THURSDAY, JANUARY 24, 1907.

SCIENCE AND TECHNOLOGY OF PAPER.

Paper Technology. An Elementary Manual on the Manufacture, Physical Qualities, and Chemical Constituents of Paper and of Paper-making Fibres. By R. W. Sindall. Pp. xv+253. (London: Chas. Griffin and Co., Ltd., 1906.) Price 12*s.* 6*d.* net.

IN the author's preface it is stated that this work took shape in a course of lectures delivered at Exeter Hall in 1904–6. There is a suggestion here that "Exeter Hall" has extended its "mission" sphere to the paper-maker, but the impression is only momentary.

As a matter of fact, the treatise is designed more expressly for the other side of the paper industry, the buyers and consumers, that is, it deals with paper from the point of view of the stationers, printers, bookbinders, and publishers; moreover, the treatment is severely material, strictly limited to "things" and to the exposition of their relations in accordance with the title and subtitle.

The first page reveals the author's purpose and method, which are entirely practical. There may be some who would question the "practical" qualifications of a technologist who gives prominence to the "ideal paper," which subject is treated in chapter i. as a *résumé* of the discussion of the important section on chemical and physical constants.

We may clear away an ambiguity associated with this well-known adjective in relation to our subject. The "practical paper-maker," as ordinarily so defined, limits his conduct and control of the processes which he superintends to sense impressions—what he can see—the appearance of the "stuff" in the beater or on the machine wire; what he can feel—the "handle" of the stuff in the beater or of the finished sheet; what he can hear—the hum of the beater roll as the measure of the distance from the bed-plate, and the beating work of his machine; what he can smell and taste are also taken as evidences of states and conditions of his material in process.

The "practical" buyer judges a paper by the eye, the hand, the tongue—an excellent provider of a slightly alkaline fluid for testing "sizing" efficiency—the ear for "rattle"—and he avails himself also of the sixth sense, muscular sense, in measuring the mechanical properties of resistance to pulling or tearing strains.

The technologist, on the other hand, sets out from the position that the actual phenomena which condition the qualities of the finished paper are mainly the invisible and intangible; they are molecular, and belong to the invisible region of the scientific imagination, and can, therefore, only be followed by the methods of science.

If we substitute for "practical" the word *thorough*, the technologist may leave the empiric invested with his lesser qualifications, and appropriate the higher designation commensurate with his comprehensive survey of fundamental principles.

The author's present contribution to the technical literature of paper-making is entirely in this spirit. The second chapter, on "technical difficulties," enforces the useful moral of the relation of difficulty and the critical investigation of defects to progress. The examples are well chosen, and it is easy to see that they represent actual working experiences.

Following these preliminary chapters we have a brief account in successive chapters of paper-making processes, classified in the accepted order, rag papers, esparto and straw, wood pulp, and the miscellaneous group of packing papers and boards. A feature of these chapters is the generalised summary of technical effects given in tabular form. Thus on pp. 48–9 is a tabulated outline of the processes involved in the preparation of half-stuff of the six leading types and grades; Table vi., p. 51, is a comparison of times of beating in relation to half-stuff and to quality of finished paper.

Table ix., p. 77, is a fitting conclusion to the section on wood pulp, giving the details of consumption of fibrous materials, fuel and water for providing the paper for a daily journal with a circulation of 200,000.

It may be noted that one average conifer furnishes the pulp for 1000 copies of the average "daily," and the coal consumed is equal to the weight of the paper produced, and may, by the way, be taken to represent many times this weight of the products of antecedent forest growth. Such tables occur throughout the book, and give an original impress to matter which otherwise treated would have the unrelieved character of "stock" information.

The section on "art" papers is an original discussion of their qualities and *defects*, with indications of the lines of investigation along which progress may be made, to the much desired ideal printing surface, which shall not involve the sacrifice of those qualities in the body-paper conditioning permanence. Our "art" papers are an interesting study in compromise, and our "imitation art" papers are still more interestingly artful. The author treats them with respectful impatience!

Upon this necessary groundwork the manual proceeds to develop the subject of physical, mechanical and chemical qualities and properties of papers, the methods of investigation adopted by the "expert," the numerical expression of the results, with a critical discussion of the value of the constants arrived at. In this section the author devotes a chapter to a further *exposé* of the "C.B.S. units," in which special attention is paid to the volume-composition of papers and to breaking strains reduced to the actual unit of sectional area of the paper. These units have proved of value in practice, and their usefulness must be insisted upon, especially in educating the young technologist to associate with his tests mental pictures conformable with the actualities of paper. In these respects the otherwise comprehensive unit of the "breaking length" adopted by the German pioneers in this branch of technology has been found wanting.

In those sections devoted to paper testing, which make up more than half the volume, the author takes pains to make his exposition lucid. We note an occasional slip, as in dealing with the question of a coloured ash left on burning a paper. "If blue, ultramarine, Prussian blue, or smalts may be present." This must be corrected as regards the cyanide blue. Again:—"the blue is tested by boiling with caustic soda and filtering." "The Prussian blue passes into solution." This inaccuracy will be evident to the chemist.

In the section on the estimation of moisture we find the expression "bone dry" for "oven dried." Bones are not dry to the chemist, only to the poet.

In the "dictionary of chemical terms" and the "glossary of various papers" which make up the concluding chapters we also note a number of slips, which perhaps may be explained by the laudable aim at short, crisp definitions; but this hardly excuses the description of caustic soda as "prepared by boiling carbonate of soda with quicklime"; bleaching powder as a "dry *pulverulent powder* prepared by exposing dry powdered quicklime to chlorine gas"—the italics here are our "note of exclamation"; "dextrine" as industrially obtained "by the action of boiling dilute sulphuric acid on starch"; "dicotyledon" as including the Coniferæ with angiosperms, such as beech and ash.

These descriptive terminologies are excellent in plan, and generally useful. They should be carefully revised, and perhaps amplified, in future editions. A section on bibliography would be a useful addition, and we think it is due from the author to acknowledge more fully the sources of much of the matter in this book, especially the German text-books and publications, of which he fully avails himself. The book is fully illustrated, and the matter thereby pointed and elucidated.

It is evident that the work is one we can appreciatively commend to the very wide circle of those interested in "paper"; as for the paper-makers, the author only indulges, with becoming modesty, the "hope that this book may prove useful to them." We think they will see the value of keeping pace with the critical knowledge of the consumers.

WEIGHTS AND MEASURES.

Outlines of the Evolution of Weights and Measures and the Metric System. By Dr. William Hallock and Herbert T. Wade. Pp. xi+304. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1906.) Price 10*s.* net.

THE literature of weights and measures is very extensive, and, as a rule, singularly uninteresting. Messrs. Hallock and Wade are therefore to be congratulated on having produced a treatise on the subject which is at once instructing and attractive. For this is an admirable piece of work, in which the result of much tedious research is presented in a bright and lucid narrative. The first chapter is devoted to a brief review of the speculations of metrologists and antiquaries concerning the weights and measures of the ancients. It includes a particularly good account of the Babylonian units and the various theories respecting them which have been deduced from the Senkereh tablet and the scale of Guldea. After a rapid survey of the weights and measures of the Hebrews, the Greeks and the Romans, the authors pass on to consider the systems in vogue in Great Britain and in France from the earliest times up to the end of the eighteenth century. The next two chapters and the fifth deal with the origin and extension of the metric system. They trace the system from its embryonic stage in the writings of Mouton, Picard, Huygens, and Cassini, to its fully-elaborated form in the law of April 7, 1795. The geodetic work of Delambre and Méchain is next described, and the opportunity is taken to introduce short explanations of a trigonometrical survey and of the determination of latitude. An account follows of the construction of the metric standards of the French Archives and of the lengthy interregnum of *mesures usuelles*.

The meeting of the International Geodetic Association at Berlin in 1867 marks an important epoch in the history of the metric system. The authors describe the influential part played by it in securing the establishment of the International Metric Commission. This leads to an interesting account of the International Committee of Weights and Measures and its bureau at Sèvres. In this connection it may be mentioned that, owing to the death of the British representative early last year, this country is at present not represented on the International Committee. The power of appointing a member to fill the vacancy rests with the committee itself. In 1884 the committee had some difficulty in finding a suitable representative for this country owing to the fact that the officer in charge of our Standards Department at that time, although an official of standing, was comparatively unknown in the scientific world. At the present time, now that all the metric prototypes have been distributed, and thus the most important object of the convention achieved, it is absolutely necessary, in order that the United Kingdom may continue to derive any advantage from its contributions to the funds of the Metric Bureau, that the representative of this country on the committee should be an official of the Government department which is charged with the construction and preservation of the Imperial and metric standards. It will accordingly, no doubt, be a matter of considerable satisfaction to the International Committee that the recently appointed Deputy Warden of the Standards is an eminent man of science, in every respect worthy of membership in that distinguished body which has included on its roll such names as Mendeléeff, Bertrand, Foerster, Mascart, Christie, and Michelson.

In their fourth chapter Messrs. Hallock and Wade have set themselves the congenial task of explaining the standards of weight and measure in vogue in their own country. The desirability of a simple and uniform system of weights and measures was fully

realised at an early stage of the existence of the United States. Washington devoted much attention to this subject, and it was under his direction that in 1791 a committee of the Senate entered upon a very full consideration of the questions involved. They reported in favour of a decimal system, and recommended the adoption of a standard of length divided into five equal parts, each of which would correspond to a foot. No legislative action was taken, however, to give effect to these recommendations. In 1819 a committee of the House of Representatives submitted a report advocating that models of the yard, bushel, and pound, conforming to those in most common use, should be made and adopted as the standard weights and measures of the United States. This proposal also proved abortive. The elaborate report prepared in 1821 by Mr. Secretary (afterwards President) Adams, a warm admirer of the metric system, was likewise without any immediate effect. The metric system was not seriously considered in the United States until 1866, when the use of the system was authorised by Congress. In 1889 copies of the international metric standards were distributed by the International Committee to the various States which were parties to the Metric Convention. The copies received by the United States were immediately adopted as primary standards, and in 1893 a formal order of the Treasury Department recognised the international prototype metre and kilogram as fundamental standards, and directed that the customary units, the yard, and pound were to be derived therefrom.

Chapters vi., vii., and viii. deal with the advantages which would be derived from the universal employment of the metric system in commerce, manufactures, and medicine. The authors admit having a bias in favour of this system, and they make out a very good case for its general adoption. In the next chapter international electrical units are considered, and attention is directed to the benefits conferred upon electrical science by the introduction of the C.G.S. system at the instance of the British Association. The United States specifications for the practical application of the definitions of the ampere and volt were prepared by the National Academy of Science in 1895, in compliance with the provisions of an Act of Congress. These specifications, which are quoted *in extenso* on pp. 211–215, differ in some slight respects from those prepared in this country about the same time by the Board of Trade.

A most instructive chapter is the tenth, which relates to the construction and comparison of standards. The various physical properties which should be possessed by primary standards are discussed, and an account is given of the different alloys which have been used in the construction of such standards. The relative merits of line and end standards are next considered, the method of subdividing a scale by means of a dividing engine being well described. It is mentioned that at the International Bureau the graduation of a metre into millimetres in this way occupies about sixteen hours. The footnote on p. 226 quoted from Guillaume appears to contradict the statement in the text respecting the accuracy attainable by this method.

A very good description is given of the comparators employed in the verification of standards of length, and the mode of using them is explained. After some account of balances of precision, the British imperial standards of length and weight are described with illustrations. The name of Mr. Chaney, the late superintendent of weights and measures, is misspelt on p. 247, and the position which he occupied is inaccurately designated as Warden of the Standards. The latter office has been since 1878 an honorary adjunct to the permanent secretaryship of the Board of Trade.

The chapter concludes with a simple and interesting explanation of measurement by means of wavelengths of light. This method was originally only applicable to the measurement of very short intervals, but Michelson has extended its application to lengths of any magnitude. It is of great interest in metrology, since by making re-determinations from time to time positive testimony may be obtained as to whether any variation is taking place in the length of a standard. At the present day the permanency of bronze standards of length is regarded with suspicion by metrologists. The authors refer on p. 219 to the fact that many of the bronze copies of the British yard which were distributed to various nations and scientific institutions in 1855 are believed to have since undergone changes in length due to molecular rearrangement. This casts some doubt upon the invariability of the Imperial Standard Yard, which is made of the same material. The recent developments of Michelson's method afford a ready means of deciding this important question.

Some useful tables are appended, and a comprehensive index brings this well-conceived work to a close.

ITALIAN SCIENTIFIC WORKS.

I grandi Trafori Alpini. By G. B. Biadego. Vol. i. Pp. xvi+1228; in addition to about 36 folded pages of tabular matter. Vol. ii. 30 large folded plates. (Milan: Ulrico Hoepli.) Price 45 lire (*1l.* 16*s.*).

Opere matematiche di Francesco Brioschi. Vol. iv. Pp. ix+418. (Milan: Ulrico Hoepli, 1906.) Price *1l.*

I Motori a Gaz. By Vittorio Calzavara. Pp. xxx+424. Manueli Hoepli. (Milan: Ulrico Hoepli, 1906.) Price 4.50 lire.

I Motori ad Esplosione, a Gas luce e Gas povero. By Ing. Fosco Laurenti. Pp. xii+361. Manueli Hoepli. (Milan: Ulrico Hoepli, 1906.) Price 4.50 lire.

THE opening of the Simplon tunnel amid a flourish of Italian trumpets was a fitting opportunity for the publication of a book dealing with this and other mountain borings. That the author might have written a book on the Simplon tunnel alone is evidenced by the fact that the part he devotes to this tunnel occupies the space of an average-size volume.

But he wisely points out that the Simplon is only one of a series of enterprises of the same kind, and while there have been improvements in the methods of working, as well as in the use of better explosives, the merit of originality belongs more properly to what is commonly known as the Mont Cenis tunnel. Tourists to whom the name Fréjus represents a town on the Riviera will be somewhat surprised to find this tunnel described as the Galleria del Fréjus, which appears to be its correct name. In addition to this, the St. Gothard, the Arlberg, and other well-known tunnels, the author describes several minor borings not commonly noticed by tourists, but which possess points of special interest; for example, one at Laveno, on Lago Maggiore. The result is a volume of 1228 pages (excluding tables), and a second volume of plates, which form a striking contrast to the small Manueli Hoepli of the same publisher. When we come to eighty pages of "Final Considerations," we cannot help being reminded of the typical interminable sermon of our early days, and the analogy is further increased by finding 115 pages of "appendix to the final considerations" to follow. But all the same, the author cannot be accused of long-windedness. There are a great many details connected with the boring of a tunnel, such as the rate of progress through different rocks, temperature conditions, descriptions of the machinery and of the accommodation for the workpeople, which interest not only the engineer, but also the general reader, and it cannot be said that the author has encumbered his subject with unimportant or uninteresting details to any appreciable extent. The only exception we notice is that the tables of mean temperatures of such places as Venice, Alassio, and San Remo do not appear to have much bearing on the Simplon tunnel, under which heading they are tabulated. The text would have been handier had it been bound in two volumes.

From the same publisher we have the fourth volume of Brioschi's works, comprising mainly papers contributed to the Lincei Academy (1885–1896), the *Comptes rendus* (1858–1878), and miscellaneous journals, together with the preface and notes written for the Italian translation of Cayley's "Elliptic Functions." The papers for this volume have all been edited by Profs. Francesco Gerbaldi and Ernest Pascal, and the volume is uniform in style with its predecessors. In view of the rapid growth of mathematical literature, one cannot help wondering, however, if it is desirable to publish collected works in such an irreproachable style. This reflection is suggested partly by the fact that though one or two English transactions have recently appeared with larger pages than formerly, they do not contain a corresponding increase in the number of words per page, though there is a great increase in their *weight*. And it should be the object of the purchaser to obtain Brioschi's works, not merely to buy good paper and printing.

The series of Manueli Hoepli, published in the form of pocket-books, numbered 900 volumes in April last. Among the latest ones dealing with technical applications of science we have before us two books on gas engines, both written by authors living in Venice, and containing respectively 160 and 162 woodcuts. The objects of the books, as stated in the prefaces, are nearly identical. Both authors point out that while other countries have advanced greatly in the study and construction of gas engines, the subject has received little attention in Italy. Curiously enough, Signor Calzavara, who is a gas engineer, says less about the question of gas than Signor Laurenti. The latter's book is divided into three parts, the first dealing with the combustibles (illuminating gas and heating gas, or "gas povero," as it is called in Italy), the second with gas generators, and the third with the gas engines themselves. On the other hand, Signor Calzavara only devotes a single chapter to the gas question. This chapter is, however, a long one, and it must be remembered that he has written several previous books on gas and gas motors.

Other differences may be noted. Thus Signor Calzavara gives a really full bibliography, while Signor Laurenti's book contains more numerical data in the form of tables. Signor Laurenti goes into detail regarding cams; the other author only just refers to distributors without discussing the cam. Signor Calzavara considers that a "poor gas" engine, with its own generator, cannot be used efficiently for installations of less than 25 horse-power; Signor Laurenti fixes the limit at 15 horse-power. These are the differences one would expect to find in two books written on the same subject by different authors, and they show that anyone interested in the subject would derive undoubted advantages from having both books for reference. G. H. B.

THE ATOMIC THEORY OF ELECTRICITY.

The Electron Theory; a Popular Introduction to the New Theory of Electricity and Magnetism. By E. E. Fournier d'Albe. Pp. xxiii+311. (London: Longmans, Green and Co., 1906.) Price 5*s.* net.

