THURSDAY, MAY 18, 1905.

## THE BIRDS OF CENTRAL AMERICA.

*Biologia Centrali-Americana. Aves.* By Osbert Salvin, M.A., F.R.S., and Frederick Ducane Godman, D.C.L., F.R.S. 4 vols. (London: 1879–1904.)

CONGRATULATIONS to the surviving author of these volumes must be mingled with deep condolence that his long-tried coadjutor and comrade should not have been spared to complete this portion of the great work in which they were jointly engaged, and to supply that summary of its contents which he, perhaps, alone could have written. But acutely as the loss of Mr. Salvin is to be lamented, if on no other account than this, no less real is the gratification with which the bringing to an end of a task that has lasted for a quarter of century is to be regarded, and the relief to Mr. Godman's mind at the accomplishment of another portion of his gigantic design must be enormous. It is getting on for twenty years since the volume treating of the mammals of Central America was reviewed in these pages by the late Sir William Flower (NATURE, xxxiv., p. 615, October 28, 1886), and that portion also suffered by the untimely death of its author, Mr. Edward R. Alston, so that instead of the comprehensive view of the mammalian fauna of the country which he had intended to appear in the introduction to the volume, we had merely a series of tables of distribution which he had prepared to found that view upon, and these tables Mr. Sclater, who prefixed a few prefatory sentences, left to speak for themselves. Speak for themselves they did, but they needed an interpreter, since they were drawn up for the most part on geographical lines—or, to be more accurate, from a politico-geographical base, the geographical element preponderating.

The tables given in the first of the volumes treating of birds, and now before us (being almost identical in form with those contained in the "Introduction"[1] to the first volume on Lepidoptera), do not differ very greatly in character, though herein the political divisions of the country are given in greater detail, so as to be more important than the geographical. Now each of these methods unquestionably has its advantages—mostly of a practical kind. If we want to see or obtain examples of any particular kind of animal, it is convenient to know where it may be found. But it can hardly be doubted that, had Mr. Salvin lived, he, with his experience of the country and its ornithology, would scarcely have been content without trying if it were not possible to treat the distribution of the species, genera, and families as well from a physical point of view. That he was fully aware of the importance of taking that aspect of the question is shown by the pithy remarks on the subject in an article published by Mr. Godman and himself in *The Ibis* for 1889 (p. 242)—several years, be it observed, after the appearance of Mr. Alston's tables. The labour, no doubt, would have been immense, and only to be performed by one possessed of such knowledge, alike minute and wide, as Mr. Salvin had; but assuredly he was convinced that it can never be too strongly impressed upon all students of topographical distribution that the key to the subject lies in the physical features of the country, especially of a tropical country of such varied character as Central America. Even an indication of the rough division into the three well known zones—the *tierra caliente*, the *tierra templada*, and the *tierra fria* would be better than nothing, though in a country extending over so many degrees of latitude and of such diverse heights, what is the *tierra templada* of one district becomes the *tierra fria* of another.

At the same time, it must be admitted that more than this is required. Comparative altitudes and the extent of forest-growths may explain some things, but they will not account in all cases for the limits of the area to which a certain form, say Pharomacrus or Oreophasis, may be confined. But if boundaries are not to be accounted for by physical characters, assuredly they can be still less rationally explained on political or geographical grounds. Considerations of this kind seem to point to the futility of attempting to lay down any boundaries at all, unless those that are physical can be traced, and of course the difficulty of tracing them is sometimes very great. To take a familiar instance here at home. Who can define on physical grounds, or correlate with them, the distribution of the nightingale in England and Wales? Hence it may be fairly urged that it would be far better for zoologists generally to leave off speaking of areas, regions, subregions, provinces, and the like, and to regard the animal population of a country solely from the faunal point of view.

Central America would seem especially to lead to some such conclusion as this. It can hardly be doubted that the existing fauna of America—North and South—is the result of at least three perfectly distinct faunas, which have originated in, or been derived from, as many different tracts, and probably at as many different epochs. In Central America all three meet, though one is overwhelmingly out of proportion to the other two. This is practically identical with the fauna of by far the greater part of South America as distinguished from that of Patagonia, which seems to have had a very different origin and history, while the former is equally distinct from that which prevails now over the greater part of North America—this last being, as Prof. Huxley long ago intimated (*Proc. Zool. Soc.*, 1868, p. 314), much more closely allied to the Palæarctic fauna, if, indeed, he might have added, it be not substantially of Palæarctic extraction. Then again, while comparatively few of the members of the fauna now dominant in Central and the greater part of South America have penetrated to the area at present occupied by the apparently much more ancient Pata-

[1] That "Introduction" also contains a succinct description, excellent so far as it goes, by Mr. Godman, of the natural features of each political district of Central America, which is taken to include the whole of Mexico from the Rio Grande and the Rio Gila, but excluding Lower California, and thence to the Isthmus of Darien in the now independent State of Panama. The subject has been much more elaborately treated, though of course with especial reference to the flora of the country, by Mr. Hemsley in his admirable "Appendix" to the fourth volume of the "Botany" of the whole work (pp. 138–170).

gonian fauna in the extreme south, a considerable portion have invaded North America—possibly re-occupying the home whence they had been driven during some glacial period, but certainly to an extent that sensibly affects the existing fauna. In the same way certain characteristic forms of the Patagonian fauna, diminishing in number as the distance from their modern focus increases, occur throughout the whole length of South America, generally clinging to the slopes of the Andes, and a few reach the highlands of Central America—Scytalopus, for instance, the sole example of that most characteristic Patagonian family, Pteroptochidæ, which has made its way into Costa Rica.

Further into detail it would be impossible here to go, for it would need the exhibition of long lists and tables showing the distribution of various groups or forms to make clear the truth of the statements just enunciated, to which, no doubt, some will demur; but it may be mentioned that their truth does not rest alone on the evidence afforded by birds, for a close examination of the other classes of vertebrates will be found to corroborate the same position, and it may be left for time to show whether the opinions here expressed are not generally accepted as true. Briefly recapitulated, they are that the whole of America is now occupied by three faunas. The very ancient and, it may be added, morphologically low Patagonian in the south; that of a somewhat higher morphological rank which peoples the greater part of South America, all of Central America, and permeates almost to the middle of North America, until it is outnumbered by still higher forms derived from a Palæarctic stock; but to lay down any boundaries, even physical boundaries, for these distinct faunas is impossible, and though we may call the first and last "Patagonian" and "Nearctic" respectively, it is not easy to find a good title for the second, unless we were to apply to it Mr. Sclater's original name, "Neotropical," restricting that in the southern direction and extending it in the northern. It has been called "Columbian" by one writer, and if that epithet had not been used before in a much more limited sense by another writer the name would not be inappropriate, for Colombia may be regarded as its modern focus, but doubtless it anciently extended much further to the northwards, and by it in remote times the Sandwich Islands were most likely colonised.

