The international rules of botanical nomenclature (adopted by the International Botanical Congress of Vienna, 1905): J. H. **Maiden.** The author gives an account of the modern attempts to evolve laws for a settled nomenclature, beginning at the International Botanical Congress of Paris, 1867.

Linnean Society, October 31.—Mr. Henry Deane, vice-president, in the chair.—Contribution to our knowledge of the action of rennin: A. H. **Moseley** and Dr. H. G. **Chapman.** It was noted (1) that when milk which showed an acid reaction to litmus was neutralised with alkali, rennin ceased to produce its customary clot, and (2) that the addition of quantities of alkali insufficient to produce neutrality of reaction to litmus inhibited the clotting of the milk with rennin. Upon investigation it was found that this action was due to destruction of rennin by hydroxyl ions, and was not dependent on any specific action of the sodium or potassium ion upon caseinogen or casein.—The geology of Samoa, and the eruptions in Savaii: H. I. **Jensen.** The phenomena presented by the Savaiian volcano afford some clue to the direction in which to look for future developments in the forecasting of earthquakes and eruptions. The eruption at Savaii was due to a movement along the great structural line between Samoa and New Zealand which opened the fissure in 1902. The increase of folding consequent upon rise of the isogeotherms accompanying the sun-spot maximum of 1905 caused the re-melting of magmas at a depth, and squeezed them into the fissure, whence they have been escaping from several vents. The ingress of sea-water has had something to do with the eruption, as shown by the hydrochloric acid evolved, and it should be

mentioned that the rainy season, January to March, was that of greatest activity. Many points of resemblance between Samoan and Hawaiian lavas command attention.—Sand-movement on the New South Wales coast: G. H. **Halligan.** The principal factors which govern the movement of sand and shingle on the littoral being ocean and tidal currents, wave action, and wind, the following matters are discussed:—the effects of strong and weak currents, counter currents, and currents due to tidal flow upon the direction and rate of sand-travel; the movement of beach material due to tidal current a negligible quantity; sand-movement more pronounced during flood tide as compared with ebb tide; a projecting headland may cause a current on its northern or southern side, according as its northern side is concave or convex, or whether the headland is at right angles to the course of the current, or meets it at an angle; the influence of the prevailing and the dominant winds upon sand-travel as shown by an analysis of the winds recorded at Sydney during the decade 1894–1903, and at the Clarence River from March, 1877, to August, 1886; the manner in which sand and shingle are moved by wave action and by currents, and the reasons why the sand on the coast of New South Wales is more readily moved to the south than to the north, where strong eddy currents do not exist; predominant influence of the strong southerly winds on the movement of sand above the limit of wave action, with instances of the northerly movement of sand-dunes on the coast.—The minerals and genesis of the veins and "Schlieren" traversing the ægirine-syenite in the Bowral quarries: D. **Mawson.** The veins ordinarily occupy fissures which may be very local, extending only a few inches, or at other times continuous by the establishment of connections between minor openings. They are classified as (1) veins of bitumen distilled from the underlying Coal-measures; (2) simple pegmatite veins of (*a*) small, and (*b*) of larger dimensions, which have originated by sweating from the sides, or by the residual gaseous and more liquid contents of the solidifying rock collecting largely in the same fashion, and crystallising out as a coarse-grained product; and (3) veins exhibiting well-marked flow-structure and of finer grain, more nearly related to the aplites.—The fixation of nitrogen by *Azotobacter chroococcum*: Dr. R. **Greig-Smith.** Azotobacter is a slime-forming microorganism, and in combination with other bacteria, such as *Bact. radiobacter* and *Bact. levaniformans*, with which it appears to associate, it quickly produces a luxuriant growth of slime on saccharine media. There is also a fixation of nitrogen, but this, as has been pointed out by Beijerinck and v. Delden, is caused by Azotobacter, and not by the other bacteria, which, however, may render assistance.—The fixation of nitrogen by *Rhizobium leguminosarum*: Dr. R. **Greig-Smith.** The investigation showed that races of the nodule former can fix atmospheric nitrogen in artificial culture, and that the fixation is coincident with, and proportional to, the formation of slime. Under conditions which assist cell growth, but which preclude the formation of slime, there is no fixation, and conversely, under conditions which assist the formation, such as the presence of another bacterium, there is an increased fixation.

CAPE TOWN.

South African Philosophical Society. October 31.—Dr. J. C. Beattie, president, in the chair.—A series of mounted Cape Alcyonaria (Cœlenterates) obtained by the Government Biological Department: J. Stuart **Thomson.** The specimens exhibited were of remarkable beauty in form and colouring. One of the most interesting of the forms exhibited was *Anthoptilum thomsoni*, a colony measuring about 3 feet long and occurring in abundance at certain places, probably forming miniature animal forests at the bottom of the sea.—Connection between the rainfall at Durban and at Mauritius: T. F. **Clanton.** The note arises out of an inquiry into the possibility of seasonal weather forecasts for Mauritius. Examination shows that the monthly departures from average of the various meteorological elements at Durban have no connection with those at Mauritius. It appears, however, that winter droughts in Durban have invariably been followed by summer droughts in Mauritius at intervals of from three to seven months, and that prolonged droughts in Natal or those commencing in the summer may be either accompanied or followed by prolonged droughts in Mauritius. There is some evidence to show that the interval depends upon the time of commencement of the drought at Durban.—Discussion of the errors of certain types of minimum spirit thermometers in use at the Royal Alfred Observatory, Mauritius: A. **Walter.** The conclusions arrived at are:—(1) the minimum thermometers (even the so-called "sensitive") should never be used as ordinary thermometers; (2) the errors from comparisons at certain temperatures may be as much as 2°; (3) the absolute minima obtained with the spherical bulb thermometers may amount to as much as +3°.—The chemical composition of berry wax: Dr. B. **van der Riet.** In this paper the author drew a comparison between constants found for berry wax (from berries of *Myrica cordifolia*) and those quoted for myrtle wax (from berries of various species of Myrica), by Dr. J. Lewkowitsch in his treatise on the chemical analysis of oils, fats, and waxes.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 20.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Track Circuit as Installed on Steam Railways: H. G. Brown.

LINNEAN SOCIETY, at 8.—Botanical Results of the Third Tanganyika Expedition, 1904–5: Dr A. B. Rendle and others.—Fossil Foraminifera of Victoria; the Balcombian Deposits of Port Phillip: F. Chapman.—*Exhibition:* Albino Woodlice: Wilfred Mark Webb.

CHEMICAL SOCIETY, at 8.30.—A New Laboratory Method for the preparation of Hydrogen Sulphide: F. R. L. Wilson.—The Reaction of Acids with Methyl Orange: V. H. Veley.—(1) Contributions to the Study of the Calcium Phosphates, I., The Hydrates of the Calcium Hydrogen Orthophosphates; (2) Contributions to the Study of the Calcium Phosphates, II., The Action of Ammonia Gas on the Calcium Hydrogen Orthophosphates: H. Bassett, jun.

THURSDAY, DECEMBER 27.

ROYAL INSTITUTION, at 3.—Signalling to a Distance: Ancient Ways of Signalling and their Modern Development: W. Duddell.

SATURDAY, DECEMBER 29.

ROYAL INSTITUTION, at 3.—Signalling to a Distance: the Invention of the Electric Telegraph: W. Duddell.

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