A GLANCE at the table of contents of this book is sufficient to show that it fills an acute want at the present time. It attempts the consistent application of the all-embracing electron theory in an elementary manner to the whole range of electromagnetic phenomena. In making this attempt, the author is to be congratulated both on the choice of his subject and the skill and originality he has displayed in accomplishing it. It is a relief to find that the treatment, though popular, is to the point, and little or nothing is said of those vague and vast speculations as to the ultimate constitution of matter which have unfortunately become identified with the words "the electronic theory."

Few possess the necessary qualifications for a task which covers such a wide range of subjects, and, so far as we know, this is the first time it has been seriously attempted. The book is therefore unique, and should prove of value to the student, the teacher, and the investigator. Although, no doubt, it would be possible to go through the work pointing out where a fuller treatment of the subject-matter would have been advantageous, this would hardly be fair in the present state of the science. We have rather to be grateful that a trustworthy guide

to the theory in its existing state has pointed the way to its wide application in a great many cases. As the author repeatedly points out, the logical consequences of the electronic theory are still very far from being worked out in many of the subjects dealt with, and this task offers a fine field of investigation, which may ultimately lead to new results of the highest practical importance.

Probably nowhere is this more true than in the field of electrochemistry, of which, however, the treatment is somewhat superficial and unsatisfying. Another topic, which fares even worse, and yet is one of which much might have been, and ultimately will be, made, is the optical activity of carbon compounds. What little is said is so misleading, for example the last sentence of chapter xii., that it should be either omitted altogether or considerably amplified. In the main, however, the treatment is refreshingly clear and interesting.

Of course, it is to the explanation of that class of phenomena known as electromagnetic that the electron theory offers the greatest simplification. Consider a phenomenon such as "the spark on break due to the extra E.M.F. of self-induction," which is nothing but the electrical analogy of the water-hammer in a pipe when a cock is suddenly closed and the water stream stopped. For water read electrons, and for pipe read conductor, and even a beginner gets a clear mental picture of the phenomena. That all magnetic and electric phenomena are to be explained by definite motions and properties of the individual electron is a simplification that may be expected to ameliorate the lot of the future student considerably. The electron theory provides for electricity that clear mental image of the processes involved, without which physical theories stagnate and become metaphysical. Nevertheless, the faculty of being able to think in more than one system is not easily acquired, and it is doubtful, for example in magnetism, if anyone trained on the present systems will ever really abandon them.

In addition to the topics already alluded to, chapters are devoted to the electronic treatment of thermo-electricity, the Hall and allied effects, optical phenomena, the Zeeman effect, radiation, voltaic electricity, radio-activity, and the electric discharge. One chapter is devoted to a speculative effort, bold and imaginative, but logical, well considered, and unexceptionable, on the similarity of the infinitely great phenomena of the cosmos with the infinitely small of the electronic universe. Finally, a new system of electrical quantities is advocated, in which electricity, represented by E, ranks as a fundamental quantity with length, mass, and time. The author uses throughout the expressions "company of electrons," "army of electrons," to represent respectively the E.S. unit (2930 million) and the coulomb (8·79 trillions), and thus once for all reduces electric quantities to a definite *number* of electrons.

Different readers will no doubt derive most benefit from different chapters according to their individual knowledge of the subjects referred to, but the book may be recommended to all interested in the progress of physical science. Dr. G. Johnstone Stoney, whose portrait appears as a frontispiece, contributes a preface to the work. F. S.

OUR BOOK SHELF.

Manual of the New Zealand Flora. By T. F. Cheeseman. Pp. xxxvi+1199. Published under the authority of the New Zealand Government. (Wellington: J. Mackay, 1906.)

THE number of botanists who have contributed towards a knowledge of the New Zealand flora during the last forty years is remarkable, especially when it is recognised that their labours followed on discoveries made by earlier explorers and collectors of eminent repute. Banks and Solander, Colenso, Sinclair, and Hooker are a few of the early botanists whose work was collated in the "Handbook of the New Zealand Flora," compiled by Sir Joseph Hooker and published in 1864. Since that date, besides Colenso, Thomas Kirk stands out prominently as an energetic collector and author; he collected not only throughout both the main islands, but also visited several of the adjacent groups. Owing to his extensive acquaintance with the subject, in 1894 he was commissioned by the Government to prepare a flora of New Zealand, but the work was only half completed at the time of his death three years later. The task was subsequently entrusted in 1901 to Mr. Cheeseman, who has contributed numerous papers on new species, on the floras of Three Kings and Kermadec Islands, and on special methods of fertilisation in various genera. The wisdom of the choice is seen in the exhaustive and careful compilation now published.

The arrangement follows the plan of Hooker's earlier work, and to students of British botany acquainted with Bentham's "British Flora" this manual presents a familiar disposition.

Turning to the subject-matter, as the result of the last forty years' work, the computation of ferns and flowering plants has risen from about one thousand to nearly sixteen hundred species—exclusive of those naturalised—spread over 382 genera. With regard to orders the predominance of Compositæ is natural, but the flora is unusually rich in ferns and species of Scrophulariaceæ, and poor in species of Leguminosæ. The number of species in some of the genera is very large, amounting to forty-three in Celmisia, of which all are endemic with one exception; Veronica shows eighty-four species, of which, in contrast to our conception of the genus, seventy-one form shrubs or small trees. The flora contains many curious plants and unique associations that have been graphically described by Dr. L. Cockayne, but from a systematic point of view the most extraordinary fact is found in the enormous proportion of endemic species, amounting to nearly three-quarters of the total.

In working through a flora of such vast dimensions and containing so many exclusive species it will be comprehended that Mr. Cheeseman has accomplished a task of no small magnitude, and from the critical notes accompanying the technical diagnoses an idea is obtained of the wide knowledge and judicious discrimination that he has brought to bear upon it. The author and the New Zealand Government are both to be congratulated on the successful completion of the work.

Evidence of incorporation of the latest discoveries is found in the new genus Townsonia and various new species. The author has provided in the appendices a

synopsis of orders arranged according to Engler's syllabus, a summary of naturalised plants, and a list of native names.

Side-Lights on Astronomy and Kindred Fields of Popular Science: Essays and Addresses. By Prof. Simon Newcomb. Pp. vii+350. (London and New York: Harper and Brothers, 1906.) Price 7*s.* 6*d.* net.

In bringing up to date and publishing in book form this collection of essays, which have from time to time appeared in various American journals, Prof. Newcomb has provided us with a volume which is at once interesting and instructive. The range of subjects is a wide one, extending from a discussion of the question, "Can We Make It Rain?" to the flying machine and the structure and extent of the universe.

The chapter on the making and using of a telescope should prove interesting to anyone who uses this instrument, whilst "The Fairyland of Geometry" will provide food for thought for many hours to those amateur astronomers whose acquaintance with the science has been restricted to observation only.

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.*]

Radium and Geology.

In considering the influence of radium on earth history, it appears to be generally assumed that the radium detected everywhere in the surface materials of the earth is an original constituent of the igneous rocks. An entirely different view has been lately pressing itself upon me. I put the view forward mainly because I think there are difficulties in the way of accepting the original or primary nature of the radium in rocks. These objections I first briefly state.

The original nature of the radium cannot be maintained without at the same time assuming the presence of the associated uranium to make good the radio-active decay. Now it is easy to show that if such uranium existed grave difficulties arise from the facts of solvent denudation. The ocean which receives the dissolved rock materials must be in an entirely different state from what is observed. Even assuming geological time as only a very few million years, the quantity of radium now in the ocean should be much greater than has been observed. If the river supply of dissolved rock materials had been sustained for only some 20×10^6 years, the sea-salt should possess a richness twenty-five times as great as the ascertained amount.

In stating this I make the assumptions—which I think, however, are not easily evaded—that radio-active substances are removed from the land along with other mineral matter, and that, along with radium brought into river water on the break-up of rock minerals, the postulated uranium is also carried to the ocean. On these assumptions we can arrive at an approximate estimate of what should be the existing state of the ocean on any possible estimate of geological time.

We do not require accurate figures. We are only really concerned with their order of magnitude. I take, in the first place, the Hon. R. J. Strutt's estimate of the radium in sea-salt, stated to be approximate only. The quantity is $0{\cdot}15\times10^{-12}$ grams per gram. From this there must be in the ocean about 8×10^9 grams. I assume the oceanic mass as $1{\cdot}468\times10^{24}$ grams. On Dr. Boltwood's result for the value of $\lambda(\text{year})^{-1}$ for radium, to maintain this quantity there must in some way be brought into the ocean $1{\cdot}78\times10^6$ grams of radium per annum.

I now turn to the approximate river supply. We have Sir John Murray's estimate of the total volume of river water and the dissolved matter therein, which annually enter the ocean. The dissolved matter amounts to $5{\cdot}1\times10^{15}$ grams. If we suppose the matter in solution still to possess the mean radium content of the igneous rocks as determined by the Hon. R. J. Strutt, that is, 5×10^{-12} grams per c.c. (and the application of this number can be justified on data at our disposal), we find that 10^4 grams of radium enter the ocean annually from the waste of the land. It will be seen, in the first place, that this quantity, unless the uranium enters along with it, is not nearly what is required to maintain the oceanic radium at its approximate present value; but if, on the other hand, the associated uranium enters along with the radium, in 8×10^5 years there would be such an accumulation of uranium in the ocean as to account for the existing amount of radium. But we have not to deal with 800,000 years. If geological time was but a few million years, and solvent denudation had progressed as here assumed, the facts as regards oceanic radium would be entirely different from the observed facts, even allowing a wide margin of error in all the data involved. In 100×10^6 years there should be $0{\cdot}19\times10^{-10}$ grams of radium per gram of sea-salt. I neglect the rate of decay of uranium, as this rate involves periods of the order of thousands of millions of years.

Is there any way of evading this difficulty? If we assume the uranium to be in some way caught in the sediments, and so brought again into dry land, we must expect to find a concentration to occur in them; but the facts are the other way. The average radium content of the sediments appears to be less than half (2×10^{-12}) that of the parent igneous rocks, and is, in the case of the detrital sediments and on the assumption of the original nature of the radium, presumably what remains behind with the less soluble constituents of the parent rocks. Nor can we suppose the uranium retained in the soils, for then we must face a still more extraordinary concentration of radium, whereas the soils are apparently poor in radium. If it is supposed to be concentrated in the rocks beneath the soils, difficulties have to be faced with other heavy metals. And in this case, of course, examination of the surface rocks tells us little as to the radium-content of the deeper lying rocks, save that these should contain much less. We are observing, in fact, the concentration products of about a mile and a half deep of parent rock removed by the wear and tear of geological time, and know not the depth to which these products extend. But such a continued accumulation on the land is hard to comprehend. It appears to me that the simplest conclusion is that there is no associated uranium generally distributed throughout the surface materials of the earth. I of course do not refer to the ore bodies, thermal springs, &c. Again, in certain igneous masses uranium undoubtedly exists occluded in the minerals, whatever history we may ascribe to it.

But if there is no associated uranium, whence comes the radium everywhere distributed over the surface of the earth? It cannot be from volcanic sources. These are entirely too local in their influence. Nor yet can we suppose it to reach the surface, as ores in general do, by means of fissure veins, &c. These, again, are quite local in their influence. Indeed, the Hon. R. J. Strutt points to examples of this in the case of the uranium deposits; the adjacent igneous rocks were not abnormal in their radium content.

By a process of exclusion, if for no other reason, we are, I think, justified in considering the possibility that the radium is picked up by the earth in its motion through space. The probable source would be the sun. There are, in point of fact, many arguments in support of this view besides that by exclusion. The fairly uniform distribution over the earth's surface at once finds explanation. The picked-up radium probably floats in the atmosphere for a long time, and ultimately is helped downwards to the surface by rain and snow, and other meteorological conditions. Once upon the surface of the land, percolating waters will carry it to all depths to which such waters penetrate. It has many thousands of years for its travels

before its radio-activity dies out. We would expect that the more impervious mineral substances would show the least amount. Quartz is without radium, as the Hon. R. J. Strutt shows by his determinations.

There appears to be no improbability that matter in minute quantities might reach us from the sun. Here we are observing the most minute traces. If the observations are correct as to the velocities of solar ejections, it would take but a few days to bring solar matter into the orbit of the earth. The sun-spot-weather connection may possibly be involved, as well as the phenomena of atmospheric radio-activity, although doubtless emanation from radium already accumulated on the surface and in the soils is mainly responsible for these latter effects. Whatever may be said as to the value of such subsidiary evidence, it appears as if only by looking to such an extra-terrestrial origin of radium can we evade the difficulties connected with the associated uranium. We are evidently not compelled to assume that the radium received upon the earth carries with it the equilibrium amount of uranium, although doubtless we may expect that some uranium is also received.

It is possible to arrive at a rough estimate of the amount of radium reaching the earth if we assume the annual oceanic supply of radium is mainly extra-terrestrial, and that a state of radio-active equilibrium with the average rate of supply has been attained. In effecting this estimate we deduct the annual river supply from the supply required for maintenance of the radium concentration of the ocean. The result is an annual supply to the ocean of $1{\cdot}77\times10^{6}$ grams. If this supply is received uniformly over the oceanic area, about 12·5 milligrams enter over each square mile per annum. This result is probably excessive, as it assumes no uranium to be in the ocean or received from extra-terrestrial source.

If it is permissible to apply to the land area the mean figure deduced for the ocean, we can ascertain the depth to which the observed radium content of the sedimentary rocks would be maintained at its present value. It is but trifling—about ten metres. As I have indicated above, however, the received radium will be washed from the surface soils and carried into the denser and more retentive rocks. The due proportion is doubtless carried to the sea on the break-up of the rocks or by percolating waters. We are no longer in difficulties on this score. J. JOLY.

Trinity College, Dublin, January 6.

P.S.—A small quantity of radium will almost certainly be carried to the land along with wind-borne sea-salts. From Pierre's measurements of the latter on a coastal rainfall of 60 cm., I find that about three thousandths of a milligram per square mile ($1{\cdot}2\times10^{-16}$ grams per sq. cm.) per annum will in this way reach coastal countries. This small quantity will not complicate the problem unless there is associated uranium, and unless, further, this latter substance accumulates in the rocks. In this case the rocks of coastal countries might in course of time come to have a higher content of radium than interior continental rocks. But, I repeat, the supposition that uranium will continually gather in the rocks and never follow the usual channels of escape seems very improbable.

Much remains for investigation, naturally arising out of Mr. Strutt's fertile work. Rain-water should be systematically examined, due allowance being made for wind-borne radium carried from the sea. I have begun such observations, but they will necessarily demand time and care if they are to be of value. In the hope of getting further light on some of the points at issue, I have the rocks of the Simplon Tunnel and certain of the deep-sea oozes under examination. J. JOLY.

January 16.

Green Sunset Colours.

THE green sky described by Mr. Collins in NATURE of January 3 (p. 224) was evidently an unusually brilliant example of the green tints often seen in a sunset sky. As I have not seen any explanation of the phenomenon, it may possibly be of some interest to give the following attempt at one.

The colour of the sky at any time is made up of two components: A, the light from the upper regions; B, that reflected from the small particles in the lower air. The A component is always blue, and its spectrum shows a deficiency in red and yellow rays. Its light passes between the particles, and therefore forms a background upon which they are projected. The spectrum of the B component is variable. When the sun is well above the horizon the light is white, and the variations in the deepness of the blue of a clear sky are due to differences in the relative proportions of A and B. As the sun nears the horizon the B light begins to lose its more refrangible rays, and the absorption extends towards the green and yellow as the sun goes down.

Now if we take two equally brilliant spectra, cut out the red, orange, and yellow from one, and the violet and blue from the other, and then mix the residues, we shall obviously have all the colours necessary to make white light with a double allowance of green. An eye receiving the whole will see pale green. This, I take it, is the origin of the green colours of the sky. The A component is deficient in the less refrangible rays, which are supplied by the B component, and the two spectra overlap in the green, showing an excess of that colour.

Occasionally, but rarely, the two are exactly complementary over a limited stretch of sky, and then white patches are seen amid the colours of the sunset which are easily distinguished from clouds. They shade off on one side into tints of green where the spectra overlap, into yellow where the B component is in excess, and into blue where the A light preponderates.

When the sky is clear it is no uncommon thing to see a considerable expanse of green, shading on the one side into pale lemon-yellow where the overlap of the spectra is considerable, while on the other side it shades through a narrow border of silvery tint where the balance is exact into a delicate rosy hue where there is a general deficiency in the central rays.

Green tints are by no means always to be seen, and I think the foregoing explanation shows why—their production depends upon such an adjustment between the brightness of the two components that they shall be approximately equal. The white patches are rarer still, as they require exact equality in brightness and correct apportionment of colour. ARTHUR W. CLAYDEN.

5 The Crescent, Exeter.

Ultra-violet Fluorescence of Benzene.

FROM my observations on the emission of light by canal rays (*Ann. d. Phys.*, 21, 401, 1906; *Physik. Zeitschr.*, 7, 355, 1906), I have concluded that absorption of light in a band spectrum (running towards the red) produces fluorescence. Hartley and others have stated that benzene has a banded absorption spectrum in the ultra-violet; adopting that principle, I conjectured that benzene had an ultra-violet fluorescence. I have confirmed this by the following method:—The ultra-violet rays from a mercury lamp by W. C. Heraeus (Hanau, Germany) fell vertically upon a diluted solution (0·25 per cent.) of benzene in alcohol, and the fluorescence light emitted by it horizontally was analysed by a quartz spectrograph. In the spectrograms obtained there appeared, besides the mercury lines, a group of four strong continuous bands situated in the ultra-violet between λλ 271 and 314 $\mu\mu$; these bands run towards the red end of the spectrum, and the heads have the wave-lengths 272, 280, 283, 292 $\mu\mu$.