If these remarks be deemed too critical, it must be understood that they are not intended to be generally opposed to the views of Mr. Godman. Writing of the butterflies in the "Introduction" before referred to, he stated expressly that the fauna of Central America "is mainly a northern extension of that of tropical South America," with a considerable number of Nearctic forms "coming down the central plateau a certain distance into Mexico, and some even into Guatemala." This is not only equally true of the birds, but the southern extension of their northern forms reaches even further. The real question is, what value is to be attached to these northern forms? A very slight examination will show that nearly all belong to families that are essentially Neotropical. It has been pointed out before now that the so-called Nearctic "Region" has not more than one peculiar family of birds (Chamæidæ), and that a very doubtful one. All the other families of land-birds are either Neotropical or Palæarctic, so that in one sense it may be said that no distinct, or peculiar, Nearctic fauna exists, the bird-population of North America having (with that one doubtful exception) wholly Palæarctic or Neotropical affinities, and those often of the very closest nature. No stronger corroboration of the views of Prof. Huxley, Prof. Heilprin, and others who have advocated the abolition of the Nearctic "Region" can be adduced than is furnished by Mr. Godman's tables, and when we speak of a Nearctic fauna, such as exists now, we mean a mixed multitude of either Neotropical or Palæarctic extraction, or having a common origin with one or the other of those faunas.

But it will not do here to follow further this interesting theme, important as it is in the light that it sheds on the history of the modern inhabitants of the earth. Something must be said before we leave these volumes of the way in which they are presented to the public. Considering that upwards of 1400 species of birds had to be included, the amount of space available for the treatment of each must necessarily be small. But here a most rigid and commendable economy has been practised. No space is needlessly taken up by considerations of taxonomy, nomenclature, or such like ancillary subjects on which so many faunal writers deem it expedient to dilate, though the first is only wanted in a general treatise and the second is regarded by the wise as a snare to be avoided by all who have no time to waste over frivolities. By many of the younger zoologists of the present day the principle of nomenclature followed by the authors will be set down as old-fashioned, but considering the weight of the authorities cited, and their number, the application of the principle is abundantly justified, though exception to some of the results may here and there be reasonably taken, and sufficient synonymy is given as to preclude any possible confusion. In like manner there is no attempt to invent a new classification, for which, in the present state of flux, all should be thankful. That which has been in use by taxonomers for some thirty years in respect to American, or at least South American, birds is adopted. Be its faults what they may, it is well understood by the great majority of those who have been most interested in the subject during that period. The localities whence each species has been recorded are duly noted in the account of it, and thus the details of its range may in most cases be very fairly traced, while reference is systematically made to the authority responsible for the statement, and this, needless to say, is a very important matter. Furthermore, the distinguishing characters of both genera and species are presented with the skill that comes only from intimate knowledge of the respective forms and careful comparison of them with their allies, a feature that is often absent in modern ornithological works, and in one of this magnitude is especially to be commended. The species

figured, one hundred and fifty in number, seem to have been well selected, and the plates in which they are represented by Mr. Keulemans are in the style which has won him so much reputation as an ornithological artist. But all these merits pale before the admiration which the bold conception and patient execution of this grand undertaking excites. There is no English work on natural history comparable in these respects with the "Biologia Centrali-Americana," and the only foreign one which it calls to remembrance is the marvellous "Madagascar" of the late M. Grandidier. The debt due by naturalists of all branches and of all countries to the enterprise, the zeal, and the perseverance of both Messrs. Salvin and Godman, and to the munificence of the latter, for without that all the rest would have availed little or nothing, is one that can never be repaid. A. N.

## VECTOR MECHANICS.

*Die Grundlagen der Bewegungslehre von einem modernen Standpunkte aus.* By Dr. G. Jaumann. Pp. vi+422. (Leipzig: J. A. Barth, 1905.)

THIS work is intended as a systematic general introduction to mechanics; as in the recent English exposition of Webster, the whole field of solid and deformable bodies is considered, so that the book has a wide range—a feature which must necessarily be purchased to some extent at the expense of depth.

Dr. Jaumann, following a method which now enjoys some popularity on the Continent, treats the subject by vectorial methods throughout. The first chapter introduces the ideas of velocity and acceleration, and with them the ideas of the vector and the scalar and vector products of two vectors. This is very natural and well written; it is, however, followed by the introduction of dyads, which was scarcely to be expected at this early stage of the work; and when the author, as is the habit of those writers who apply vectors, takes the liberty of making some additions to the vector calculus itself, and plunges us forthwith into an able but somewhat difficult discussion of "rotary" dyads, we are thrown into doubt as to the class of readers for whom the book is designed.

After this we come back to the ideas of partial and absolute acceleration, illustrated by astronomical considerations, and to the conception of gravitation, with an account of Kepler's laws. This closes the first section of the book, which, though interesting, leaves an unsatisfied and helpless feeling behind it, for the student (if the book is written for students) has not learnt how to find for himself the path of a point in a given field of acceleration, which is surely the main problem of this part of the subject. Thus, although Foucault's pendulum is described, the theory of it—which would make no greater demand on the mathematical capacity of the reader than the rotary dyads require—is not worked out.

The author now introduces the idea of mass, which is defined (as in most good modern works) by means of what used to be called the principle of action and reaction; in other words, the ratio of the masses of two particles is defined as the ratio of the accelerations which they induce in each other when moving under each other's influence, and the idea of "force" is altogether abandoned. These ideas are again supplemented by astronomical illustrations, even the tides being worked into the scheme; and after this we have more vector calculus, with Stokes's theorem in the vector notation.

Dr. Jaumann next discusses rigid bodies, rigidity itself being defined by a vector equation! He discusses the constants of inertia, and solves some very elementary problems, and then passes on to a sketch of acoustics.

The last principal division of the book deals with deformable media—elastic solids, liquids, and gases. The treatment here is good so far as it goes, but too slight to be very satisfying.

Considering the work as a text-book, it must be said that the difficulty of the vectorial methods so freely used is hopelessly out of proportion to the results achieved. The student who has mastered the whole machinery of the treatise will still be unable to solve for himself any but the most rudimentary of the actual problems of dynamics. The author seems to overlook the cardinal fact that the solution of every moving material system depends ultimately on the integration of the associated differential equation, or some equivalent process, and that this is the really difficult part of the subject, the rest being child's play in comparison. A book which devotes scores of pages to symbols and formulæ, and yet never brings the reader into close grip with this essential kernel of the subject, is open to the charge of beating about the bush.

## GREATER AUSTRIA.

*Geologie der Umgebung von Sarajevo.* By Ernst Kittl. Part iv. of the *Jahrbuch der k.k. geologischen Reichsanstalt* for 1903. (Vienna: R. Lechner, 1904.)

THIS general essay, with its plates of fossils and numerous geological sections in the text, corresponds to one of the memoirs on special districts issued by our own Geological Survey. It includes, moreover, a folded geological map on the scale of 1:75,000, and is thus a complete guide for future scientific visitors. The map itself reminds us of the charm of the Bosnian capital, set in its semicircle of craggy hills, where the gorge of the Miljačka broadens out towards the alluvial basin of Ilidže. We trace the mountain-road from the Ivan Pass coming out suddenly on this cultivated plain, and see again the minarets of Sarajevo shining like white masts under the background of Triassic precipices.

The author's introduction shows how the geological survey by Austrian observers followed hard upon the capture of the city, which had risen fanatically to arms. The famous ammonite-locality of Han Bulog, on the way to Mokro, was thus discovered as early as 1880; and the important part played by Triassic rocks east of Sarajevo was made known by

Bittner and Kellner, and in 1892 by the author, who was sent by von Hauer to collect for the museum in Vienna. The whole Alpine Trias seems well represented near the city, some of the massive limestones, rich in Diplopora, being spoken of as "Riffkalke." The red limestone with Ptychites, the rock best known in our collections, is on an Upper Muschelkalk horizon. While the Eocene period is probably represented by a Flysch-facies, the Oligocene and Miocene lagoons and freshwater lakes show that the mountain-land of Bosnia was rising above the sea in Middle Cainozoic times.

The author's detailed descriptions of the region, district by district, are illustrated by sections drawn on a correct vertical and horizontal scale, and by occasional sketches and photographic views. As a type of the sketches, we may mention the effective Fig. 16 (p. 611), showing the rounded forms of the Flysch deposits banked and sometimes faulted against the scarped Triassic masses to the east. Another section (p. 639) shows well how the Flysch strata, extending north towards Doboj and the great Hungarian plain, have been tilted and overfolded during the orogenic movements of the Dinaric Alps, which continued, as we now know, far into Pliocene times. The steep forms of the lowland landscape, cut into by frequent streams, are readily appreciated from the section.

The palæontological portion of the memoir records fossils from the "Kulmschiefer," including, curiously enough, *Modiola lata*, described by Wheelton Hind as recently as 1896. The author supports (p. 671) E. Haug and J. P. Smith in restoring Goniatites as a restricted generic term, so that we again have *Goniatites crenistria* and *truncatus*, as well as *sphaericus* and *striatus*. Osmanoceras and Tetragonites are described as new genera of goniatites. The Bellerophon-beds of the Upper Permian yield, amid a fairly rich fauna, Promyalina, a new member of the Aviculidæ. These forms, and a number of new species, are suitably figured, either in the text or in the plates. It is pleasant to recall the bookshops in Sarajevo on the way to the bazaar and the river-side, where this last product of Austrian investigation will appear for sale under the shadow of the Sultan's mosque. G. A. J. C.

## ECONOMIC SCIENCE.

*Economic Essays by Charles Franklin Dunbar.* Edited by O. M. W. Sprague, with an introduction by F. W. Taussig. Pp. xvii+372. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1904.) Price 10*s.* 6*d.* net.

NO American economist has been held in higher repute for judiciousness, breadth of view, and "soundness" than Charles Franklin Dunbar, professor of political economy at Harvard from 1871 until his death in 1900, sometime Dean of the college (between 1876 and 1882), and later Dean of the faculty of arts and sciences. But his output was never extensive, perhaps because the university teaching of political economy was not his first choice, or at any rate not his first calling. It was not until Prof. Dunbar had attained the ripe age of forty-one that he was appointed to his professorship at Harvard. Previously he had engaged in newspaper work, and had edited between 1859 and 1869 the *Boston Daily Advertiser*. To the work of the editorship of this paper Prof. Dunbar returned for a brief space to fill a breach at a time of crisis in 1884.

Having taken to the profession of teaching after engaging in practical affairs and feeling the excitements of politics, it is somewhat remarkable that Prof. Dunbar's interests after his appointment at Harvard should have been "academic" to so exclusive an extent. He studiously avoided making contributions to magazines upon the economic aspects of current events, and appears to have held that it was the main duty of the economist to trace the leading trends of social forces rather than to spend his energies in directing minor circumstances. Prof. Dunbar's best known work was done upon the subject of banking, and we are told by Prof. Taussig in his introduction to this collection of his late colleague's economic essays that he had meditated a comprehensive treatise relating to America upon the wider subject of which banking is a part, namely, financial history. Prof. Dunbar's little "History of Banking" is read to-day by all students of economics of this country and the United States at least.

The collection of essays before us contains a good deal of material that was not easily accessible previously, and some matter that is now published for the first time, upon the range of subjects which Dunbar made peculiarly his own. Eight out of the twenty essays included deal specifically with banking, and some of them are valuable contributions to our knowledge of the history of banking—for instance, the two dealing with early banking schemes in England and the Bank of Venice. Eight more essays are concerned more particularly with finance, for example, analyses of certain crises, the examination of the direct tax of 1861, and the discussion of the precedents followed by Alexander Hamilton. The remaining four essays arose out of the author's other chief interest, namely, the literature of classical economics; they are entitled "Economic Science in America, 1776–1876," "The Reaction in Political Economy" (written in 1886), "The Academic Study of Political Economy," and "Ricardo's Use of Facts." Certain of these essays were executed so long ago as almost to have become themselves a part of the old literature of classical economics; but, taken as a whole, they will prove enlightening even to economists who have benefited from the analysis effected and researches carried out since Prof. Dunbar's discussions appeared, for without exception the essays collected in this volume are thorough, scholarly, well pondered, and finely proportioned. Prof. Sprague's work of editorship appears to have been done admirably. All students of economics will be grateful to him for having made a collection of Prof. Dunbar's scattered writings and brought to the press the work which he left behind in manuscript.

## OUR BOOK SHELF.

*Beiträge zur Physik der freien Atmosphäre.* Edited, with the cooperation of a number of distinguished meteorologists, by R. Assmann (Berlin) and H. Hergesell (Strassburg). Vol. i. Part i. (Strassburg: Trübner, 1904.)

ON receiving the first number of a new periodical, the question of the need and room for such a publication first rises to one's thoughts. It must be admitted that it is not easy to see the necessity for a magazine so highly specialised as the one before us. That the investigation of the upper atmosphere is a separate branch of study in itself is very questionable; and there are already the *Meteorologische Zeitschrift*, the *Veröffentlichungen der internationalen Kommission für wissenschaftliche Luftschiffahrt*, and the *Illustrierte Aëronautische Mitteilungen*, all suitable for the discussion of such investigations.

The subject-matter of this first number of the *Beiträge* is exceedingly interesting, and of no little importance. It contains three articles, each by a high authority on the subject dealt with.

The first, by Prof. Hergesell, is devoted to proving that kites can be raised to great heights quite independently of the weather conditions where a large expanse of water and a high-speed motor-boat are at the disposal of the observer, this being the same result as that arrived at by Rotch and by Dines. The more immediate object of the present article is to urge the possibility and necessity of founding an observatory on Lake Constance specially devoted to the investigation of the upper atmosphere.