As Hartley has shown, the absorption spectra of the benzene derivatives are produced by an alteration (both in intensity and spectral position) of the simple benzene spectrum; such an alteration is produced by condensation and substitution. According to our principle, the same is true for the fluorescence spectra of the benzene derivatives. The question as to the relations between chemical constitution and fluorescence is thus reduced to the question of the relations between chemical constitution and absorption, and banded absorption must be explained with regard to the fact that it is coupled with fluorescence. There may also be drawn from the above result some conclusions about the constitution of the benzene ring.

J. STARK.

THE KINGSTON EARTHQUAKE.

WHEN Port Royal was destroyed by the great earthquake of 1692, some of the surviving inhabitants took refuge on ships, others moved across the haven to a place called Kingstown or Killscown, where, in huts made of boughs, exposed to the heavy rains and in close proximity to hundreds of dead bodies in the bay, they "died miserably in heaps." Port Royal was rebuilt and maintained as a naval station; its successor, as a place of business, was founded the following year at Kingston, and by the earthquake of January 18 has now met with a similar, though fortunately less complete, destruction.

The two earthquakes differed considerably in intensity. In 1692 the whole island suffered. Scarcely a house in any part of it was left standing. By numerous land-slips, the mountains were stripped of vegetation and altered in form. The earthquake of that year was one of the first order of magnitude. The most remarkable fact about the recent shock is the very limited area of damage. Kingston seems to have suffered most severely. The more important buildings are ruined, and few, if any, houses have escaped some injury. Port Royal, six miles to the south, and St. Andrew, within five miles to the north, have shared to a great extent in the ruin, but outside a radius of ten or twelve miles from Kingston the loss to property is small. Some houses in Spanish Town, eleven miles to the west, are said to be damaged, while Port Antonio, twenty-eight miles to the north-east, and Holland Bay, thirty-eight miles to the east, are almost unharmed.

From the small area of excessive damage and from the rapid decline in the intensity of the shock, it may be inferred that the focus was situated close to Kingston and at no great depth below the surface. Partly to the proximity of the focus, partly also to the sandy or gravelly nature of the ground (for earthquakes are always more strongly felt on loose, friable beds than on hard, compact rock), we must attribute the destructive energy of the shock. That, in its initial power, the earthquake was inferior to those of Valparaiso and San Francisco is clear from the smallness of the meizoseismal area, and also from the comparatively slight disturbances recorded at the observatories of Washington, Shide, and Edinburgh.

The onset of the shock was sudden, there being no warning tremors or sound. For thirty-six seconds the motion was like that felt on a ship in a choppy sea. All observers agree that the movement was chiefly vertical. It is said that objects jumped from the ground, and this, if it be true, shows how violent was the shock and how close was Kingston to the focus. In many places the ground is fissured, the electric-tram rails are twisted, and the water-supply pipes are partially damaged—all indications of a neighbouring focus. The direct line of cable to Colon is broken about three miles from the shore, pointing either to a displacement of the ocean-bed or to a submarine land-slide—probably to the latter, for there were no marked seismic sea-waves on the south side of the island,[1] and the shipping in the roadstead and harbour are unharmed. The subsidence of the battery at Port Royal and the sinking of the shore at Kingston show that the superficial beds, at any rate, have undergone important changes of level.

Whether these changes be due to bodily displacements of the crust, to mere shifting of the surface-beds or to both is by no means clear. When the island was surrendered to English forces in 1655, the spit, called the Palisadoes, which now terminates in Port Royal, was discontinuous, and the end resembled one of the quays or small islands outside the harbour. By 1692 the gap was bridged by a bar of sand. During the earthquake of that year a portion of the spit, a quarter of a mile in length, suddenly subsided, so that only the chimneys or upper parts of houses that were not overthrown appeared above the water. The harbour of Port Royal also sank, so that the streets along the harbour-side afterwards lay at a depth of from four to eight fathoms. Yet the depression of the ground itself at Port Royal and in other places was not supposed to exceed a foot.

There can be no doubt from the evidence above described that the seismic focus was situated, in part at least, almost vertically below the haven between Kingston and Port Royal, though a portion of it may have extended as far as three miles to the south of the coast. It is also probable that the Port Royal and Kingston earthquakes originated roughly within the same focus.

The West Indian region is distinguished by those steep surface-gradients which characterise areas of great instability. Jamaica, in common with Porto Rico and the south of Haiti, lies along a crust-ridge, which towards the west is prolonged into the mountains of Honduras, while it is separated from a corresponding ridge, constituting the island of Cuba, by the submarine depression of the Bartlett deeps. To the east, the Jamaican and Cuban arcs unite in one main ridge which bends round to overlap the curved line followed by the volcanic islands of the Lesser Antilles. These form the north and east boundaries of the great deeps of the Caribbean Sea. On the south lie the mountain ranges of Venezuela, &c., which, as we know from the destructive earthquakes of Cumana in 1799 and 1853 and of Caracas in 1812, are still in the stage of vigorous growth. Towards the west, and connected with the West Indian series, are the central American chains, also studded with volcanoes, and in parts frequently visited by violent earthquakes. In this West Indian region, as elsewhere, it is not unlikely that the mountain arcs have a tendency to press forward on their outer and convex side, and to subside towards the interior of the arcs. The movements along the line of the Lesser Antilles certainly suggest a slipping westwards into the Caribbean deeps. In Jamaica, along the northern boundary of that sea, the movement may be more complex, the northern side of the Jamaican ridge having a tendency to move northwards and forwards towards the Bartlett deeps, while on the south there is a continued subsidence and slipping towards the Caribbean Sea. Of such intermittent slips, the Port Royal and Kingston earthquakes appear to be some of the latest manifestations.

So far as I am aware, there is no evidence of that intense crushing that was so conspicuous a feature of, say, the Japanese earthquake of 1891. Extension rather than compression was manifested in 1692, for at Port Royal one whole street, in which many houses were left standing, was said to have been doubled in width by the earthquake. There is much evidence to favour such a view in the case of the Kingston earthquake—the extremely local character of the destructive shock, the snapping of the cable to the south, and the minor character of the disturbances registered by distant seismographs.

CHARLES DAVISON.

[1] A so-called "tidal" wave was observed on the north side of the island. It is said that Anotta Bay was inundated and that houses were swept away. No time is mentioned, and, if the sea-waves were of seismic origin, we should expect to hear of similar reports from Port Antonio and other adjoining harbours.

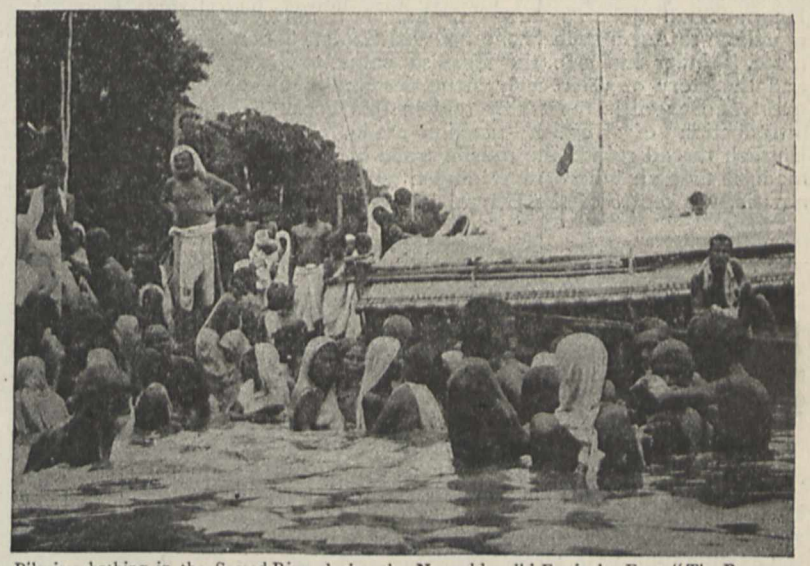
A PICTURESQUE HISTORY OF DACCA.[1]

THIS very interesting and picturesque historical story portrays the dwellers in the land where the two great waterways of eastern India, the Brahmaputra and Ganges, unite before they fall into the Bay of Bengal. It tells how they and their forefathers have by their persevering industry, ingenuity, and commercial ability made Dacca and its adjoining predecessors, Rampal and Sonargaon, capitals of a kingdom which, though often disorganised by misgovernment and robbed by its neighbours, the Mughs and Assamese, yet always when allowed to manage its own affairs in peace rose again to be a busy and prosperous manufacturing city.

The early history of these successive towns is traceable in the annual popular religious festivals of the country. The two chief of these are, first, the Jamastami, held on the 23rd of the lunar month Srabon (July–August), as the birthday of Krishna, tutelary god of the weavers of the incomparably fine muslins which had enriched the merchants of Dacca and its predecessors when weaving was the chief industry, and, secondly, the Nangul-bundhi plough (nangul) making festival of Cheit 8 (March–April), of which an illustration is here reproduced. Both are admirably described in this book, but it is the last which creates the greatest and most universal popular enthusiasm, as being the birthday of the land and of the plough which tilled the fields of cotton whence the Dacca muslin was woven.

The plough-god of the feast is Parasu-Rāma of the two-bladed axe (parasu), whose first birth story was framed in western India by the fire-worshippers who made the household and altar fire their national god. In the Mahābhārata he is the great-grandson of Bhrigu, the father of fire, whose son Richika, the fire-spark (richi), begot from the two sacred mother fig-trees the Banyan and Pipal, whence the altar fire was engendered, Jama-d-agni, the twin (jama) fires (agni). His wife was Renuka, the flower-pollen (renu), and their fifth son was Parasu-Rāma. He slew his mother with his two-bladed axe, the two lunar crescents of the waxing and waning moon; and this story tells us in symbolical language that he was born as the generating seed to be ploughed into the earth when his flower-mother died. In his history, as told in this book (pp. 295–8), he fled to the source of the Brahmaputra to obtain pardon of the sin of matricide, and there God changed his axe to a ploughshare, which cleft the mountain and made a way to the sea for the holy river. In his western Indian legend he is said to have made the sons of the fig-tree rulers of India by conquering and slaying its Haiheya masters, who survive in eastern India as the Mughs, who gave their name to Maghada, now Behar. They were the first settlers in the Gangetic valley, and in the history of Dacca always attacked and robbed its people when they were unable to protect themselves; and their successors, Parasu-Rāma's sons, ploughed the cotton fields which fed the looms of the Dacca weavers. Like the Kurmis who first grew cotton in the black soil of western India, they covered the country with water-tanks like those made by the road- and lake-making Sen king Ballal Sen, whose capital, Rampal, took its name from the plough-father Rāma, whose sons peopled the Indian river valleys before the later traders, whose god was Krishna.

The early history of the union of the farming, pastoral, and artisan founders of the Indian nation is told in the Gond poem the Song of Lingal, the Linga god. It says that Lingal united them as subjects of the Tortoise (Kush), which in the primitive national geography supports the earth floating on the ocean. The races thus united were the Nāga-Kushikas, who with their successors, the Ikshvāku, sons of the sugar cane (iksha), laid the foundations of Indian society. The Nāgas were the Haiheyas, whose empire, when they were conquered by the Mahrahtas in 1740 A.D., had shrunk to the Nāga countries of Nagpur and Chutia Nagpur in Central India. The Kushika were the sons of the Kusha grass sacred to Krishna, the black antelope god, and it was with it that in their ritual his national earth altars on which milk libations were poured were thatched, and their Prastara, the magic rain-compelling wand borne by the high priest, was made of Kusha grass. These altars were by the Ikshvākus, who offered animal sacrifices, thatched with the boughs of a new sacred fig-tree, the Plaksha or Pakur (*Ficus infectoria*), and their Prastara was made of Ashvavala (*Saccharum spontaneum*), wild sugar-cane grass. The Kushika marriage rite, which united each wedded pair by binding their hands together with Kusha grass, still survives among the Chasas and Koch Rajbunses, the chief cultivators of Oussa and eastern Bengal, and many other trading castes.



Pilgrims bathing in the Sacred River during the Nangul-bundhi Festival. From "The Romance of an Eastern Capital."

The artisan and trading offspring of these pioneer races ruled Rampal when its kings were, at the close of the age when Buddhism was the prevailing religion of India, the Pals. They belonged to the Subarna Bhanik clan, of which many of the richest merchants and bankers of Dacca are members, and which claims descent from the Nāga Rishi and

[1] "The Romance of an Eastern Capital." By F. B. Bradley-Birt. Pp. x+349. (London: Smith, Elder and Co., 1906.) Price 12s. 6d. net.

Kashyapa, the Kushika father. Also their successors, the Sen kings, who restored the Hindu ritual and made Sonargaon their capital, are shown by their name to belong to the Subarna Bhanik clan.

The later kings of this dynasty became tributary to the first Mohammedan conquerors under Bukhtiyar Khiliji, and were finally dethroned by Tughral Khan and Balin, Emperor of Delhi, and his successor, Alla-uddin, made Sonargaon and its territories the eastern province of Bengal. Its subsequent history tells of the rule of successive viceroys, their rebellions and wars with the Delhi emperor, ending with the conquest of Bengal by the Afghan king Sher Shah and his clan, of whom the last ruler was Isha Khan, the converted Hindu. His marriage with the Hindu Sona Bibi, his successor, and his submission to Man Singh Akbar's general whom he had worsted in single combat, furnishes one of the most stirring tales here told. The story then tells of the building of Dacca by Jehangir's viceroy, Islam Khan, in 1608 A.D., and of the generally troublous rule of the viceroys of the Emperors Jehangir, Shah Jehan and Aurungzebe, in whose reign Dacca enjoyed twenty-five years of exceptional prosperity under Shaista Khan, Shah Jehan's first cousin, and uncle by marriage to Aurungzebe, who married Shaista Khan's niece. Under his rule the English came to Dacca, and the story of their early struggles and final conquest of Bengal is most ably told in this book. The introduction of English machine-made cloth and English thread ruined the muslin trade of Dacca, and made it first an indigo mart and afterwards what it now is, the centre of the Bengal jute trade.

J. F. HEWITT.

PLANT LIFE.[1]

UNDER the somewhat indefinite title "How Ferns Grow," the author refers mainly to the changes that occur in the succession of leaves from the cotyledon of the sporeling to the mature leaf of the sporophyte. It is suggested that in addition to the possibility of tracing phylogeny by means of ontogeny, a knowledge of the successive stages is likely to be of importance in the determination of species and varieties. These ideas are not, however, followed up, nor does the author offer the deductions that would be expected after the examination of a large number of series of young plants. From the illustrations it appears that a reniform shape characterises the earliest leaves of *Pellaea atropurpurea*, and the juvenile leaves of *Onoclea sensibilis* are somewhat similar; also the early leaves of the hart's-tongue and the walking fern, *Camptosorus rhizophyllus*, show similarity. But the figures given and the number of species examined are too few to permit of much, if any, generalisation.

Books on plant life are becoming numerous, too numerous, and yet books on the subject suited to the special requirements of different schools are not obtainable. Of the various books written for children in elementary schools, the "Study of Plant Life," by Miss Stopes, is quite the most logical and intelligent that we have seen.

Beginning with the physiology of the plant, the first object is to show that a plant lives, that it breathes, eats, grows, and moves. These functions are severally made apparent by simple experiments that can for the most part be carried out by children, and are explained with due care to impress their significance. The parts of the plant body and their uses are then discussed, and this prepares the way for the descriptions of their more marked and common modifications. The fourth part briefly enumerates the characters of the five great classes of plants. Passing to the consideration of plants in their homes, typical plant formations are described, and finally it is indicated how a botanical survey is made and plotted.

The foundation of the book is laid in the first part, treating of the plant's vitality, where the argument is well set out. The only suggestions that occur are of a minor nature, such as recommending other plants,

Victoria Regia in a public park in Minnesota. Reduced from an illustration in "The Romance of Plant Life."

the fuchsia or *Eupatorium adenophorum*, rather than the vine for root pressure, directing attention to the necessity of setting up a large number of culture solutions, &c. Throughout the book it will be found that the information is essentially clear and practical, the specimens selected for study easily obtainable, and the arrangement well balanced. While the figures generally are good, the plates illustrating water-plants and bladder-wrack are specially clever reproductions; altogether the book provides an admirable presentment of botanical instruction for children.

"Plant Life," by Mr. H. C. Jones, in contrast with the last, provides a series of notes on suitable work for nature-study classes.

It is divided into two portions, the first referring to plant life in the garden, the second to plant life in the school. The former includes chapters on twigs, bulb-beds, insect fertilisation, underground stems and roots,

[1] "How Ferns Grow." By M. Slosson. Pp. vii+156. (New York: Henry Holt and Co.; London: Geo. Bell and Sons, 1906.) Price 12*s*. 6*d*. net.

"The Study of Plant Life for Young People." By M. C. Stopes. Pp. xii+202. (London: de la More Press, 1906.) Price 2*s*. 6*d*. net.

"Plant Life: Studies in Garden and School." By H. F. Jones. Pp. xii+260. (London: Methuen and Co., n.d.) Price 3*s*. 6*d*.

"The Romance of Plant Life." By G. F. Scott-Elliot. Pp. 380. (London: Seeley and Co., 1907.) Price 5*s*.

"The Green Gateway: a Peep into the Plant World." By F. G. Heath. Pp. xi+138. (London: The Country Press, n.d.) Price 3*s*. net.

creeping plants, and other modifications. Strange to say, modifications of flower form are omitted except in the occasional notes. The second is a physiological course dealing with the energies of the plant. This is more systematic in arrangement, and the experiments are tersely explained, but no new ideas or special hints are offered. The methods suggested for setting up some of the experiments are by no means the most practical, to mention only the growing of a seedling in a funnel, or extracting chlorophyll by boiling the leaf in alcohol over a Bunsen flame. As an indication of observational and experimental work that can be performed with simple apparatus, the book will be found serviceable, and the appendix contains a useful list of plants for growing.

Mr. Scott-Elliot brings to his subject an extensive knowledge of the ways of plants, and the instinct of imagination that enables him to appreciate the romance connected with the facts he has collected. He relates, however, no tales so fascinating as the accounts one has read of the adventures of collectors in quest of orchids or other rare plants, nor is any attempt made to depict that most attractive of all phases of plant life, the tropical forest. The author has selected most of his scenes from non-tropical regions, except where he writes of mangrove swamps and deserts. The various relationships between animals and plants, specialisations of flowers, fruit and seed, and of the plant generally are among the subjects treated, and economic botany receives a due share of recognition. There is no want of variety in the book; in fact, the fragmentary nature of the subject-matter constitutes its chief defect, and much of the information whets the appetite for more. The author has, we think, produced his best results where, as in the sketch contrasting ancient and modern Britain, he pursues a continuous topic.

As a compilation of curious facts about plants, spiced with occasional grains of humour and light caustic satire, the reader will find much of passing interest and not a little that is worthy of closer attention. The best illustrations represent economic scenes, but a more romantic subject is shown in the picture reproduced on the preceding page.

There are various ways of appealing to the youthful mind, that adopted by the author of "The Green Gateway" being to arouse interest by copious allusions to magic, fairy work, and jewels. Although fairy tales may be useful to stimulate the imagination, it is doubtful whether they form a suitable medium in which to portray science. A tree and its parts form the central subject of the book, but it is probable that children will be most interested in the tales of the animal inhabitants and visitors of the tree, that are attractively described without reference to fairies and magic.

PROF. A. F. W. PAULSEN.

IT is with great regret that we chronicle the death of Prof. Adam F. W. Paulsen, which occurred in Copenhagen on January 11. Born in 1833 at Nyborg, in the island of Funen, Paulsen studied at the University of Copenhagen, in which town he subsequently held the position of professor of physics at the Lycée. In 1884 he was appointed director of the Danish Meteorological Institute, one of the most important official meteorological positions, in view of the fact that the Danish Institute is responsible for the meteorological organisations of Greenland and Iceland. He was also a member of the Permanent International Meteorological Committee.

Among Prof. Paulsen's most important scientific labours must be reckoned his researches on the aurora borealis. His attention was first actively directed towards this phenomenon during his stay at Gothaab in 1882–3 as head of a scientific expedition sent out by the Danish Government. The question of the aurora remained one of absorbing interest to Paulsen, and in 1899–1900 he obtained from the Government the means for equipping an expedition to visit Iceland for the purpose of studying the spectrum of the aurora with the aid of modern photographic methods. At the comparatively advanced age of sixty-six years he assumed personal command of the expedition, and brought back with him some highly interesting results. He read a brief account of these before the British Association at the Southport meeting in 1903, which he attended as a member of the Permanent International Meteorological Committee.

As director of the Danish Meteorological Institute, Prof. Paulsen was the head of that meteorological organisation of which the area of observation lies nearest to the North Pole. He never ceased to point out the intimate connection which exists between the meteorological conditions of Greenland and Iceland and those prevailing over Europe, and it is largely owing to his efforts that, after many years of discussion and negotiation, Iceland has at length been brought into telegraphic communication with Europe. The daily service of meteorological messages which was established shortly before his death is likely to prove of great value both in the practical matter of forecasting and in the study, from the scientific point of view, of the permanent Icelandic low-pressure system and its influence on the weather of north-western Europe.

Prof. Paulsen was a familiar figure at international scientific meetings, where his charm of manner, combined with great accuracy of judgment and a clear mode of expression, rendered him deservedly popular. His last visit to this country occurred in the summer of 1904, when he attended the meeting of the International Association of Academies as delegate of the Royal Danish Society of Sciences.

NOTES.

AT the annual meeting of the British Science Guild, to be held at 4 p.m. on Monday next, January 28, at the Mansion House, under the presidency of the Lord Mayor, the Right Hon. R. B. Haldane will deliver an address in relation to the work of the Guild. Other speakers will probably be the Hon. and Rev. E. Lyttelton, Sir David Gill, Sir Wm. Mather, Sir Henry Roscoe, Sir Philip Magnus, M.P., Prof. Meldola, Mr. A. Haworth, M.P., Mr. Mosely, and Mr. Verney.

WE regret to see the announcement that Miss Agnes M. Clerke, the gifted author of several well-known works on astronomical subjects, died on January 20 at the age of sixty-four years. The first important work on astronomy written by Miss Clerke was the "Popular History of Astronomy during the Nineteenth Century," published in 1885. Other works of outstanding merit are "The System of the Stars" (1890) and "Problems in Astrophysics" (1903). Her command of language and acquaintance with astronomical literature were extraordinary, and empowered her to produce books distinguished by literary finish as well as by scientific value. Miss Clerke was a most industrious compiler of methods and results of astronomical investigation. The "History of Astronomy" was her most valuable contribution to scientific literature; and her later works, though marked by the same inspiring style, dealt with the more special aspects of astrophysics. In

reading these works, it is impossible not to feel regret that an enthusiasm so great should have lacked the advantage of a laboratory training, which would have enabled Miss Clerke to estimate the real value of the various researches successfully recorded. "No one writing a history of modern astronomy," says a correspondent of the *Times*, "can fail to acknowledge the great debt owed to the masterly array of facts in her 'History.' No worker in the vast field of modern sidereal astronomy opened by the genius of Herschel and greatly widened by the application of the spectroscope to the chemical and physical problems of the universe lacked due recognition by Miss Clerke, who performed as it seemed no other writer could have done the work of collation and interpretation of this enormous mass of new material, ever pointing the way to new fields of investigation, often by one pregnant suggestion sweeping aside a whole sheaf of tentative conjectures and indicating, if not the true line—for in many cases the truth is yet to seek—at least a plausible and scientific line well worth pursuing."

THE Rothamsted Experimental Station (Lawes Agricultural Trust) has received a donation of 2000*l.* from the Permanent Nitrate Committee, to be invested and added to the general endowment fund of the station. A donation of one hundred guineas has also been received from the Fertiliser Manufacturers' Association. During the past summer the station entered into occupation of the "James Mason" Bacteriological Laboratory, the gift of Mr. J. F. Mason, M.P. The society for extending the Rothamsted experiments, which was formed to obtain funds wherewith the experimental station might enlarge the scope of its work and initiate further agricultural investigations, has further received during the past year subscriptions and donations amounting to 240*l.* Further subscriptions are still urgently needed to secure a more adequate staff, and may be addressed to the Secretary of the Rothamsted Experimental Station, Harpenden, Hertfordshire.

A REUTER message from The Hague, dated January 22, reports that a wave has destroyed the southern coast of the island of Simalu, near Sumatra. The island of Simalu has nearly disappeared. Violent earthquake shocks have occurred daily.

A REUTER telegram from Vyernyi (Turkestan) states that the eclipse of the sun on January 14 was not observed there owing to cloudy and foggy weather.

THE second National Poultry Conference will be held on July 9–11 at University College, Reading. The honorary secretary of the conference is Mr. Edward Brown, 12 Hanover Square, W.

DR. H. R. MILL has been elected president of the Royal Meteorological Society for the ensuing year, and Mr. F. C. Bayard and Mr. H. Mellish secretaries of the society. At the annual general meeting of the society on January 16, Mr. Richard Bentley, the president, on behalf of the members of the council, presented an illuminated address to Mr. William Marriott in recognition of his services as lecturer.

THE annual general meeting of the Iron and Steel Institute will be held on Thursday and Friday, May 9 and 10. The annual dinner will be held—under the presidency of Sir Hugh Bell, Bart.—in the Grand Hall of the Hotel Cecil on May 10. The council will shortly proceed to award Carnegie research scholarships, and candidates must apply before February 28. The awards will be announced at the general meeting.

THE Explosives in Coal Mines Order of December 17, 1906, has been issued by the Home Office in the form of a pamphlet of sixty-six pages (price 4½*d.*). It contains full details of the composition of the fifty-eight explosives the use of which is permitted in unsafe collieries if certain specified conditions be observed.

THE pipe line conveying petroleum from Baku to the Black Sea has been completed. It is 550 miles long, and is capable of passing 400,000,000 gallons of oil yearly. Another important oil-pipe line has been built for transporting Texas and California petroleum across the Isthmus of Panama. It is 8 inches in diameter and fifty-one miles long.

ON Tuesday next, January 29, Prof. A. C. Seward will commence a course of two lectures at the Royal Institution on "Survivals from the Past in the Plant World," and on Thursday, January 31, Major P. A. MacMahon will deliver the first of two lectures on "Standards of Weights and Measures." The Friday evening discourse on February 1 will be delivered by Sir Almroth E. Wright, on "The Methods of Combating the Bacteria of Disease in the Interior of the Organism."

THE thirty-eighth general meeting of the German Anthropological Society will be held in Cologne in August next. It is proposed that this meeting should be constituted an international congress, and the Cologne Anthropological Society has issued a cordial invitation to fellows of the Anthropological Institute and others interested in anthropology and archæology to attend the congress. It is further proposed to arrange a tour of two or three weeks in the Low Countries and France to take place after the congress. During this tour places of the greatest interest from an anthropological point of view will be visited. In case a section of the visitors would prefer to make a tour in Germany, the authorities state that they will consider the possibility of carrying out any proposition they may receive. A complete programme will be published very shortly. Meanwhile, fellows of the institute and other students of anthropology and archæology who would like to attend this congress are requested to communicate with the secretary of the Anthropological Institute, 3 Hanover Square, W.

THE Faraday Society, the object of which is to promote the study of electrochemistry, both pure and applied, and also the study of chemical physics, is endeavouring to develop this latter side in the hope that the physical-chemical work done in this country may be published in its Transactions instead of being published in various journals, and much of it abroad. With this object in view the society held a meeting on January 15 to discuss the electron theory as applied to conduction in electrolytes, and on Tuesday, January 29, there will be a meeting at which a general discussion on osmotic pressure will take place. Prof. Armstrong will be in the chair, and the Earl of Berkeley will exhibit and describe his apparatus for the direct measurement of osmotic pressure. Mr. W. C. D. Whetham will speak on indirect methods of measuring osmotic pressure, Dr. T. M. Lowry on osmotic pressure from the standpoint of the kinetic theory, and a paper by Prof. Kahlenberg is expected upon the bearing of osmotic-pressure experiments upon the conception of the nature of solutions. The society invites all who are interested in the subject to be present. The meeting will be held, as

usual, in the library of the Electrical Engineers, 92 Victoria Street, S.W.

A RECEPTION and exhibition of recent progress in science was held by the New York Academy of Sciences in conjunction with the American Museum of Natural History on December 28 and 29, 1906, and, for the benefit of the public, the exhibition was continued daily until January 14. The 353 exhibits were arranged in eighteen sections, covering nearly every department of natural knowledge, and the exhibition as a whole was a tribute to the organising powers of the managing committee. The New York Academy of Sciences is one of the oldest among American societies, having been established in 1817 as the Lyceum of Natural History. It embraces all branches of science; its scope, in fact, is similar to that of the older European societies. Its publications have long been familiar to readers of NATURE. Its membership includes a maximum of fifty honorary members elected from representative men of science throughout the world, more than 200 corresponding members, who are expected to communicate the results of their researches to the academy from time to time, and the active and associate members. Active membership is not restricted to specialists, but is open to those who take a general interest in science. Fellows are chosen from among the active members in recognition of scientific attainments or services.

A DEPUTATION representing the Infants' Health Society waited upon Mr. John Burns, M.P., President of the Local Government Board, on January 17, with reference to the supply of sterilised milk to infants. Several local authorities have recently established depôts for the supply of sterilised milk for infant feeding. The opinion has been expressed that in so doing the authorities have exceeded their legal powers, and Mr. Burns has therefore intended to introduce a Bill to legalise their action. The Infants' Health Society, believing that sterilisation is of doubtful value, and that refrigeration is preferable, asked that before sterilisation was sanctioned an investigation should be made by a committee of experts which it is proposed to form. Sir Thomas Barlow, Sir Lauder Brunton, and Mr. Mayo Robson having detailed the views of the society, Mr. Burns in reply said that he knew that sterilisation was not the last word in dealing with the problem of the milk supply, and at present he saw no reason why a choice should not be given between the two methods of sterilisation and refrigeration, and why he should not embody in his Bill the power being given to local authorities to sterilise milk. With regard to the investigation of the question by a joint committee, he would be glad if such a committee would communicate to him the results of their investigations.

THE valuable collection of British and foreign Algæ made by Mr. E. M. Holmes, of the Pharmaceutical Society, has, through the generosity of Mr. William A. Cadbury, been acquired for the botanical department of the University of Birmingham. The collection is a very large one, including about 13,000 specimens, and constituting the produce of more than thirty years of Mr. Holmes's activity as a collector. The British portion of the collection is of exceptional value, owing to the singularly prolific nature of Mr. Holmes's personal investigations. When he commenced his work thirty-five years ago there were some 400 species of British marine Algæ known. There are now about 750; and 225 of the new species were distributed by Mr. Holmes himself, in eleven fasciculi. Of these, twenty-five sets only were issued, and with three or four exceptions these sets were acquired for national collections or British or foreign universities. As some of the best collecting grounds of the past, such as those near Weymouth, Plymouth, and Falmouth, have been in large measure spoilt by extensions of building areas, the difficulties in the way of making a complete collection are of increasing magnitude, while three or four of the specimens included in the collection are unique. The foreign portion of the collection is as complete as could have been made in the period, and includes authentic sets sent out by all the best-known algologists, such as Harvey, Agardh, Bornet, Thuret, Crouan, Ferguson, and others. Here also not a few of the specimens are types, having been used as the basis of published specific descriptions. As Mr. Holmes had long planned that his collection should be fitted for public rather than private ownership, exceptional care has been taken throughout in respect of display and mounting, and different species or different varieties are in no case included upon the same sheet. The donor also states, as a condition of gift, that the collection shall be accessible to algologists generally for any purposes of serious study or of reference.

BRITISH sea-fisheries, and more especially those of the North Sea, form the subject of an instructive article in the January number of the *Quarterly Review*. After a survey of the results of earlier investigations, the author discusses those of the last three or four years, which are based on much more precise information than was available in the case of the former. Starting with the axiom that a given area of the sea can nourish only a limited amount of fish, it is pointed out that if the methods of capture tell more heavily on one kind than on another it is quite probable that valuable species may be largely displaced by inferior ones. This seems to be the condition of affairs in the North Sea, where the worthless dab is increasing at the expense of the plaice. Possibly the remedy for this is the introduction of young plaice. Subsequently, in discussing the excessive destruction of young fish which undoubtedly takes place, the question is raised whether this has really any marked effect on the adult population; certainly it does not appear to do this in the case of the herring. Be this as it may, it seems clear that the Grimsby supply is largely maintained by drawing on immature fish. Admitting this, it has yet to be proved that the destruction of young plaice is not the consequence rather than the cause of the depletion of the grounds. If this be so, it follows that the undersized-plaice problem must be considered from a fresh standpoint—the expectation that by checking the capture of young fish the sea will be replenished being obviously untenable. Apart from the grave condition of that of the North Sea, the author expresses the opinion that the condition of British fisheries generally was never better than at present. Obviously, however, interference of some kind must eventually be necessary in nearly all cases, and if this be so it is of the utmost importance that our knowledge of the fishery problem in all its aspects should be made as nearly as complete as possible while prosperity lasts. The Government is, therefore, urged to increase rather than slacken its efforts and support.

IN connection with the preceding note, it may be mentioned that there has been recently installed in the central hall of the Natural History Museum an exhibit prepared by the Marine Biological Association, Plymouth, to illustrate the growth of plaice and pollack, and the methods of ascertaining the ages of individual specimens of each.

In the case of the former, the age estimate is made by counting the annual rings of growth in the ear-bone or otolith, whereas in the latter the scales are employed for the same purpose. Enlarged photographs of these structures in the two species are exhibited.

THE Colonial Office has just issued a report of the advisory committee of the Tropical Diseases Research Fund for 1906. This committee was constituted in July, 1904, and consists of Sir T. Barlow, Sir M. Foster, Sir P. Manson, Sir R. Moor, Surgeon-General Bransfoot, and Messrs. Holderness, Lucas, and Read, with Sir West Ridgeway as chairman. The revenue of the fund for 1906 amounted to 3000*l.*, and was made up of contributions from the Imperial Government, Government of India, Rhodes trustees, and various colonial Governments. The expenditure consisted of a grant of 500*l.* to the Liverpool School of Tropical Medicine, of 1000*l.* to the London School, of 750*l.* to the University of London, and of 500*l.* to the Royal Society. The report includes summaries of work done during 1906. Mr. Leiper, the helminthologist of the London School, has investigated the life-history of the *Dracunculus medinensis*, or guinea-worm, the cause of a disease widely disseminated in tropical Africa. The embryo, after leaving the human body, develops into larvæ, which enter the body of a small fresh-water crustacean of the genus Cyclops. The larvæ do not spontaneously leave the Cyclops, but if the crustacean be treated with 0·2 per cent. hydrochloric acid it dies, and the larvæ are awakened into activity and escape. This suggests that man is infected by swallowing water containing infected Cyclops, and by feeding monkeys with infected Cyclops guinea-worm infection was produced. Dr. Wenyon describes a new species of spirochæte of the mouse, and summaries of investigations on the value of arsenical preparations in sleeping sickness and on other subjects are also given.