In the second article Prof. Assmann describes "a year's simultaneous kite ascents in Berlin and Hamburg," with special reference to the existence of a warm current of air flowing almost constantly between 500 metres and 1000 metres above the surface. That such a current should exist is very interesting, and further observations as to its extent, strength, and permanency are very much to be desired.

The remaining article treats of the methods employed by Dr. A. de Quervain in determining the paths traversed by balloons sent up with registering instruments only. The methods described can only be employed so long as the balloon remains within the range of vision of a telescope; they are really trigonometrical. The first is the simple method of two theodolites at the ends of a base line, and the second similar, with the exception that only one theodolite is used, the heights of the balloon at the moments of observing with the theodolite being obtained later from the curve drawn by the barograph carried with the balloon.

Articles for future numbers, which are to be published as may be found convenient, are promised by Prof. Sprung, Prof. Wiechert, Dr. J. Maurer, and Dr. A. de Quervain. G. C. S.

*The Inventor's Guide to Patent Law and the New Practice.* By James Roberts, M.A., LL.B. Pp. viii+109. (London: John Murray, 1905.) Price 2*s.* 6*d.* net.

THIS is a well written handbook on British patent law and practice in which the inventor will find information of use to him. The new practice referred to in the title is the search by officials of the Patent Office for anticipations within the fifty years prior to an application, and the possible enforced statement as to these which the patentee may have imposed upon his own specification.

While the information derived from a search by officials of the Patent Office may be of the greatest use to a patentee, there is considerable doubt as to the advantage either to the patentee or to the community of allowing what may in reality be a specification of a valuable invention to be marred by an official statement as to certain prior specifications. There is a fear that an official with insufficient experience of practice either in works or in the Chancery Court may attach too great importance to what are known as paper anticipations, and by insisting on referring to them prevent a patent which otherwise might have been the basis of a successful manufacturing process, and be good enough to stand attack in the courts, from being even looked at by any manufacturer. However this may be, it is impossible to cast any doubt upon the Patent Office without paying a tribute to the great courtesy with which the humblest stranger who goes there is met, and the help that he is sure to receive short of professional advice. The library, too, and its arrangement is an admirable feature.

References to large standard works on patent law are very numerous, and will be of great service to the reader who desires more detailed information on difficult points than can possibly be given in a moderate compass. B.

*A Manual of Mining.* By M. C. Ihlseng and E. B. Wilson. Fourth edition. Pp. xvi+723. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1905.) Price 21*s.* net.

BASED on the course of lectures delivered at the School of Mines of Colorado, Prof. Ihlseng's book, which is regarded in America as the best text-book on the subject, has been enlarged under the joint authorship of Mr. Wilson to include coal mining, which received scant attention in previous editions. Excepting that ore dressing and coal washing are not touched upon, it now covers much the same ground as Sir C. Le Neve Foster's "Elements of Mining and Quarrying." The arrangement is, however, altogether different. The book is divided into two parts, mining engineering and practical mining. The former deals with prospecting, preparatory work, methods of mining, power generation, hoisting machinery, electric generation and water power, hoisting machinery and underground conveyances, underground haulage systems, wire rope transmission, the compression of air, pumping, mine gases, ventilation, distribution of air, the illumination of mines, and accidents in mines.

The second part deals with shafts, sinking in running ground, timbering, driving drifts, tunnels and gangways, drilling and boring machines for explorations, miners' tools, channelers, drills and coal-cutters, and blasting. It is difficult to see the object of this division into mining engineering and practical mining. In this country it is not usual to draw a sharp distinction between theory and practice in engineering work. Moreover, the order of the chapters in each section does not appear to be so logical as that followed in English and Continental text-books. Thus on p. 30 the steam shovel is described, but it is not until p. 621 that we come to a description of the ordinary pick and shovel. On p. 47 the blasting of coal is dealt with, but it is not until p. 685 that the operation is described and the theory of blasting explained. The book contains much useful information, but the lack of method in the arrangement cannot fail to militate against its use as a text-book. The illustrations, many of which are excellent, are largely borrowed from makers' catalogues, and are not nearly so useful for educational purposes as rough sketches specially drawn would be.

The frequent misprints in figures in the index and in the references should have been carefully guarded against in a book intended for students. Several

names also are incorrectly printed, and the references given at the end of the chapter on mine illumination mostly refer to ventilation. On p. 681 the student is taught to load a hole "with nitroglycerine by pouring from a tin cup upon the fuse with its cap and covering the mass with water." Evidently the Coal Mines Regulation Act has no analogue in a country where, as the authors point out, "each new camp, untrammelled by tradition to keep it in the rut of prejudice, displays its genius for organisation and absorbs the latest devices, tried and true."

*The Practical Photographer.* (Library Series.) Edited by Rev. F. C. Lambert. No. 16, *Pictorial Composition.* Pp. xx+64. No. 17, *Animal Photography.* Pp. xxiv+64. (London: Hodder and Stoughton, 1905.) Price 1s. net.

In the first of these books the editor gives an interesting account of the pictorial work of Bernard Alfieri, illustrating it with six excellent reproductions of this well-known worker's studies. Among the other sections of the book, which are written by various authors, those on the principles of composition, by Arthur Burchett, and some notes on composition in landscape, by Horace Mummery, will be found of great practical value. In these the pen and ink sketches showing the several methods of producing balance in pictures call for special attention. Other articles, such as that on the arrangement of the foreground, are well worth perusing. Numerous well reproduced illustrations, serving as examples of good and bad composition, accompany the text. The second of the above books appeals to another class of photographers, for, with the exception of the editor's article on the pictorial work of Viscount Maitland, it is devoted to the photography of animals. Like the former book, numerous authors have contributed to the text, and a very wide range of points of view is included. It is written on the same practical lines, and is accompanied by fifty-five well selected illustrations. Both volumes will add to the value of this useful library series.

*Determination des Espèces minérales.* By L. M. Granderye. Pp. 184. (Paris: Gauthier-Villars, n.d.) Price 2.50 francs.

In this little book, which is a publication of the "Encyclopédie scientifique des Aide-Mémoire," the author has apparently attempted to devise a royal road for the determination of a mineral species. For this purpose he has compiled a number of lists of the more common minerals arranged according to physical characters, viz. crystal-system, colour, structure, density, &c., and has supplemented these with some instructions on blowpipe analysis and chemical examination in the dry way. Such lists are certainly of great value for determination purposes, but, as regards the more common minerals, at any rate, it would be a mistake to encourage the student to rely upon any methodical scheme of determination to the neglect of an acquisition of a thorough knowledge of the characters of the individual species. For many minerals, especially with imperfectly crystallised specimens, we fear these tables would prove an uncertain guide in the absence of any observations of the optical characters or of chemical examination in the wet way. In Brush and Penfield's standard work on determinative mineralogy it is true that no account is taken of the optical characters, but sufficient importance is given to chemical tests in the wet way. The tables are not altogether free from errors and misprints; thus a saline taste is attributed to sodalite, rhodonite is described as a carbonate, and the density of wolframite is given as 5·5 on one page and 7·5 on another. The book concludes with a list of 600 minerals with their principal characters, viz. density, hardness, &c.

## 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.*]

### The Dynamical Theory of Gases and of Radiation.

I AM glad to have elicited the very clear statement of his view which Mr. Jeans gives in NATURE of April 27. In general outline it corresponds pretty closely with that expressed by O. Reynolds in a British Association discussion at Aberdeen (NATURE, vol. xxxii. p. 534, 1885). The various modes of molecular motion are divided into two sharply separated groups. Within one group including the translatory modes, equipartition of energy is supposed to establish itself within a small fraction of a second; but between the modes of this group and those of vibration included in the other group, equipartition may require, Mr. Jeans thinks, millions of years. Even if minutes were substituted for years, we must admit, I think, that the law of equipartition is reconciled with all that is absolutely proved by our experiments upon specific heat, which are, indeed, somewhat rough in all cases, and especially imperfect in so far as they relate to what may happen over long intervals of time.

As I have already suggested, it is when we extend the application of the law of equipartition to the modes of æthereal vibration that the difficulties thicken, and this extension we are bound to make. The first question is as to the consequences of the law, considered to be applicable, after which, if necessary, we may inquire whether any of these consequences can be evaded by supposing the equipartition to require a long time for its complete establishment. As regards the first question, two things are at once evident. The energy in any particular mode must be proportional to $\theta$, the absolute temperature. And the number of modes corresponding to any finite space occupied by the radiation, is infinite. Although this is enough to show that the law of equipartition cannot apply in its integrity, it will be of interest to follow out its consequences a little further. Some of them were discussed in a former paper,[1] the argument of which will now be repeated with an extension designed to determine the coefficient as well as the law of radiation.

As an introduction, we consider the motion of a stretched string of length $l$, vibrating transversely in one plane. If $a$ be the velocity of propagation, $\xi$ the number of subdivisions in any mode of vibration, the frequency $f$ is given by

$$f = a\xi/2l \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

A passage from any mode to the next in order involves a change of unity in the value of $\xi$, or of $2lf/a$. Hence if $e$ denote the kinetic energy of a single mode, the law of equipartition requires that the kinetic energy corresponding to the interval $df$ shall be

$$2le/a.df \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

In terms of $\lambda$ the wave-length, (2) becomes

$$2le/\lambda^2.d\lambda \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

This is for the whole length of the string. The longitudinal *density* of the kinetic energy is accordingly

$$2e/\lambda^2.d\lambda \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

In each mode the potential energy is (on the average) equal to the kinetic, so that if we wish to reckon the whole energy, (4) must be doubled. Another doubling ensues when we abandon the restriction to one plane of vibration; and finally for the total energy corresponding to the interval from $\lambda$ to $\lambda+d\lambda$ we have

$$8e/\lambda^2.d\lambda \quad . \quad . \quad . \quad . \quad . \quad . \quad (5)$$

When we proceed to three dimensions, and consider the vibrations within a cube of side $l$, subdivisions may occur in three directions. In place of (1)

$$f = a/2l.\sqrt{(\xi^2+\eta^2+\zeta^2)} \quad . \quad . \quad . \quad . \quad (6)$$

where $\xi$, $\eta$, $\zeta$ may assume any integral values. The next step is to ascertain what is the number of modes which corresponds to an assigned variation of $f$.

If the integral values of $\xi$, $\eta$, $\zeta$ be regarded as the

[1] "Remarks upon the Law of Complete Radiation," *Phil. Mag.*, xlix. p. 539 June, 1900.

coordinates of a point, the whole system of points constitutes a cubic array of volume-density unity. If R be the distance of any point from the origin,

$$R^2=\xi^2+\eta^2+\zeta^2;$$

and the number of points between R and R+$dR$, equal to the included volume, is

$$4\pi R^2 dR.$$

Hence the number of modes corresponding to $df$ is

$$4\pi(2l/a)^3 f^2 df,$$

or in terms of $\lambda$

$$4\pi.8l^3.\lambda^{-4}d\lambda \quad . \quad . \quad . \quad . \quad . \quad . \quad (7)$$

If $e$ be the kinetic energy in each mode, then the kinetic energy corresponding to $d\lambda$ and to unit of volume is

$$32\pi e\lambda^{-4}d\lambda \quad . \quad . \quad . \quad . \quad . \quad . \quad (8)$$

Since, as in the case of the string, we are dealing with transverse vibrations, and since the whole energy is the double of the kinetic energy, we have finally

$$128.\pi.e.\lambda^{-4}d\lambda \quad . \quad . \quad . \quad . \quad . \quad . \quad (9)$$

as the total energy of radiation per unit of volume corresponding to the interval from $\lambda$ to $\lambda+d\lambda$, and in (9) $e$ is proportional to the absolute temperature $\theta$.

Apart from the numerical coefficient, this is the formula which I gave in the paper referred to as probably representing the truth when $\lambda$ is large, in place of the quite different form then generally accepted. The suggestion was soon confirmed by Rubens and Kurlbaum, and a little later Planck (*Drude Ann.*, vol. iv. p. 553, 1901) put forward his theoretical formula, which seems to agree very well with the experimental facts. This contains two constants, $h$ and $k$, besides $c$, the velocity of light. In terms of $\lambda$ it is

$$E\,d\lambda=\frac{8\pi ch}{\lambda^5}\frac{d\lambda}{e^{ch/k\lambda\theta}-1} \quad . \quad . \quad . \quad (10)$$

reducing when $\lambda$ is great to

$$E\,d\lambda=8\pi k\theta\lambda^{-4}d\lambda \quad . \quad . \quad . \quad . \quad . \quad (11)$$

in agreement with (9). $E\,d\lambda$ here denotes the volume-density of the energy of radiation corresponding to $d\lambda$.

A very remarkable feature in Planck's work is the connection which he finds between radiation and molecular constants. If N be the number of gaseous molecules in a cubic centimetre at 0° C. and under a pressure of one atmosphere,

$$k=\frac{1{\cdot}013\times10^6}{273N} \quad . \quad . \quad . \quad . \quad . \quad . \quad (12)$$

Though I failed to notice it in the earlier paper, it is evident that (9) leads to a similar connection. For $e$, representing the kinetic energy of a single mode at temperature $\theta$, may be identified with one-third of the average kinetic energy of a gaseous molecule at that temperature. In the virial equation, if N be the total number of molecules,

$$\tfrac{2}{3}pv=\Sigma\tfrac{1}{2}mV^2=3Ne,$$

so that

$$e=pv/2N \quad . \quad . \quad . \quad . \quad . \quad . \quad (13)$$

If we apply this to one cubic centimetre of a gas under standard conditions, N has the meaning above specified, $v=1$, and $p=1{\cdot}013\times10^6$ C.G.S. Accordingly, at 0° C.

$$e=1{\cdot}013\times10^6/2N,$$

and at $\theta$°

$$e=\frac{1{\cdot}013\times10^6\times\theta}{2\times273N} \quad . \quad . \quad . \quad (14)$$

Introducing this into (9), we get as the number of ergs per cubic centimetre of radiation

$$\frac{64.\pi.1{\cdot}013.10^6.\theta.d\lambda}{273.N.\lambda^4} \quad . \quad . \quad . \quad (15)$$

$\theta$ being measured in centigrade degrees. This result is eight times as large as that found by Planck. If we retain the estimate of radiation used in his calculations, we should deduce a value of N eight times as great as his, and probably greater than can be accepted.