No. 9 of the *Kew Bulletin*, completing the volume for the past year, contains a list of marine algæ from Corea, by Mr. A. D. Cotton, and a decade of new orchids named by Mr. W. E. Rolfe. Mr. W. B. Hemsley communicates a note on a new fruit from Uruguay, about the size and shape of a very small apple, having an agreeable taste and said to possess remarkable digestive properties. The plant belongs to the Sapotaceæ, and receives the name of *Pouteria suavis*. Short notices of the dye substance known as barwood, now referred to *Pterocarpus Soyauxii*, and varieties of the Chinese drug, "huan-ch'i," furnished by species of Astragalus, are contributed by Mr. J. M. Hillier and Mr. E. H. Wilson.

A PAPER on the planting of high moorlands appears in the Transactions of the Royal Scottish Arboricultural Society, vol. xx., part i., wherein the writer, Sir John Stirling-Maxwell, advocates a Belgian system of utilising the turfs cut out from the drains as mounds in which to plant out seedlings. A variety of *Pinus montana*, grown largely in the Pyrenees, is mentioned as a tree that is likely to grow well on high moorland. Dr. R. S. MacDougall contributes an entomological article on the life-history of the large larch sawfly, *Nematus erichsoni*, and Mr. E. S. Grant describes a method of trapping the pine weevil, *Hylobius abietis*. A useful set of measurements indicating the increase during fourteen years of a larch crop growing at Murthly, Perthshire, is given by Mr. A. Murray, and a table for the amount of creosote absorbed by various timbers is furnished by Mr. W. B. Havelock.

IN the *Journal de Physique* for December, 1906, M. U. Schoop describes experiments for determining the lines of flow in electrolytes and the distribution of currents in accumulators. The method consists in using an analyser formed of two electrodes of spongy platinum placed close together and connected with a galvanometer; when the electrodes coincide in direction with the equipotential lines no deviation is shown. In this way the lines of the field are capable of being plotted, and a further experimental method enables the intensity of the current to be found at different points.

IT has been shown by Lord Rayleigh that there are certain cases in which an oscillation can be maintained or intensified by a periodic force of double its frequency, as, for example, a stretched string excited by a longitudinal force of half the period of lateral vibration. In the *Quarterly Journal of Mathematics*, 148 (1906), Mr. Andrew Stephenson extends this result by discussing cases in which the ratio of the frequencies, instead of being 2, is one of the numbers 1, $\frac{2}{3}$, $\frac{2}{5}$, $\frac{2}{7}$, &c., *i.e.* a fraction having 2 as its numerator.

IN the Manchester Memoirs, l. (1906), 8, Mr. R. F. Gwyther discusses the range of Stokes's progressive waves of finite amplitude. By studying the paths of the fluid particles, the author shows that the class of wave in question is capable of indefinite propagation with uniform velocity; moreover, the motions of the particles can be determined, within a certain range, to any required degree of accuracy by means of series. There is a limit to the height of the waves when their profile shows a finite angle at the crest, and this "highest wave" is the same as that investigated by Mitchell in 1893.

THE interest taken by American mathematicians in what is done in other countries is well illustrated by Prof. Virgil Snyder's short article on the mathematical tripos of 1906 in the Bulletin of the American Mathematical Society for December, 1906. The article contains an outline of the general characteristics of the various parts of the tripos and the number and subject-matter of the papers in each part. It is illustrated by specimens of the papers reprinted by permission, one in applied mathematics from the first four days, one in pure mathematics from the higher part of part i., and one on divisions ii.–iv. from part ii. Reference is made to the fact that in part i. the "riders" generally have only a very distant connection with the bookwork.

THE "Notes in Mathematics," edited by Prof. Morley, form a pleasing addition to the dry details of class-lists and time-tables published in the Johns Hopkins University Circular, 1906, No. 9. The notes in question deal with the linear relations among the minors of symmetric determinants, by Dr. A. B. Coble; the use of a special type of rational curve (the De Jonquières curve) for the illustration of binary syzygies, by Mr. A. E. Landry; curves with a directrix, by Mr. Clyde S. Atchison; and a note on the determination of multiple points of rational algebraic curves, by Mr. H. Ivah Thomsen. These notes bear testimony to Prof. Morley's activity in organising university research, more especially seeing that the *American Journal of Mathematics* is also issued under his editorship by the Johns Hopkins Press.

A RECORD has been set up in Bendigo for the greatest depth at which gold has been found, gold ore having been struck in driving a cross-cut at 4254 feet at the Victoria quartz mine. The record find in depth previously was held by the New Chum mine, at 4226 feet.

WE have received from Dr. G. F. Kunz a collection of papers relating to the lilac-coloured spodumene, known as kunzite, from California. These spodumene crystals are of extraordinary size, transparency, and beauty, and the various papers recording the remarkable discovery were noticed in NATURE in 1903 (vol. lxviii., p. 460).

THE magnificent collection of jadeite and nephrite presented by the late Mr. Heber R. Bishop to the Metropolitan Museum of Art of New York has, as stipulated in the gift, been duly catalogued. The exhaustive catalogue, of which only one hundred copies have been prepared, is described by Dr. G. F. Kunz in the Bulletin of the Metropolitan Museum of Art, 1906. It covers a thorough investigation of the subject. No copies were sold, the entire edition having been distributed amongst the important public institutions of the world.

PROF. W. GALLOWAY, who has invented many valuable improvements in mining methods and machinery, has devised an ingenious apparatus for automatically stopping and re-starting mine waggons, and recently read a paper describing the invention to the North of England Institute of Mining Engineers (Newcastle-upon-Tyne, 1906). The points at which this appliance can be most usefully employed are at the weighing machine between the top of the shaft and the screens, and in front of the cage at the top and bottom of the shaft. By it, all the weighing on the surface and the loading and unloading of the cages have been effected automatically for upwards of a year at a colliery in South Wales.

AT the Institution of Mining and Metallurgy a paper was read on January 17 by Mr. E. A. Smith on the assay of silver bullion by Volhard's ammonium thiocyanate method. It has recently been the practice to modify slightly the method of finishing the assay by adding sufficient ammonium thiocyanate to the check assay to intensify the red colour of the ferric thiocyanate, and to use this colour as a standard of comparison. Experiments described by the author proved that, by finishing the assay in this way, a limit of accuracy of less than 0·1 per 1000 of silver can be obtained by Volhard's method. Working in the ordinary way, the limit of accuracy is 0·2 to 0·3 per 1000.

ATTENTION was directed by Mr. Bennett H. Brough in his lectures on perils underground (Journal of the Society of Arts, January 11) to the fact that, whilst from time to time some terrible colliery explosion occurred claiming scores of victims at once, every-day fatalities from falls of roof added up to a far higher total. This statement is strikingly borne out by the Home Office tables of fatal accidents and deaths in and about the mines and quarries of the United Kingdom during the year 1906, of which we have received an advance proof. The total number of deaths caused by explosions of fire-damp or coal-dust was fifty-four, and that caused by falls of ground was 547. Of other deaths, sixty-eight were due to shaft accidents, 329 to miscellaneous accidents underground, and 135 to accidents on the surface. Altogether there were 1133 deaths from accidents as compared with 1159 in 1905.

MR. P. E. RADLEY, of 30 Theobald's Road, London, has compiled and published at one penny a booklet of 64 pages dealing with metric and English weights and measures. The publication may be regarded as a modern "table book," and should serve to popularise the decimal system of coinage and weights and measures generally.

IN the *Times* of January 15 Dr. H. R. Mill gives the results of a preliminary discussion of the rainfall observations of the British Isles during the past year. The production of such a general summary in so short a time is at least a remarkable performance, and highly creditable to the British rainfall organisation; the preparation for final publication, after careful scrutiny, of some 4000 records will take about six months to complete. Dr. Mill states that the year 1906 was not remarkable with respect to annual rainfall, "unless it be remarkable to coincide almost exactly with the average, the portions of the country which were unduly wet compensating for those which were unusually dry." This remark calls to mind one made by Dr. Shaw, referring to the *Weekly Weather Report*, at one of the recent useful discussions at the Meteorological Office, viz. that the *average* value was apparently one not very likely to occur. The mean of the percentage figures given in Dr. Mill's diagrams shows that the general rainfall of England and Wales was exactly the average, while that of Scotland shows an excess of 9 per cent., and that of Ireland a deficiency of 4 per cent. The special monthly features were principally a wet January and dry April in the south of England, a wet May in Scotland and the north of England; a storm with excessive rainfall in the south-east half of England on June 28; a very dry summer (with the exception of a wet August in Scotland); a wet October; and heavy snowfall near the end of December.

WE have received a copy of the January issue of Mr. C. Baker's (244 High Holborn) classified list of second-hand instruments. Men of science and teachers who are requiring microscopes, surveying instruments, telescopes, spectroscopic apparatus, barometers, or other instruments or accessories will do well to examine this catalogue.

MESSRS. REYNOLDS AND BRANSON, LTD., of Leeds, have sent us a series of their recent issues of illustrated catalogues of chemical and physical apparatus which they are prepared to supply. Every requirement of the teacher of science and of the investigator appears to have been borne in mind in preparing the catalogues, which are models of clear arrangement for easy reference.

MESSRS. LONGMANS, GREEN AND CO. have issued an abridged edition of the late Mr. F. W. H. Myers's "Human Personality and its Survival of Bodily Death." The abridgment and editing have been done by Mr. Leopold H. Myers. The original work was reviewed at some length by Sir Oliver Lodge, F.R.S., in our issue of June 18, 1903, and readers may be directed to the account there given of the line of argument followed by Frederic Myers. The price of the present book is 10*s*. 6*d*. net.

AN address on the "Modern Theories of Electricity and their Relation to the Franklinian Theory," delivered in Philadelphia by Prof. E. Rutherford at the celebration in April of last year, under the auspices of the American Philosophical Society, of the 200th anniversary of the birth of Benjamin Franklin, is published in the official record of the celebration. In his address Prof. Rutherford gave a comprehensive review of the development of the conceptions which have been formed of positive and negative electricity from the time of the one-fluid theory of Franklin to the present day, and briefly summarised recent views of the constitution of matter from the standpoint of the theory of electrons.

OUR ASTRONOMICAL COLUMN.

THE PROPER MOTION OF CASTOR.—Taking into account both the true proper motion and the orbital motion of the system of Castor, Mr. Crommelin has determined a new value for the proper motion of the centre of gravity of the system. This new value is $-0.0135s.$, $+0''.120$, and it represents the facts much more closely than those previously determined by Auwers and Newcomb respectively. In fact, the latter would have become entirely erroneous, in N.P.D., within a few years, for they were based on the assumption that the proper motion was uniformly rectilinear, whereas the orbital motion in N.P.D. will, in a few years, be entirely reversed. It is interesting to note that the new value was obtained by taking into account the spectroscopic as well as the meridian-observation results, and that the mass ratio obtained by Dr. H. Curtis, which shows that the mass of a_1 is six times greater than that of a_2, is hereby confirmed (Monthly Notices R.A.S., December, 1906).

LINE INTENSITY AND SPECTRAL TYPE.—The results of an interesting investigation of compound lines shown on the stellar spectrograms obtained at the Mills Observatory, Chile, are published in No. 5, vol. xxiv., of the *Astrophysical Journal* by Dr. Sebastian Albrecht. From the spectrograms of stars of different types it was found that certain compound lines give progressive differences in the determined radial velocities as one passes from the type F to the type Mb in the Harvard classification. The investigation showed that these differences are probably due to the variation of intensity, rather than the presence or absence, of the same components of the blended line in passing from one stellar type to another. It also showed that, considering the origins of the variable lines, the physical conditions in the stars as we pass from the F (Procyonian) to the Mb (Antarian) type vary roughly in the same direction as from the sun to the sun-spots, a conclusion confirming that arrived at by Sir Norman Lockyer (Proc. Roy. Soc., vol. lxxiv., p. 53) in a paper which does not appear to have been noted by the American observers who have since dealt with this subject.

The awkwardness of having an arbitrarily chosen code, instead of self-explanatory generical names, to represent stellar types, is strikingly illustrated in the present paper, where the reader's mind is constantly taxed in trying to remember the significance of such signs as Ma, K_5M, F_8G, and so on.

SILICON IN THE CHROMOSPHERE.—At the last meeting of the Royal Astronomical Society, Mr. Fowler read a paper in which he demonstrated the probable presence of silicon in the chromosphere. This element was identified by the presence of two of its strong lines, λ 6347·3 and λ 6371·6, as well-marked lines in the chromospheric spectrum. Both lines occur in the Fraunhofer spectrum, with intensities and characters 2N and 1Nd? respectively, and the latter was ascribed to iron by Rowland, who failed to find an origin for the other. Both are probably enhanced lines, and are almost obliterated in the sun-spot spectrum (Monthly Notices, No. 2, vol. lxvii.).

VARIATION OF WAVE-LENGTHS IN THE SOLAR SPECTRUM.—Whilst discussing his 1901–6 observations of the sun's rotation period, Dr. Halm discovered a previously unknown "shift" in two of the spectrum lines employed. The method used at Edinburgh is that in which the difference of the interval between certain solar and atmospheric lines at the sun's centre and at the limb is measured, this difference giving the "Doppler" displacement at the limb due to the sun's rotational motion. Dr. Halm found that this interval was not the same in 1906 as in 1901, and on analysing his results further he also found some indication of a three-year period in the variation, thus giving additional confirmation to the existence of a short period in solar phenomena such as found by Dr. W. J. S. Lockyer when discussing the relations between solar and terrestrial meteorological phenomena. Dr. Halm suggests that the "shift" discovered by him may be due to difference of pressure (*Astronomische Nachrichten*, No. 4146).

MEETING OF THE AMERICAN ASSOCIATION AND ITS AFFILIATED SOCIETIES.

THE fifty-seventh meeting of the American Association for the Advancement of Science and of the societies affiliated with it was held at New York, N.Y., during the recent convocation week (December 26, 1906, to January 2), under the presidency of the distinguished pathologist Dr. William H. Welch, of Johns Hopkins University. The meetings brought together a larger number of scientific men than ever before, and it is estimated that about 1800 scientific men and women were in attendance. The meetings for the most part were held in the compact group of buildings forming the Morningside Heights property of the Columbia University, but the medical meetings of Section K (Physiology and Experimental Medicine) of the association, of the American Physiological Society, the American Bacteriological Society, and the American Society of Anatomists were held at the College of Physicians and Surgeons and at the Rockefeller Institute. The Geological Society of America and Section E (Geology and Geography) met at the American Museum of Natural History, and the Botanical Society of America and Section G (Botany) met at the Botanical Gardens. The opening meeting was held in Earl Hall, Columbia University, when the retiring president, Prof. C. M. Woodward, of St. Louis, introduced his successor, Dr. William H. Welch. An address of welcome was given by Dr. Nicholas Murray Butler, president of Columbia University, to which Dr. Welch responded.

The address of the retiring president, Prof. Woodward, was delivered at the Teachers' College on Thursday night, December 27, 1906, and was entitled "The Science of Education," a peculiarly apt topic for this meeting, since a new section, "L—Education," was founded at this time.

The addresses of vice-presidents, that is, the chairmen of sections, were extremely interesting. On Thursday afternoon Vice-president Ward, in his address before the Section of Zoology, used as his subject "The Influence of Parasitism on the Host"; Vice-president McNair, before the Section of Mechanical Science and Engineering, spoke on "Some Problems Connected with Deep Mining in the Lake Superior Copper District"; Vice-president Fisher, before the Section of Social and Economic Science, spoke on the topic, "Why the *Laisser-faire* Doctrine Failed"; Vice-president Rice, before the Section of Geology and Geography, spoke on "The Contributions of America to Geology"; Vice-president Sedgwick, before the Section of Physiology and Experimental Medicine, spoke on "The Expansion of Physiology"; Vice-president Eichelberger, before the Section of Mathematics and Astronomy, had as his title "Clocks—Ancient and Modern"; Vice-president Mabery, before the Section of Chemistry, spoke of the "Education of a Professional Chemist"; Vice-president MacCurdy addressed the Section of Anthropology on the subject of "Some Phases of Prehistoric Archæology"; Vice-president Crew, before the Section of Physics, spoke on "Fact and Theory in Spectroscopy"; and Vice-president Smith, before the Section of Botany, under the title "Problems in Plant Pathology."

One of the most interesting and important features of the meeting was the holding of a number of joint sessions between different societies and sections. For example, the afternoon of December 27 was devoted to a symposium under the auspices of Section K (Physiology and Experimental Medicine) at the College of Physicians and Surgeons on the subject of protozoa as factors in disease, a discussion in which both the pathologists and the botanists joined. On the following day a joint meeting of the Society of Zoologists and the Sections of Zoology and Botany was held for the reading of papers on heredity in plant and animal breeding, and on that day Section K held a joint meeting with the Society of American Bacteriologists. There was also a general discussion under the auspices of the American Society of Naturalists on the general topic "The Biological Significance and Control of Sex." On the same day a new Entomological Society of America was founded, with nearly 200 members, and a public lecture was delivered under its auspices by Dr.

Wm. M. Wheeler, on "The Polymorphism of Social Insects."

On Saturday, December 29, a general meeting and luncheon was given at the College of the City of New York, where lectures were given on "The Effort to Save Niagara," by Dr. John M. Clarke, and "On the Industries of Niagara," by Prof. C. F. Chandler. In the afternoon a general meeting was held at the American Museum of Natural History to attend the ceremonies connected with the unveiling of the busts of American men of science presented to the museum by Mr. Morris K. Jesup. Five-minute speeches of presentation were made by Dr. H. C. Bumpus, Hon. Joseph H. Choate, Dr. S. Weir Mitchell, the representative of the German Ambassador, Dr. C. Hart Merriam, Dr. N. L. Britton, Dr. R. S. Woodward, Dr. Arthur T. Hadley, Dr. Hugh M. Smith, Dr. W. K. Brooks, and Dr. H. F. Osborn. A reception was given at the museum in the evening by the trustees of the museum and the New York Academy of Sciences, with an exhibition of scientific progress by the academy, including a demonstration and short addresses.