A critical comparison of the two processes would be of interest, but not having succeeded in following Planck's reasoning I am unable to undertake it. As applying to all wave-lengths, his formula would have the greater value if satisfactorily established. On the other hand, the reasoning which leads to (15) is very simple, and this formula appears to me to be a necessary consequence of the law of equipartition as laid down by Boltzmann and Maxwell. My difficulty is to understand how another process, also based upon Boltzmann's ideas, can lead to a different result.

According to (15), if it were applicable to all wave-lengths, the total energy of radiation at a given temperature would be infinite, and this is an inevitable consequence of applying the law of equipartition to a uniform structureless medium. If we were dealing with elastic solid balls colliding with one another and with the walls of a containing vessel of similar constitution, energy, initially wholly translational, would be slowly converted into vibrational forms of continually higher and higher degrees of subdivision. If the solid were structureless, this process would have no limit; but on an atomic theory a limit might be reached when the subdivisions no longer included more than a single molecule. The energy, originally mechanical, would then have become entirely thermal.

Can we escape from the difficulties, into which we have been led, by appealing to the slowness with which equipartition may establish itself? According to this view, the energy of radiation within an enclosure at given temperature would, indeed, increase without limit, but the rate of increase after a short time would be very slow. If a small aperture is suddenly made, the escaping radiation depends at first upon how long the enclosure has been complete. In this case we lose the advantage formerly available of dividing the modes into two sharply separated groups. Here, on the contrary, we have always to consider vibrations of such wave-lengths as to bear an intermediate character. The kind of radiation escaping from a small perforation must depend upon the size of the perforation.

Again, does the postulated slowness of transformation really obtain? Red light falling upon the blackened face of a thermopile is absorbed, and the instrument rapidly indicates a rise of temperature. Vibrational energy is readily converted into translational energy. Why, then, does the thermopile not itself shine in the dark?

It seems to me that we must admit the failure of the law of equipartition in these extreme cases. If this is so, it is obviously of great importance to ascertain the reason. I have on a former occasion (*Phil. Mag.*, vol. xlix. p. 118, 1900) expressed my dissatisfaction with the way in which great potential energy is dealt with in the general theory leading to the law of equipartition. RAYLEIGH.

May 6.

## The Cleavage of Slates.

IN his critique of Dr. Becker's theory of slaty cleavage in NATURE of May 4, "A. H." says that it is substantially the same as mine, and rightly objects that, "if the cleavage plane were a plane of shearing it would correspond with a circular section of the ellipsoid" of distortion. It is true that I made that suggestion in the body of my first paper on cleavage in the *Geological Magazine*, 1884, but in a postscript to that paper I stated that a conversation with Mr. Harker had led me to the conclusion that the cleavage surfaces are determined by the position of the principal axes of the ellipsoids of distortion produced by a shearing movement, and to this view I have ever since adhered.

"A. H." says that "there are many slates in which the strain ellipsoid is actually presented in deformed spherical concretions or colour-spots." Is this certain? Is it not probable that these discolorations took place after the rock became a slate? In that case the chemical influence emanating from the foreign particle, usually obvious in the centre of the spot, found the greatest conductivity in the direction of the longest axis of the ellipsoid, the next greatest along the mean axis, and very little along the least. It is from this property of little conductivity across the cleavage that slates are eminently suited for roofing. I have a piece of a school slate with two sharply defined oval patches, of each of which the two diameters are 25 mm. and 16 mm. The thickness of the slate is less than 4 mm., and yet the discoloration does not pass through to the other side. If these spots are sections of ellipsoids formed out of spheres by compression, the resulting condensation must have been incredibly enormous. The spots in Borrowdale slates are of a different character from spots of dis-

coloration. They existed in the rock before cleavage was induced. Many of them are broken up like broken egg-shells. Those which are complete lie with their longest axes in the plane of cleavage, and would well agree with the theory that they were deformed along with the enveloping rock by a shearing process, and that the plane of the greatest distortion was the plane of cleavage.

In my paper on cleavage and distortion in the *Geological Magazine* I pointed out that it is to Sir John Herschel that we are indebted for the theory of the "molecular movement," which, I remarked, was in fact a "shear"—a term which has now been universally accepted for this kind of action in rocks; and in my "Physics of the Earth's Crust" I have explained how the crumpling in the harder and cleavage in softer layers of a rock would simultaneously arise from such a shearing movement.

O. FISHER.

Harlton, Cambridge, May 8.

## A Relation between Spring and Summer.

A FAIR idea of the larger fluctuations of a given meteorological element may be had by means of a two-fold smoothing process, *e.g.* adding the series of values in groups of five (1 to 5, 2 to 6, 3 to 7, &c.), and then doing the same with those sums. In each case the sum is put opposite the middle member of the group.

When this is done with (*a*) the amounts of rainfall in spring (March to May) at Greenwich since 1841, and (*b*) the numbers of warm months in summer (same place and period), we have the two curves in the diagram. The

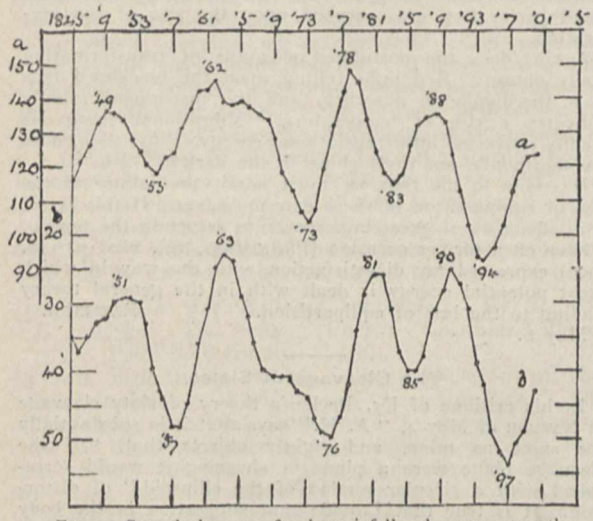


FIG. 1.—Smoothed curves of spring rainfall and summer warmth.

lower one (that for summer) is *inverted*, so that its crests represent *few* warm months, or coolness.

One must be struck, I think, with the similarity of the curves; four long waves (roughly) in each, those of the lower curve lagging in phase somewhat (one to three years) on those of the upper curve. The four *centres of wetness*, as we may call them, of the spring series are followed at a brief interval by four *centres of cold* in the summer series, and the four *centres of dryness* in the former, at much the same interval, by four *centres of warmth* in the latter.