The most important actions taken by council and by the association at the New York meeting were as follows:—(1) The addition of a new section to the association, viz. L—Education; (2) the change of the title of Section H from "Anthropology" to "Anthropology and Psychology"; (3) a standing committee of fifteen on seismology was appointed; (4) a Darwin memorial committee of ten was appointed to consider the manner in which the association may suitably commemorate the fiftieth anniversary of the publication of the first edition of "The Origin of Species," and this committee was authorised to make overtures to the British Association in order to ascertain whether joint action in this matter cannot be taken; (5) the permanent secretary was authorised to publish hereafter in the official programme of the association all the programmes of all the affiliated societies, whether holding joint sessions with the sections of the association or not; (6) Section E and other sections desiring to do so were authorised to hold a summer meeting during the summer of 1907; (7) a memorial was presented to Congress urging the passage at the present session of the Bill creating forest reserves in the White Mountain region and in the Lower Appalachian region.

In accordance with the policy adopted of recent years, the general committee chose as the place of next meeting the city recommended by the last general committee, namely, Chicago, and recommended to the next general committee that the meeting of 1908–9 should be held in Baltimore. A cordial invitation was received from the president of the University of Chicago, from the Field Columbian Museum and from the Mayor of the city, and also from the president of Johns Hopkins University, of Baltimore. The alternation of eastern and mid-western meetings appears to be, on the whole, satisfactory, although the eastern meetings have been much more largely attended. Chicago, however, is a great scientific centre, and is so easily accessible by rail that the next meeting bids fair to be a large one.

The officers elected for the Chicago meeting were as follows:—President, Prof. E. L. Nichols, Cornell University, Ithaca, N.Y.; vice-president and chairman of Section A (Mathematics and Astronomy), Prof. E. O. Lovett, Princeton University, Princeton, N.J.; vice-president and chairman of Section B (Physics), Prof. Dayton C. Miller, Case School of Applied Science, Cleveland, Ohio; vice-president and chairman of Section C (Chemistry), Prof. H. P. Talbot, Massachusetts Institute of Technology, Boston, Mass.; vice-president and chairman of Section D (Mechanical Science and Engineering), Prof. Olin H. Landreth, Union College, Schenectady, N.Y.; vice-president and chairman of Section E (Geology and Geography), Prof. J. P. Iddings, University of Chicago, Chicago, Ill.; vice-president and chairman of Section F (Zoology), Prof. E. B. Wilson, Columbia University, New York, N.Y.; vice-president and chairman of Section G (Botany), Prof. C. E. Bessey, University of Nebraska, Lincoln, Neb.; vice-president and chairman of Section H (Anthropology), Dr. Franz Boas, American Museum of Natural History, Central Park, New York, N.Y.; vice-president and chairman of Section I (Social and Economic Science), Dr. John Franklin Crowell, c/o *The Wall Street Gazette*, New York, N.Y.; vice-president and chairman of Section K (Physiology and Experimental Medicine), Dr. Ludwig Hektoen, University of Chicago, Chicago, Ill.; vice-president and chairman of Section L (Education), Hon. Elmer Brown, U.S. Commissioner of Education, Washington, D.C.

SOME RECENT WORK OF GEOLOGICAL SURVEYS.

THE Summary of Progress of the *Geological Survey of the United Kingdom* for 1905 (London: H.M. Stationery Office, 1906, price 1*s*.) contains new information regarding the granites of Cornwall and the results of subterranean vapour-action on their flanks. The associated elvan-dykes are now recognised as cutting the granite, and not as offshoots from the more coarsely crystalline mass. The Ordovician beds of South Wales are being divided into zones, under the care of Mr. Strahan. We may note that the spelling "Llandilo" is officially accepted. At the same time, the Coal-measures of South Wales continue to receive close attention; and Messrs. Gibson and Cantrill describe the progress of the search for coal beneath the Permian and Trias of the English Midlands. Mr. Flett's account of the Lewisian rocks that have been recognised within the area of the Moine gneisses in northern Scotland shows that the ancient intrusive gneisses are accompanied by still older rocks of sedimentary origin, which have been metamorphosed by them. Following Dr. Peach, the occurrence of an unconformity between this older complex series and the Moine gneisses is regarded as extremely probable (pp. 103, 166, &c.). Mr. Howe furnishes a summary of the work done in the museum at Jermyn Street on the samples of road-metal tested in Mr. Lovegrove's machines at Hornsey. The full results are now available in a separate work (see NATURE, vol. lxxv., p. 220).

The Geological Survey also issued in 1906 a colour-printed edition of Sheet 110 of the English map, with the superficial deposits represented, and an accompanying memoir of 138 pages on "The Geology of the Country around Macclesfield, Congleton, Crewe, and Middlewich" (price 2*s*. 6*d*.). The only things that we miss in this memoir are photographic illustrations to show the contrast between the drift-covered plain of Cheshire and the scarped and broken country leading northwards from Mow Cop. Even a vignette of Moreton Hall, and another of the spoil-heaps of a coal-mine, might express the social and industrial contrast, which is so well known to road-travellers between Chester and the Pennine Chain. The "general description," however, makes good amends from the point of view of structural geology. The details of the superficial deposits are the newest feature in the memoir, and the glacial beds are regarded as the product of an ice-sheet about 1100 feet in thickness (p. 79). The marine shells found in the high-level gravels "may well have been caught up by the ice in its passage over the Irish Sea." Examples of these occur east of Macclesfield at a height of 1200 feet above the sea. But Mr. T. I. Pocock, who treats of this area in the memoir, believes that the shelly sands formerly to be seen under Macclesfield itself (p. 84), at a height of about 450 feet, may have been deposited in a shallow sea. The perfect state of preservation of large numbers of the molluscan remains, and the absence of glacial indications in the beds, influence him in this opinion, which is quite in accordance with what is admitted in countries outside the British Isles. At home, however, it is certain to be questioned, as is also the dim suggestion of an inter-Glacial epoch in the succession of events tabulated upon p. 88. The economic geology of the area is dealt with in chapter ix.

Earlier in the year, Mr. G. Barrow's memoir on "The Geology of the Isles of Scilly" (price 1*s*.) was issued, to accompany a convenient map which includes the whole group in a single sheet. Here photography has freely been called in, and the relations of the isles to human interests are well touched on. Mr. Flett's petrographic notes appear,

happily, in connection with the description of the rock-masses in the field. An outlier of gravel (p. 15), "largely composed of Chalk-flints and Greensand-chert," forms a cap on the eastern promontory of St. Martin's, and may be a relic of a river-gravel, spread from Dartmoor over a continuous land-surface in Eocene times. The old pre-Glacial beach, now near sea-level, has been raised at least 40 feet, and again lowered by that amount, since its formation (p. 33); the evidence of this comes from the mainland, but is sufficiently conclusive. The warping in the beach itself may be brought to the attention of those who are captivated by the theory of fluctuations in the volume of the sea rather than by that of recent movements of the land.

Part iv. of the *Administration Reports of Ceylon* for 1905 includes one on the Mineralogical Survey, by the director, Dr. A. K. Coomaraswamy. This raises a number of points of great interest to the petrographer as well as the mineralogist. The graphite of Ceylon is regarded as a product of vein-filling processes, following the reasoning of Weinschenk—here styled, as so often happens, Weinschenck. If, however (p. E3), the crystalline limestones of the district are organic, the graphite may possibly have had "an indirect organic origin." The similarity of the deposits in Ceylon to those of Quebec, which are directly associated with limestone, is not so great as Osann has recently suggested. The discovery of thorianite by the director has led to investigations in a number of valleys (p. E 6); but, knowing the country intimately, Dr. Coomaraswamy does not believe that it would be practicable to divert the courses of the streams to facilitate the raising of the material. An illustrated account is given of the native method of dredging for gems, and there is a fine plate showing the weathered surface of limestone associated with bands and lumps of granulite. A parallel to this "interstreaking" of the two rocks can surely be found in the west of our own islands, where the "granulite" is clearly an invader in the limestone. This report, so closely and simply written, provides more agreeable reading than many ambitious volumes with wide margins and encyclopædic information.

From the *New Zealand Geological Survey* we have received Bulletin No. 1, describing the geology of the Hokitika sheet, by J. M. Bell and Colin Fraser (pp. xii+102, 1906). Some of the topographical work has to be carried out by the Geological Survey, and maps are usefully added in an envelope at the end of the bulletin. The area described lies in North Westland, and contains both alluvial gold and coal. The relics of formerly extensive glaciers, with snowy gathering-grounds at a height of about 5500 feet above the sea, afford especially interesting features in a latitude of 43° S. One of these narrow shrunken glaciers is shown in the illustration here selected (Fig. 1), and the memoir abounds in photographic views which will appeal equally to the geographer and the geologist. It should have been noted, perhaps, by the authors that some of these views represent more than the perpetual snow. On p. 21 it is suggested that the glaciation began to spread from the new mountain-range "during or perhaps just following Lower Cretaceous times." On the next page this is, we think, corrected by the statement that "glaciation started in Miocene time." The great advance of the ice, reducing the island to the condition of Greenland, probably took place in the early Pleistocene. Whether this was due entirely to the upheaval of a mountain-chain across the direction of the prevalent winds is left an open question. We gather that the great mountain-building movements were of early Eocene age.

The authors have no doubt as to the excavating power of the glaciers in the past, and quote the forms of the lake-bottoms in support of their conclusions. The petrology is illustrated by a striking series of enlargements from rock-slices, reminding one, on a still bolder scale, of the pioneer work of the late Sir R. Daintree. Nephrite (p. 69) is found occurring as segregations in talc-rock or talc-serpentine-rock, the lumps being from about 1 inch to 2 feet across; these are pointed out (p. 99) as of economic value. On p. 93 we have the interesting suggestion that boulders of "grauwacke" in Butcher's Creek supply sufficient ferrous carbonate to act, when they decompose, as precipitants of gold in the solutions permeating the surrounding gravels. These boulders were examined chemically, owing to the greater richness of the gravel round them as compared with that round boulders of other rocks. Another remarkable record is the discovery of platinum in quartz-veins (p. 96). The whole bulletin, with its introduction on the botany, soil, climate, and communications of the area, shows that the survey has a high conception of its duties in carrying on the scientific investigation of New Zealand.

The *Annual Report of the State Geologist of New Jersey* for 1905 shows the local survey in cooperation with that of the United States, and even competing with it in the production of geological maps on a large scale (p. 4). As is now the case with most surveys, economic observations occupy an important place, and it is doubtless found that the necessity for close scrutiny and all-round questioning which such inquiries involve reacts favourably on the character of the more purely scientific work. In New Jersey, however, the Geological Survey goes outside ordinary lines, and deals, for instance, with water-supply and coast-protection from an engineering point of view. Mr. Berry describes (p. 135) the Cenomanian flora of the Magothy beds at Cliffwood. Messrs. Parmelee and McCourt contribute ninety pages on the nature and uses of peat, and on the peat-deposits of the State, with a general bibliography.

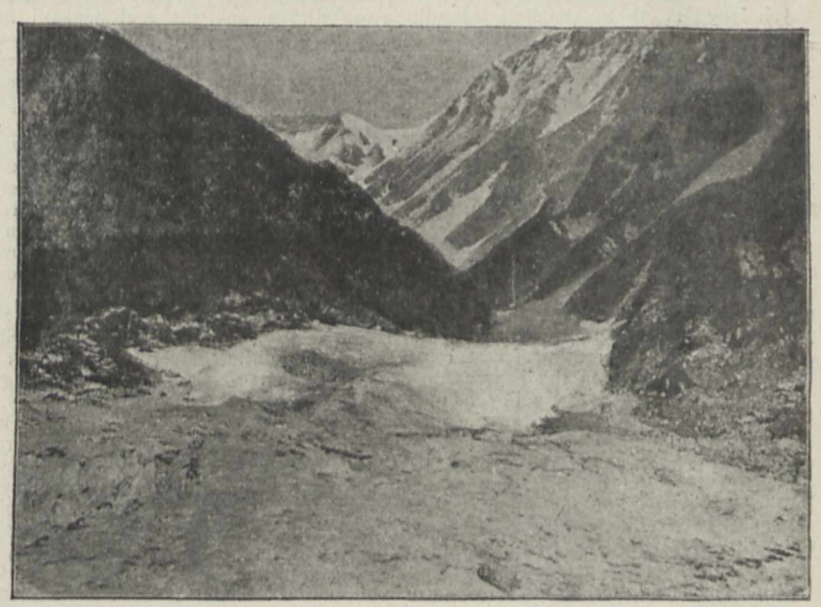


FIG. 1.—Grave Creek Glacier, with Mount Walter (6350 feet) at the back.

The recent work of the *United States Geological Survey* has been dealt with lately in a special article (NATURE, December 20, 1906, p. 182). Mr. Calhoun has now issued a professional paper on "The Montana Lobe of the Keewatin Ice-sheet," which contains interesting details (p. 40, &c.) as to the influence of the main ice-sheet on the course of the Missouri River. Students of dry river-courses in glaciated areas will find the Shonkin Sag of interest, a channel with characteristically fresh surface-

features (Fig. 2), and cut to a depth of 600 feet across, and not down, the slope of a hillside for a length of eighty miles (pp. 12 and 43). This is explained by the action of an overflow-stream from a lake held in between the ice-front and the hills. Parts of several pre-Glacial stream-cuts were utilised in its course.

The work of the *Geologische Reichsanstalt* of Vienna may conveniently be touched on in this article. In vol. lvi. of the *Jahrbuch* of this institute (May, 1906, p. 298) Dr. Stuchlik attributes a lateritic origin to the "bunte Mollasse" of the Oligocene of southern Bavaria, and urges that the red ferruginous material was washed down from tropical deltas into a shallow sea. B. Granigg's paper (p. 367) on the Ober-Mölltal in Carinthia contains some observations on the origin of serpentine; and it is instructive to note that the intrusive masses from which this rock has been produced have metamorphosed the adjacent mica-schist and quartzite in very various degrees. Contact-alteration is at times hardly perceptible, a fact that may be taken into account in the discussion on the origin of the South African diamantiferous material. In the *Verhandlungen* of the Reichsanstalt, 1906, pp. 146–164, Dr. F. E. Suess gives a general account of the geology of the complicated district in the environs of Brünn. The

FIG. 2.—The wall of the Shonkin Sag, a valley of glacial drainage in Montana.

sheet of the geological map described includes part of the ancient Bohemian plateau on the north-west, and part of the Cainozoic foothills of the Carpathians on the south-east. The picturesque and varied scenery on the old high-way from Hungary to Prague is recalled to us in this lucid memoir. Brünn, little visited as it is, should clearly be an exceptional centre for the study of geology. The Ortler group furnishes W. Hammer (p. 174) with material for a discussion of Termier's views on Alpine structure. Dr. Kossmat (*Jahrbuch der k.k. Reichsanstalt*, 1906, p. 274) similarly finds himself involved with Termier and Lugeon in the "Gebiet zwischen dem Karst und dem Zuge der Julischen Alpen." A specialised congress on Alpine structure, with months of field-excursions, would be needed for the answering of all these questions; but even then the new views daily propounded would effectually overwhelm the answers. M. Vacek (*Verhandlungen*, 1906, p. 203) is allowed free scope for a highly controversial paper on the basin of Graz, in which he compares the "green beginner" in geology, who rushes into tectonics, to a stutterer delivering a public speech. The name of the specially "green" one is presently shouted across the barriers of this scarcely edifying tourney. The geological sections given are, of course, of considerable interest, and show a country rich in transgressions and unconformities. Vacek points out the need for considering the isolated masses of Palæozoic and Mesozoic sediments in relation to the geography of the times when they were laid down. Thus in many cases they were deposited in gulfs running along the hollows of an ancient crystalline series. The author strips away these sediments, and seeks to trace the surface of a central Alpine land-mass denuded in pre-Palæozoic times. G. A. J. C.

OCEANOGRAPHICAL RESEARCH.

THE Prince of Monaco presided at the formal opening of the Scottish Oceanographical Laboratory at Edinburgh on the afternoon of Wednesday, January 16. A distinguished gathering of representative naturalists from the leading cities of Scotland took part in the ceremony. On the motion of the Lord Provost of Edinburgh, the Prince of Monaco was called upon to take the chair. A brief explanatory statement of the genesis and development of the laboratory and of the end aimed at was given by Mr. W. S. Bruce, the leader of the Scottish Antarctic Expedition and the founder and director of the laboratory. He showed how Scotland might be regarded as the cradle of oceanography, Edinburgh having been associated with the study of the oceans for a longer period than any other place in the world. The gathering together and arrangement of the material had been going on for years, and represented the work of eight scientific expeditions. In many respects it was an absolutely unique collection. The place it was now in was essentially a workshop for oceanography, and Mr. Bruce appealed to the people of Scotland to support this movement to place oceanographical research on a permanent footing. There were men able and willing to do the work if once the laboratory were properly established and affiliated to the great teaching institutions of the country.