Let us look briefly at the nature of those centres, and we may do so by indicating, first, the character of the group of five springs about each of the dates 1849, 1862, 1878, and 1888 (wave-crests of upper curve), and the corresponding summer groups (wave-crests of lower curve). We find in each group of five springs an excess in the total rainfall, and at least three of the five wet; further, in each summer group a small number of warm months.

| 5 Springs about | Rainfall | Relation to av. | Wet Springs | 5 Summers about | Warm months |
|---|---|---|---|---|---|
| 1849 | 28·5 | +3·8 | 3 | 1851 | 6 out of 15 |
| 1862 | 28·5 | +3·8 | 3 | 1863 | 5 ,, |
| 1878 | 31·2 | +6·5 | 4 | 1881 | 3 ,, |
| 1888 | 27·9 | +3·2 | 3 | 1890 | 3 ,, |

Making a similar comparison of the centres of dryness in spring with the centres of warmth in summer, we have:

| 5 Springs about | Rainfall | Relation to av. | Wet Springs | 5 Summers about | Warm months |
|---|---|---|---|---|---|
| 1855 | 23·9 | −0·8 | 2 | 1857 | 12 out of 15 |
| 1873 | 20·2 | −4·5 | 1 | 1876 | 11 ,, |
| 1883 | 22·3 | −2·4 | 1 | 1885 | 10 ,, |
| 1894 | 15·9 | −8·8 | 0 | 1897 | 12 ,, |

Here the relations are all of an opposite character.

To what are those long waves of variation to be attributed? And can any physical explanation be given of the sequence which has been indicated? Perhaps some of your readers may be able to throw light on these points. I will only remark that there is no obvious connection with the sun-spot cycle. Thus the first two crests in the upper curve come close after maxima (1848 and 1860), while the two latter are near minima (1878 and 1889).

With regard to the point now reached by this curve (*a*), the rainfall of the present spring (already in excess, May 10) should extend it upwards, but it must apparently be near another crest. Some help in forecasting our summers might perhaps be derived from a consideration of the facts above given.

ALEX. B. MACDOWALL.

## Fictitious Problems in Mathematics.

IN NATURE of April 27 (vol. lxxi. p. 603) your reviewer finds fault with Cambridge examiners for endowing bodies with the most inconsistent properties in the matter of perfect roughness and perfect smoothness—"A perfectly rough body placed on a perfectly smooth surface." Your reviewer adds, the average college don forgets that roughness or smoothness are matters which concern *two surfaces*, not *one* body.

Will your reviewer give a reference to some page of Whittaker's book (that under review), or to some page of any other text-book used in the last half-century at Cambridge, in support of his charge against Cambridge examiners? Fifty years ago, William Hopkins was still directing the mathematical teaching of Cambridge, and enforcing the conservation of energy where friction is taken into consideration. A perfectly rough sphere moving on a rough surface is intended to mean that, during the motion considered, the sphere rolls without any slip. "A perfectly rough sphere moving on a smooth surface" would no doubt be equivalent to "A sphere moving on a smooth surface"; but where does the phrase occur?

AN OLD AVERAGE COLLEGE DON.

THE alleged inaccuracies of language in stating the assumed conditions of smoothness or roughness prevailing between two bodies in contact are unfortunately so common that it is the exception rather than the rule to find any problem in which these conditions are correctly worded. In working through a chapter of Besant's "Dynamics" with a class the other day, I came across no less than two problems in which a "perfectly rough" body was supposed to be in contact with a second body which in turn rested against a third "perfectly smooth" body. In these cases the framer of the question carefully avoided giving any information as to the roughness or smoothness of the middle body, so that the inaccuracy of language might easily be overlooked. But this does not apply to the following example:—

"A person is placed at one end of a perfectly rough board which rests on a smooth table. Supposing he walks to the other end of the board, determine how much the board has moved. If he stepped off the board, show how to determine its subsequent motion" (Routh, "Elementary Rigid Dynamics," 1882 edition, p. 69, example 4).

At the time of writing the review I was quite unaware that such an example had found its way into a text-book written by so careful a teacher of applied mathematics as Dr. Routh, and it says much for the prevalence at Cambridge of these erroneous forms of statement that this wording failed to attract the author's attention. Since writing my review, it has been brought to my notice that similar inaccuracies widely prevail in the statement of problems involving so-called "perfectly elastic" or "inelastic bodies."

THE REVIEWER.

## SCIENTIFIC RESULTS OF THE NATIONAL ANTARCTIC EXPEDITION.

THE April number of the *Geographical Journal* contains a series of short papers by members of the *Discovery* Expedition which may be regarded as forming together a kind of "preliminary report" on the work of the expedition in the Antarctic regions. These papers are five in number; Captain Scott deals with the general geography, Mr. Ferrar with physical geography, Lieut. Royds with meteorology, Dr. Wilson with seals and birds, and Mr. Hodgson with the marine biological collections. Captain Colbeck also contributes a paper on the Antarctic sea-ice, discussing the observations made on the *Southern Cross* in 1898–1900 and on the *Morning* in 1902–4.

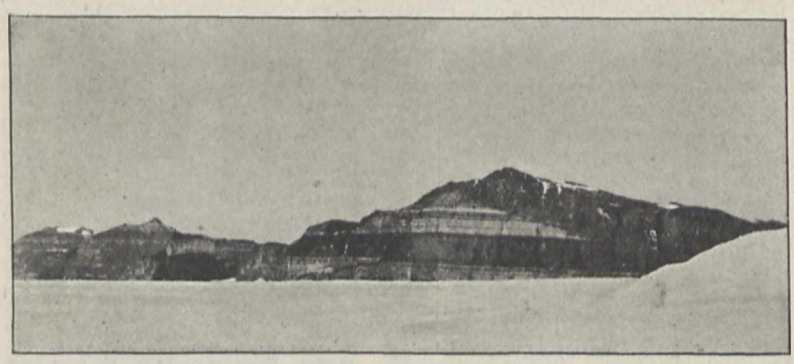

FIG. 1.—Beacon Heights. Sandstone and Basalt.

Without attempting to summarise the contents of each paper, we may try to indicate what are the chief problems which have attracted the attention of the members of the expedition, and what materials they have provided for their discussion. All things considered, perhaps the most important questions concern the remarkable ice conditions observed by Captain Scott and Mr. Ferrar. "There are innumerable glaciers on the coast of Victoria Land," says Captain Scott, "but the great majority merely discharge local *névé* fields lying in the valleys of the coastal ranges. Very few run back to the inland ice, and these may be divided into two classes—the living and the dead. In the long stretch of coast between Cape Adare and Mount Longstaff, over 11° of latitude, there appears to be only four living ice-discharges from the inland." "The Ferrar glacier is typical of the dead glaciers; the ice lies in the valley practically stationary, and gradually wasting away from the summer thawing." "The Ferrar glacier probably contains as much ice as any hitherto known in the world; the Barne and Shackleton glaciers contain a great deal more, and since they are now in such a diminished state it is interesting to think what vast streams of ice they must have been at their maximum." "To what extent the inland ice sheet stood above its present level is also interesting to surmise; one would submit a possibility of 400 or 500 feet."