In a short address the Prince of Monaco paid a high tribute to the admirable work which had been accomplished by Mr. Bruce and his companions in the Antarctic seas. Their expedition had been probably the most fruitful of all the expeditions carried out about the same time, and yet by far the most economical. Seven other speakers, representing various interests, spoke as to the claims Mr. Bruce's new venture had on the people of Scotland. Sir William Turner referred to the close connection which the University of Edinburgh had had with the *Challenger* expedition and with later expeditions of a like character. Dr. Dobbie said that the seals and birds which the Scottish Antarctic Expedition had presented to the Royal Scottish Museum were probably unsurpassed by any like collection in any museum of the kingdom, and that other museums had greatly benefited through the generosity of Mr. Bruce. Dr. Horne, as representing various scientific societies, made special reference to the geographical knowledge which had been gained by the staff of the *Scotia*, to the practical sympathy which the Scottish Geographical Society had taken in the expedition, and to the generous manner in which the Royal Society of Edinburgh, in spite of its straitened means, had undertaken the publication of the memoirs describing the results. Prof. Arthur Thomson, as representing other Scottish universities, directed particular attention to the character of the Oceanographical Laboratory as a place where a man could train himself for oceanographical work. Mr. Henry Coates, of the Perthshire Society of Natural Science, commented on the value of the collections in the laboratory being arranged as a regional museum. Dr. Rottenburg, of Glasgow, and Mr. Robert M'Vitie, of Edinburgh, expressed their sympathy with a project which seemed to be a natural consequence of the Antarctic Expedition, the success of which had rejoiced the hearts of the many who had been interested in it.

The laboratory occupies a low one-storied building on the north side of the Surgeons' Hall. There are four rooms, the largest of which is filled with cases stored with specimens from the Arctic, while another contains specimens from the Antarctic. Each case is devoted to a particular group of animals, crustacea, fishes, molluscs, sea-urchins, &c., systematically arranged, with the memoirs and papers describing them placed on the lower shelf. One interesting case is arranged bathymetrically, the typical animals of different depths being placed on corresponding shelves. In the Antarctic room special cases are devoted to special regions, such as the Weddell Sea, Scotia Bay, &c., or to different islands, the South Orkneys, Gough Island, the Falklands, and so on. One interesting specimen in the collection is a large granite boulder, ice-marked, weighing 3 or 4 cwt., which had been dredged up from a depth of 1775 fathoms in lat. 62° 10′ S. and long. 41° 20′ W. The whole collection, Arctic and Antarctic, represented the gatherings of the scientific work of five vessels, the *Balaena*, the *Windward*, the *Blencathra*, *Princess Alice II.*, and the *Scotia*. Photographs of these and of interesting scenes during the *Scotia's* voyage decorated the walls. At the present time many of the specimens are in the hands of the naturalists who are working up the various groups, while the larger animals are for the most part distributed throughout Scotland in various museums. There are many duplicates which should prove useful in effecting exchanges with other similar institutions, and so gradually increase the value of the Edinburgh collection.

The inauguration of the Scottish Oceanographical Laboratory was the first of a series of public and semi-public functions at which the Prince of Monaco was the leading figure. On the evening of January 16 he was the principal guest at the dinner of the Royal Society Club. Lord Kelvin presided, and Prof. Geikie acted as vice-chairman. On Thursday, January 17, the Prince received the degree of Doctor of Laws from the University of Edinburgh. On the evening of the same day he delivered an address on the exploration of the high atmosphere before the Royal Scottish Geographical Society. Prof. Geikie, president of the society, occupied the chair, and introduced the Prince as one well known as an enthusiastic, devoted, and successful student of natural science. His investigations had been conducted on a scale which had only been rivalled by Government expeditions sent out by great nations. For at least twenty-five years he had traversed the ocean in search of knowledge. He had established a great oceanographical institute at Monaco, a weather bureau, and a museum, and last year he endowed at Paris an oceanographical institute at a cost of not less than 160,000*l*. The president then handed to the Prince the gold medal which the society had awarded him in recognition of his scientific work.

In the course of his address, the Prince said that in the last few years the improvements in the manufacture of steel had made it possible to fly kites at great heights, carrying self-registering apparatus. Also the india-rubber industry had enabled balloons, carrying self-registering apparatus, to be sent to altitudes hitherto inaccessible. Through the liberality of the German Emperor a great establishment had been set up at Lindenberg for the systematic investigation of the upper-air meteorology. This was over the land. In 1904 the lecturer had become interested in the subject, and he began to make plans for investigating the problem over the sea. To reach great heights it was necessary to attach to the line or wire a series of kites at intervals, and if no layers of calm air were encountered a very great height could be reached, and the kite kept there by the vessel moving with a speed of not less than 7 metres per second. There were many difficulties on board ship due to complications of wind distributions in the different layers. After a season's work with kites in the Atlantic the Prince resolved to try the *ballons-sondes*. The method first adopted was to use two light india-rubber balloons filled with hydrogen. The one carried the self-registering apparatus, while the other and more inflated balloon was attached to it, and aided the ascent to the required height. At this height the upper balloon burst, and the lower balloon with its instruments descended as a parachute, and hovered over the sea so long as the float at the end of the stray line touched the surface of the water. This could be seen at a distance of eight or ten miles. The bursting of the balloon was somewhat indefinite, and an improvement was subsequently effected by means of which the one balloon was released altogether at the desired height. This was done by means of a current from a small dry cell set in action when the pen of the barograph on the lower balloon touched a conductor set at the pressure corresponding to the desired height. Also by use of a formula taken in connection with the observed ascent of the system, the line of descent of the "*ballon parachute*" could be approximately calculated, and the ship steered for the place. By means of apparatus of this kind pressure and temperature curves had been brought back from a height of 7500 metres in latitude 78°·55. In the high latitudes the experiments had been greatly interfered with by fog. The drift of air in still higher regions had been studied by means of pilot balloons, which had been followed through the telescope of a theodolite to heights of nearly 30,000 metres. These indicated that in latitude 80° north, at a height of about 13,600 metres, there were at times winds blowing with a velocity of 60 metres per second, or 130 miles per hour. The results of several cruises had shown that "if the principal States of the world were willing to diminish a little the expense of international quarrels by submitting them to the judgment of a tribunal less costly than that of war, and if they preserved more resources for the veritable interests of humanity, it would be possible with powerful means very soon to know the laws of meteorology, the key to which seemed to be found in the higher atmospheric regions."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The voting on the proposed reform of the mathematical tripos will take place on Friday and Saturday, February 1 and 2.

The placet executive committee has issued a letter to non-resident members of the Senate pointing out that "the proposed scheme is supported by a large majority of the resident members of the Senate, a majority which includes eight heads of houses, more than thirty professors, all the official university teachers of mathematics, and the whole mathematical staff of several of the larger colleges. Moreover, the principles of the reform have already been approved by the Senate. It is, however, impossible for the reform to be carried into effect unless it is supported by the votes of a large number of non-residents. . . . The rejection of the proposed reform would be a great calamity for the future of the Cambridge School of Mathematics. Further, the precedent established by the reversal of a decision already made would be a serious menace to the practical working of the government of the University."

THE citizens of Montreal resolved at a meeting on January 16 to raise 200,000*l*. for an endowment fund for the McGill University. Mr. Robert Reford promised to contribute 10,000*l*. Lord Grey presided, and Lord Strathcona was also present at the meeting.

A COURSE of eight lectures on "Certain Fundamental Problems in Physiology Common to Animals and Plants," to be given at University College, London, by Dr. W. M. Bayliss, F.R.S., commenced on Wednesday, January 23. The lectures are open to all students of the University of London.

MR. G. P. DARNELL SMITH has been appointed assistant director of technical education and manual training to the Board of Education, Auckland, New Zealand. Mr. Darnell Smith has been on the staff of the Merchant Venturers' Technical College, Bristol, since September, 1892, and some time ago he was promoted to the post of assistant professor of chemistry in the college.

THE Duke of Northumberland on January 17 opened the new Royal Grammar School at Newcastle-upon-Tyne, which has been built by the governors at a cost of 60,000*l*. to take the place of an older building. In his inaugural address the Duke of Northumberland said, with regard to recent elementary education, we have probably over-

weighted the coach. Small brains have been strained further than they should be; a smattering rather than a real grounding in knowledge, and a "cramming" rather than a forming of character, have been given. He hopes that the revival of the interest in secondary education is a sign that we are going to mend our ways in these directions. My own belief, he continued, is that the proper form for education to take is to teach very few subjects in the elementary schools and to teach them thoroughly. Then, instead of wasting time in making a level of mediocrity, let promising children be taken out of the elementary schools, and, when they are really likely to profit by superior and special instructions, bring them into secondary schools. All the population who show that they are able to profit by the advantages of secondary education should receive it. Some of the money spent on elementary education might be saved and spent on technical education.

PROF. SCHUSTER has offered to the University of Manchester during the next three or four years an annual sum of 350*l.* as the stipend of a reader in mathematical physics. The council and senate have accepted with great gratification Prof. Schuster's generous gift, and the post will be instituted forthwith. The reader will be attached to the department of physics. His primary duty will be the promotion of research in the subject of mathematical physics, but he may also be called upon to give a course of lectures on the subject. Prof. Schuster, in a letter to the Vice-Chancellor, gave his reasons for making his offer, as follows:—"I have been watching for some time with considerable apprehension the growing separation between the subjects of mathematical and experimental physics. This separation followed perhaps naturally on the rapid growth and exceptional success of the experimental side during the last twenty years, but it cannot, in my opinion, fail to be detrimental to the further progress of the science. I have been trying in the physics honours school of our university to give equal weight to the two branches of the subject, and the offer I now make is intended to emphasise the close connection which should exist between experimental and theoretical work. I believe that at the present moment the foundation of such a readership as I contemplate would be of advantage to science generally and to our school of physics."

MR. E. B. SARGANT, education adviser to the High Commissioner of South Africa, read a paper at the meeting of the Royal Colonial Institute on January 15 on federal tendencies in education. Among other subjects of educational importance, Mr. Sargant dealt with movements especially characteristic of higher education, such as the unceasing stream of young men of good circumstances which flows from the various parts of Greater Britain through our ancient universities, a movement which, in the case of Oxford, was so powerfully reinforced by the bequest of the late Mr. Rhodes. From the point of view of our larger national character, it is difficult to put too great a value upon the influence exerted by such a circulation of students through the heart of our higher educational system. He then spoke of the need of reproducing this kind of education in the colonies themselves, and said that our great public schools and colleges ought to realise that at no distant date they may themselves be asked to extend into Greater Britain. Mr. Sargant also discussed the federal stimulus in education, of which the London University, in its purely examinational aspect, must be considered to be a first cause, and observed that, from an Imperial point of view, the University of London has centred the thoughts of many of our fellow-subjects in all parts of the British Dominions upon the value of some unity of educational aim, even though it may be only a unity of standard. In the discussion which followed, Sir A. Rücker pointed out that in any dominion of the Crown it is possible for a candidate to test himself in order to see whether he has attained a standard equal to that which is attained by a good English schoolboy or undergraduate.

PROF. RUDOLF TOMBO, jun., of Columbia University, has compiled an interesting set of registration statistics concerning the principal universities of the United States. The statistics are published in the issue of *Science* for December 21, 1906. Comparing the figures for 1906 with those of the preceding year, it is seen that California, Leland Stanford, Johns Hopkins, North-Western, and Columbia universities have all suffered a decrease in attendance. The greatest gains have been made by Pennsylvania, New York, Indiana, Missouri, Syracuse, Virginia, Nebraska, Ohio, Cornell, Illinois, Chicago, and Michigan universities. Harvard and Yale with a few other universities have remained stationary in numbers. Examining the numbers of students taking different faculties, most of the institutions this year show an increase in enrolment in the arts department. This is true, so far as men are concerned, of every institution in the table, with the exception of Johns Hopkins and Wisconsin, though several universities for a number of years have registered continual losses in their arts departments, these losses being in many cases due to corresponding gains in the scientific schools. Prof. Tomba says a reaction has apparently set in in this direction, at least at a number of institutions. At Princeton, for example, the number of arts students has increased from 629 to 758, at Yale from 1323 to 1350, at Columbia from 557 to 606; whereas the number of science students at the same institutions has decreased from 624 to 484 in the case of Princeton, from 1028 to 929 in the case of Yale, and from 566 to 524 in the case of Columbia. At Harvard the discrepancy is even greater. The largest gain in the number of science students has been made by Illinois (from 880 to 1020).

THE *Times* recently published some details of the work done by the London County Council Education Committee in the direction of the proper training of children on the physical side. With regard to hygiene and medical work, the head teachers of the schools are instructed to give attention to such questions as ventilation, the scrubbing of floors, and the inspection of the "offices." Children who come to school dirty are washed, or if further purification is needed they are sent home. Notification is made to the medical officer when any child attends school suffering from an infectious disease or after coming from an infected home. Defective children receive special attention, and lists are made in order that they may be medically inspected. The staff of trained medical nurses now numbers thirty-two. The nurses are constantly at work visiting the schools, where they closely examine the children, confer with the teachers, schedule the unclean and those suffering from skin diseases, and generally continue the work of the teachers in these matters. The education committee has its own medical officer, an assistant, and twenty-three other qualified medical men or women, who give a half or a quarter of their time. These medical officers, if necessary, exclude a child from school, and recommend the temporary closing of the school itself in case of extensive prevalence of infectious disease. In examining the children reported to be defective, if they find that the defect is such as to make it desirable that the child should be remitted to a "special" school, they recommend accordingly. The question of bad teeth is not overlooked. Much care is devoted to cases of defective sight. Care is exercised in seeing that no child's sight is strained, and the number of children who visit the hospitals for treatment is very large. Physical exercises, including all that modern scientific and practical experience can suggest as best fitted for the pupils, form an important part of the curriculum of every school. The exercises are health-giving, and are enjoyed by both boys and girls. Games are also encouraged and even organised by the voluntary efforts of the teachers. Most schools have their athletic clubs, and the Council is now making a new departure by providing playing grounds.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 15, 1906.—"Calcium as an Absorbent of Gases, and its Applications in the production of High Vacua and for Spectroscopic Research." By Frederick **Soddy**. Communicated by Prof. J. Larmor, Sec.R.S.

By means of a special electric furnace, surrounded by a porcelain tube and enclosed within a glass tube, it has been found possible to heat reagents *in vacuo*, in sealed

soft glass apparatus, to a far higher temperature than the softening point of glass. Calcium heated in this manner is, under suitable conditions, an absorbent of all the known gases, with the exception of those of the argon group. Provided the initial gas-pressure does not exceed a few millimetres of mercury, all the common gases are rapidly and completely absorbed by calcium between 700° C. and 800° C., and a vacuum attained through which the electric discharge cannot be forced. Arndt (*Ber. d. d. Chem. Gesell.*, 1904, xxxvii., 4733), in an investigation of the melting point of calcium, noticed that the calcium volatilised freely below its melting point when heated in a vacuum of 1 mm. mercury, and the vapour reacted energetically with the oxygen and nitrogen of the residual air, producing a great improvement in the vacuum. He did not investigate the behaviour of other gases.

This behaviour of calcium is all the more surprising because in ordinary circumstances it shows a great disinclination to react, and may be heated in a tube filled with air at atmospheric pressure to a very high temperature without causing much absorption. A low initial pressure of the gas and volatilisation of the metal are essential in using calcium as an absorbent. Barium and strontium behave in a manner very analogous to calcium. In the case of hydrogen and its compounds, the absorption becomes more complete, and the vacuum improves when the calcium is allowed to cool owing to the hydride possessing an appreciable tension of dissociation at the high temperature.

The high vacua readily produced by the absorption of residual gases by calcium are at least equal to the highest attained by any other process. By filling the apparatus with mercury after the action of the calcium, and compressing any residual gas several hundred times into a tiny spectrum tube, it was found that the vacuum was still so high that the spectrum tube was of high resistance and fluoresced brightly under the discharge, showing a faint hydrogen spectrum. Since argon is not absorbed, the air must be first removed from the apparatus by means of a Fleuss pump and by replacement of the last traces with some argon-free gas, before the calcium is brought into action. The condensed gases evolved from the apparatus on heating usually suffice to replace the last of the air during the mechanical exhaustion. The calcium, being a good conductor of electricity, may be readily heated to the required temperature within the sealed glass vessel by induction through the walls from an alternating circuit outside the vessel. The special feature characterising the new method is the rapid and complete absorption by the calcium of the gases condensed on the walls, and in the electrodes, &c., of the apparatus being exhausted as soon as these are expelled by heating. These gases, known technically as "film gases," consist largely of hydrogen and carbon compounds, and cause most of the difficulty experienced in practice, for they readily re-condense and introduce a kind of steady vapour pressure within the apparatus, greatly increasing the time required for exhaustion.

In the apparatus usually employed for experimental work a porcelain tube with an external screw-thread is wound with a platinum resistance wire through which a current is passed. A porcelain test-tube containing the reagent is slipped within this furnace tube, which in turn slips within a wider porcelain tube, which again slips within the external glass tube provided with platinum wires sealed through the glass for conveying the heating current. This tube is then sealed to the apparatus to be exhausted.

In one form of apparatus for heating the calcium by induction, a calcium disc is bored with central hole through which a short bundle of soft iron wires pass. Two porcelain crucible lids bored with central holes fit over the calcium disc, the ends of the iron wires projecting beyond the lids. This arrangement is slipped into a glass tube with the axis of the iron core at right angles to the length of the tube. A coil of soft iron wire is cut at one point and bobbins of wire slipped over the two ends, which are then brought opposite and close to the ends of the iron core within the glass tube. On exciting the bobbins with an alternating current of high periodicity (200 to 400 periods) a current of the order of a kiloampere is induced in the calcium disc, heating it to the required temperature.

The phenomena when successive quantities of air are admitted into an apparatus containing heated calcium are of special interest, for all but the 1 per cent. of argon is rapidly absorbed, and in this way the minimum quantity of argon necessary to carry the discharge and show a spectrum has been determined. Below 1/50 mm. argon does not conduct; at this pressure the green and orange lines are faintly visible; at 1/25 mm. the reds appear; at 1/2 mm. the spectrum tube has a resistance equivalent to an alternative air gap of 5 mm., while at 1 mm. pressure the tube is still brilliantly fluorescent. With helium, introduced into the apparatus as a mixture of oxygen with a known small quantity of helium, the tube is non-conducting to the discharge at pressures below 1/20 mm. of helium when every trace of other gases is absent. In presence of hydrogen or oxygen one-hundredth part of this amount is sufficient to show the D_3 line of the helium spectrum. The conclusion is drawn that the inert monatomic gases in the absence of every trace of polyatomic gases show a great disinclination to conduct the discharge, and this accounts for many isolated facts familiar to workers with high vacua. The rapid "running out" of spectrum tubes filled with inert gases is due, not to the absorption of these gases, but to the absorption by the electrodes of the traces of hydrogen, &c., always present initially or introduced by the electrodes (compare Skinner, *Phil. Mag.*, 1906 [vi.] 12,481). When this has occurred the pure monatomic gas no longer conducts. The fact observed by Lord Blythswood and H. S. Allen (*Phil. Mag.*, 1905 [vi.] 10,497), that an X-ray bulb may be readily exhausted from atmospheric pressure of air to a "vacuum so good that the tube had to be heated to allow the discharge to pass through it," by the use of charcoal cooled in liquid air according to the method of Sir James Dewar, at first seems inconsistent with the fact that seventeen parts per million of the air, consisting of helium and neon, remain unabsorbed, and the residual pressure must therefore be about 1/75 mm. The explanation is to be found again in the disinclination of these monatomic gases to conduct when pure. For this reason the electric discharge test of the goodness of a vacuum is altogether misleading, for with the inert monatomic gases pressures within the range of the mercury barometer appear to be high vacua. The great power of calcium in absorbing every trace of carbon dioxide, hydrogen, water vapour, hydrocarbons, &c., derived from impurities in the apparatus, and from the lubricating grease of stop-cocks, makes it a powerful aid to the methods of spectroscopic research.

Appendix.—"Results of Gauging High Vacua by the Evaporation Test." By A. J. **Berry.**

The degree of high vacua produced by different processes may be gauged by the rate of evaporation of liquid air in a Dewar vessel exhausted by the process. The same globular vessel of about 1 litre capacity, silvered internally, was exhausted (1) by the mercury pump; (2) by the use of cooled charcoal from atmospheric pressure, using two successive quantities of charcoal; (3) by cooled charcoal after the air had been first removed by a mechanical pump. It was to be expected from the conclusion drawn in the preceding paper that the degree of vacuum obtained in the second test would be much inferior, tested by the evaporation method, to that obtained in the third. The expectation was fully borne out by the experiments. The liquid air evaporated at the rate of 898 grams in four days in the vessel exhausted by the second method, which was rather faster than in the first method, when the vacuum was produced by a mercury pump. The vacuum produced by the third method was far better, 942 grams evaporating in six days, and only 610 grams in four days.

December 6, 1906.—"The Theory of Photographic Processes. Part iii. The Latent Image and its Destruction." By S. E. **Sheppard** and C. E. K. **Mees.** Communicated by Sir William Ramsay, K.C.B., F.R.S.

The authors consider that "developability" is brought about by the acceleration of reduction by preliminary treatment. The essential chemical reaction in development is

$$Ag + R'' \rightleftarrows Ag|met| + R',$$

which normally proceeds to a state of equilibrium. If now to this state of equilibrium any cause tending to lower

the metastable limit of the silver solution be introduced, then the halide becomes developable. The following substances can act as germs for a dry plate:—(*a*) silver, introduced as colloidal silver and then converted to the metallic state; (*b*) gold; (*c*) platinum; (*d*) silver sulphide; (*e*) gas ions from flame gases.

All evidence tends to the conclusion that a necessary and sufficient condition for "developability" is the production in the silver-halide grain of a new substance. The authors have accepted a chemical theory of the latent image chiefly on account of the way in which the latent image gives certain definite chemical reactions, and especially on account of the destruction of the latent image by oxidising agents. They have made an extended investigation of the destruction of the latent image by chromic acid, with especial reference to the theory of primary and secondary development put forward by Mr. Sterry in January, 1904. This theory suggests that the primary image formed by the development of the "latent" image is intensified by silver transferred from other parts of the film.

The authors found that exposed plates, dipped in chromic acid solution before development, have their γ_∞ and inertia unaltered, but the development-velocity constant, K, lowered by the action of the chromic acid adsorbed to the silver bromide. This chromic acid was destroyed by sodium sulphite, and the plates then gave a normal K. If, however, a plate was left after chromating, before development a fall in γ_∞ was found which could not be destroyed by sulphiting, and which therefore showed an absolute destruction of the latent image. Probably this action was a re-oxidation process.

The second part dealt with a peculiar action of salts of copper, iron, mercury, and uranium, which desensitise the plate, so that enormous exposures are required to produce normal results. If the plates are exposed and developed after desensitising, K and γ_∞ are found to be normal. If, however, the plates are left for a long period after exposing, then the desensitisers destroy the latent image by lowering γ_∞ in the same way as chromic acid.

The theory advanced for this action was that desensitisers act by catalysing the oxidation reaction, which is the opposite to the ordinary light reduction action, and this view was supported by experiments which showed that with copper, quinine salts, and with iron, oxalates restored the lost sensitiveness, a result analogous to that obtained for the negative catalysis of quinine in the case of the catalysis of sodium sulphite oxidation by copper salts.

The authors have also repeated the experiments of Abney and Englisch upon the failure of the Bunsen-Roscoe reciprocity law, and of the integration of intermittent exposures. The results obtained agree with those previously found. The authors consider ripening to be due to the joint action of the (*a*) formation of resonating systems; (*b*) formation of reduction product, the function of the gelatin being to form resonators and to assist in reduction.

The authors consider the formation of the latent image to be connected with the photoelectric effect, and to be due to the liberation of electrons which ionise the halide and the surrounding gas. This theory accounts for the action of dyes as sensitisers for their own region of absorption, since these electrons will ionise the halide effectually. Ionisation leads to chemical reduction, resulting in the formation of a subhalide in solid solution.

PARIS.

Academy of Sciences, January 14.—M. A. Chauveau in the chair.—A comparison between chemical phenomena determined by a heating resulting from external calorific causes and those due to a heating produced by electrical actions: M. **Berthelot.** Stress is laid on the fact that changes undergone by a substance when heated by passage of an electric current cannot be entirely regarded as due to the thermal effect of the current.—The so-called artificial plants: Gaston **Bonnier.** An adverse criticism of a recent paper of M. Stéphane Leduc.—The eighth campaign of the *Princess Alice II.*: The **Prince of Monaco.** A general account of the work done on Spitsbergen in the fields of geography, hydrography, meteorology, oceanography, zoology, and physiology.—The critical points of inverse functions: A. **Hurwitz.**—The critical points of a class of functions: Georges **Rémoundos.**—The potentials of an attracting volume the density of which satisfies Laplace's equation: Tommaso **Boggio.**—The movement of liquids with high velocity through very large conduits: H. **Merczyng.** Experiments on pipes of 38 cm. and 50 cm. diameter, the water flowing at rates between 3 and 4 metres per second, gave results differing markedly from those obtained by an extrapolation from Darcy's formula. Experiments were also made on the quantities of sand carried in suspension by the water at different velocities.—The importance of the thickening of the anterior edge of the wing of the bird in flight: application to aëroplanes: E. **Seux.**—A new wireless telemechanical apparatus: G. **Gabet.**—The exact calculation of the molecular weights of gases: Daniel **Berthelot.** A comparison of the results of the application of two methods of reduction of experimentally determined gas densities to the determination of the molecular weights of hydrogen, nitrogen, carbon, and chlorine in terms of oxygen = 32.—A sulphate of chromium the acid of which is entirely hidden, and on the equilibrium of chromic solutions: Albert **Colson.** The salt, the method of preparing which is described, has the composition $Cr_2(SO_4)_3+6H_2O$. The solution of the salt reacts with barium chloride very slowly.—Dyeing and ionisation: Léo **Vignon.**—The action of silicon chloride upon chromium: Em. **Vigouroux.** These two substances react at about 1200° C., Cr_2Si_2 being formed. The properties of this silicide have already been described by MM. P. Lebeau and Figueras.—A new silicide of manganese described by M. Gin: Paul **Lebeau.** The author gives reasons to suppose that the silicide of manganese recently described as new by M. Gin is in reality impure $SiMn_2$.—A continuous apparatus for the preparation of pure oxygen for use in organic analyses: A. **Seyewetz** and M. **Poizat.** Acid solution of potassium permanganate is allowed to flow into hydrogen peroxide solution. The advantages of ease of control and purity of the gas are claimed.—The study of a case of isomerism in the oxonium combinations of Grignard and Baeyer: W. **Tschlinzeff.** An attempt to discriminate between the two formulæ suggested by Baeyer and Grignard respectively for the addition compounds of magnesium alkyl compounds and ether. Thermochemical experiments led to indecisive results, but the action of water on the substances obtained in different ways tends to support Baeyer's views.—Methylethylketone peroxide: M. **Pastureau.** Details of the preparation, properties, and reactions of methylethylketone peroxide.—The acyclic unsaturated and β-chlorethyl ketones. A method of synthesis of the 4-alkylquinolines: E. E. **Blaise** and M. **Maire.**—A method of destroying larvæ in plantations of trees: M. **Eberhardt.** A solution of formol, glycerol, and water is used, and details are given of the mode of application in different cases. The treatment has given excellent results in trees already attacked by larvæ.—A new antelope from the valley of Ituri, *Cephalophus ituriensis*: Maurice **de Rothschild** and Henri **Neuville.**—The Liriopsidæ, crustacean isopods, parasites of the Rhizocephalæ: Maurice **Caullery.**—A precaution to be taken in the observation of colours: E. P. **Fortin.** If a coloured object is subject to a constant illumination, the colour seems to differ according as the eye is or is not exposed to light. The precautions necessary on this account are indicated in the cases of coloured chemical reactions, in meteorological observations, and in the examination of paintings.—The Aptian, Gault, and Cenomanian, and on the general characters of the Lower and Middle Cretacian in the Atlas of eastern Morocco: W. **Kilian** and Louis **Gentil.**—The relations between the Tertiary strata and volcanic rocks in Anglona (Sardinia): M. **Deprat.**—The Calabrian earthquake of September 8, 1905: G. **Mercalli.**

NEW SOUTH WALES.

Linnean Society, November 28, 1906.—Mr. T. Steel, president, in the chair.—Recent travels among the aborigines of the north coast of Australia between Broome, on the north-west, and the Gulf of Carpentaria, and at Melville Island, for the purpose of ethnological and anthropological

study: Prof. **Klaatsch.** The aborigines of the northern half of the continent are more numerous than is generally supposed, and their number may be estimated as between 100,000 and 150,000. An appeal was made by the lecturer, on behalf of the northern blacks, for greater consideration in the way of a more adequate provision of reserves, and for more effective protection than the southern blacks have received in the past. Apart altogether from humanitarian questions, the demand for their more enlightened treatment is justifiable on scientific grounds alone.—Contribution to a knowledge of the flora of Australia, part v.: R. T. **Baker.** Two additions to the flora are described—*Acacia fuliginea*, an ally of *A. ixiophylla*, Benth., *A. viscidula*, A. Cunn., and *A. dictyophleba*, F.v.M. (section Plurinerves), from the Rylstone district, New South Wales; and *Callitris Morrisoni*, an unrecorded pine from West Australia, with fruits not unlike those of *C. Drummondii*; and branchlets which would pass muster for those of *C. robusta*, R.Br. An analysis of the oil of *Eucalyptus Rudderi*, Baker and Smith, is given, together with other economic notes on this species. New localities or an extended range for a number of species are recorded.—New Australian species of the family Æschnidæ (Neuroptera: Odonata): R. J. **Tillyard.** The species herein added to the Australian list form about as miscellaneous and remarkable a set of insects as it would be possible to find, and serve to show the composite character of the Australian Odonate fauna. They comprise an East Indian species, a Chilian species (*Petalia apollo*, Selys [♀], of the subfamily Cordulegasterinæ, determined by Dr. Ris, of Belgium), and three species described as new, of which one is referable to an Indian genus, and two are probably the types of new genera.—Notes from the Botanic Gardens, Sydney, No. 12: J. H. **Maiden** and E. **Betche.** The following species are described as new:—*Boronia Deanei*, in swamps between Clarence and the Wolgan, Blue Mountains, a handsome species nearest to *B. parviflora*, Sm.; *B. repanda*, formerly recorded as *B. ledifolia*, J. Gay, var. *repanda*, F.v.M.; *Toechima dasyrrhache*, a sapindaceous plant from Tintenbar, published on behalf of Prof. Radlkofer, and at his request; *Acacia accola*, from the borders of New South Wales and Queensland, nearest allied to *A. neriifolia*, A. Cunn.; and *Rottboellia truncata*, an aberrant species from Yandama, north-west New South Wales. New varieties are also described, and new records for New South Wales.—Revision of Australian Lepidoptera, iii.: Dr. A. J. **Turner.** This instalment comprises supplementary notes on families previously treated of, namely, the Syntomidæ, the Notodontidæ, and the Geometridæ. Three genera and thirty-one species are described as new.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 24.

ROYAL SOCIETY, at 4.30.—Experiments on the Dark Space in Vacuum Tubes: Sir William Crookes, F.R.S.—On a New Iron Carbonyl, and on the Action of Light and of Heat on the Iron Carbonyls: Sir James Dewar, F.R.S., and Dr. H. O. Jones.—On Regeneration of Bone, Part ii., Sir William Macewen, F.R.S.—Note on the Application of Van der Waals's Equation to Solutions: The Earl of Berkeley.—On the Presence of Europium in Stars: Joseph Lunt.

ROYAL INSTITUTION, at 3.—Recent Advances in the Exploration of the Atmosphere: Dr. W. N. Shaw, F.R.S.

SOCIETY OF ARTS, at 4.30.—The Bhils of Western India: Captain E. Barnes.

INSTITUTION OF ELECTRICAL ENGINEERS at 8.—Investigations on Light Standards and the Present Condition of the High-Voltage Glow Lamp: C. C. Paterson.

FRIDAY, JANUARY 25.

PHYSICAL SOCIETY, at 5.—The Strength and Behaviour of Brittle Materials under Combined Stress: W. A. Scoble.—A Spectrophotometer: F. Twyman.—Photographs of Electric Sparks: K. J. Tarrant.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Alternating-Current Commutator Motors: C. A. Ablett.

SATURDAY, JANUARY 26.

THE ESSEX FIELD CLUB (at Essex Museum of Natural History, Stratford) at 6.30.—Occurrence of the Sea Bream (*Pagellus centrodontus*) in Essex Waters: Dr. James Murie.—The Evolutionary History of Carts and Waggons: Thomas W. Reader.

MONDAY, JANUARY 28.

ROYAL GEOGRAPHICAL SOCIETY at, 8.30.—A Journey through Central Asia to Northern China: Major C. D. Bruce.

SOCIETY OF ARTS, at 8.—Gold Mining and Gold Production: Prof. J. W. Gregory, F.R.S.

LONDON INSTITUTION, at 5.—The Transmutation of Elements: Sir William Ramsay, K.C.B., F.R.S.

INSTITUTE OF ACTUARIES, at 5.—Further Notes on some Legal Aspects of Life Assurance Practice: A. R. Barraud.

TUESDAY, JANUARY 29

ROYAL INSTITUTION, at 3.—Survivals from the Past in the Plant World Prof. A. C. Seward, F.R.S.

MINERALOGICAL SOCIETY, at 8.—Experiments bearing on the Order of Crystallisation of Rock-constituents: Prof. H. A. Miers, F.R.S.—Isomorphism as illustrated by Certain Varieties of Magnetite: Prof. B. J. Harrington.—Serpentine-rock from the Tarnthaler Köpfe, Tyrol: Dr. A. P. Young.—A Simple Tabular Arrangement of the Thirty-two Crystallographic Classes: Dr. J. W. Evans.

FARADAY SOCIETY, at 8.—*Discussion on Osmotic Pressure.*—Apparatus for the Direct Measurement of Osmotic Pressure: Earl of Berkeley.—Indirect Methods of Measuring Osmotic Pressure: W. C. Dampier Whetham, F.R.S.—Osmotic Pressure from the Standpoint of the Kinetic Theory: Dr. T. Martin Lowry.

WEDNESDAY, JANUARY 30.

SOCIETY OF ARTS, at 8.—Apprenticeship: J. Parsons.

SOCIOLOGICAL SOCIETY, at 8.—Swiss Referendum as Instrument of Democracy: J. A. Hobson.

THURSDAY, JANUARY 31.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* On the Two Spectra of the Elements as Evidence of the Composite Nature of the Atoms: Prof. W. N. Hartley, F.R.S.—On the Explosion of Pure Electrolytic Gas: Prof. H. B. Dixon, F.R.S., and L. Bradshaw.—On the Firing of Electrolytic Gas by a Compression Wave: L. Bradshaw.—A Recording Calorimeter for Explosions: Prof. B. Hopkinson.—On the Discharge of Negative Electricity from Hot Calcium: Dr. F. Horton.

ROYAL INSTITUTION, at 3.—Standards of Weights and Measures: Major Percy A. Macmahon, F.R.S.

FRIDAY, FEBRUARY 1.

ROYAL INSTITUTION, at 9.—The Methods of Combating the Bacteria of Disease in the Interior of the Organism: Sir Almroth E. Wright, F.R.S.

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