Again, referring to the Great Barrier, Captain Scott says:—". . . the barrier edge sixty years ago was in advance of its present position, in places as much as 20 or 30 miles."

These facts, along with many others, such as observations by Dr. Wilson and Mr. Ferrar of moraines and erratics high above the level of the ice-sheet, all go to show that "the majority of curious and often vast ice-formations met with in the Ross sea must be regarded, not as the result of present day conditions, but as the rapidly wasting remnants of a former age."

One of the most remarkable observations is that while, as just explained, the ice from Victoria Land does not make any important contribution to the ice-barrier in the Ross Sea, that ice is moving northward at the rate of about 600 yards in a year. Captain Scott believes that the greater portion of the ice-sheet in the Ross Sea is afloat, and that the high coast line of Victoria Land continues southward in a direction towards Graham's Land. Here there is obviously a fruitful source of discussion, but whatever the result, with regard to the distribution of land and sea, it may be taken as proved beyond doubt that the ice in at least this part of the Antarctic regions is in a state of fairly rapid retreat, and it is known that the same thing is happening in the Arctic regions.

Mr. Ferrar's geological observations in Victoria Land have an important bearing on the problem of the outline of the land mass, as well as great intrinsic value. In the Royal Society range a gneissic platform was found, probably of Archæan age, and above it in order are granites, sandstone, and basalt. The granites are, according to Mr. Ferrar, of two ages; the sandstone is 2000 feet thick, while the basalt caps the sandstone, forming plateaux which have been dissected by denudation, and probably also broken up by faulting. At the base of the basalt a thin carbon-

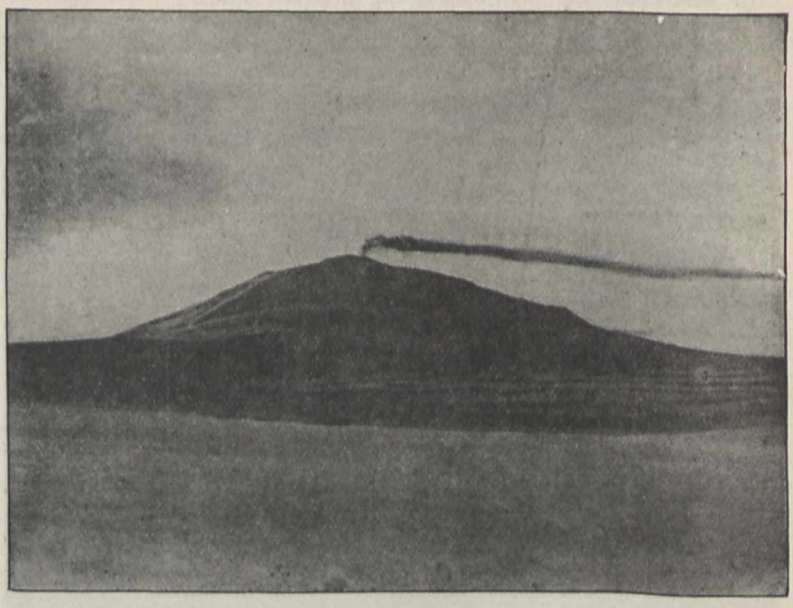

FIG. 2.—Mount Erebus with smoke.

aceous seam, not more than one-eighth of an inch in thickness, was found. This seam yielded carbonaceous matter which it is agreed must be due to vegetation, but the plant remains are unfortunately beyond identification.

With regard to questions of climate, it is more necessary to await the full discussion of the observations, but a number of interesting points have already cropped up. The smoke from Mount Erebus blew almost persistently to the east, but every record of the Ross Expedition describes it as going to the west. At the *Discovery's* winter quarters the prevailing winds were south-easterly; the observers are strongly of opinion that this is a local phenomenon. Captain Scott's general conclusions are to the effect that the prevailing direction of the surface winds is west-by-south throughout the winter, and more southerly during summer; and that there is no snowfall except in the summer and on the rare occasions when the wind blows almost due south. These snow-bearing winds were warm, rising to a temperature of 10° C. to 15° C. even in the depth of winter. Their occurrence seems somewhat difficult of explanation, but they obviously have a very important bearing on the relation of temperature and quantity of moisture in causing glacial periods, and modifying their intensity.

In describing the distribution of Antarctic seals, Dr. Wilson records that the Weddell seal was the one most often met with near the land. The expedition made an addition to the list which Dr. Wilson thinks "will prove to be a wanderer from the Southern Ocean islands, representing the now rare sea-elephant of the M'Quaries." Dr. Wilson thinks little of the prospects of the Antarctic seal-fishery, notwithstanding the increased demand for skins of hair-seals, the chief reason being that few skins escape the unsightly scars inflicted by the killer whale. The expedition collected much valuable material with regard to doubtful species of birds, especially cases like the emperor and king penguins and the white-winged and royal albatrosses, where in the adults it is hard to find specific differences, although the chicks are quite distinct.

FIG. 4.—Emperor Penguin Rookery.

FIG. 3.—Pinnacled ice floating in McMurdo Bay.

Perhaps the most significant point in Mr. Hodgson's report is that, contrary to expectation, it was found that outdoor biological work could be carried on all the year round, "and that even with comfort." As a result, a continuous daily routine left no time for examining the material collected. Everything goes to show that animal life is very abundant in the southern seas, and a predominant feature is the enormous quantity of sponges. One organism, regarded as a Nemertine, though suspected to be something else, appeared when it arrived frozen at the ship to be "close on 20 feet long, of a light brown colour, and about the diameter of an ordinary boot-lace."

In summarising the observations on the sea ice, Captain Colbeck has "no hesitation in saying that the pack should be entered between long. 178° and 180° E., as early in December as possible."

## *THE STATE AND HIGHER EDUCATION.*

MR. CHAMBERLAIN, in moving a vote of thanks to the Lord Chancellor—who as Warden of the University of Birmingham gave an address in Birmingham on May 13—delivered a speech emphasising the importance to the nation of higher scientific education. During his remarks Mr. Chamberlain directed attention to the fact that the University of

Birmingham is indebted to the local authority for an income of 6000*l.* a year, and referred regretfully to the circumstance that the neighbouring local authorities have not contributed very largely to the funds of the university. It must be admitted that the contribution of the city of Birmingham to its university is a handsome tribute to the value attached by the local authority to university instruction, and we join with the Chancellor of the university in hoping that suitable sums of money will be devoted in the near future by local authorities in adjoining areas to the purposes of higher education in the Midlands.

It is, however, to be regretted that Mr. Chamberlain made no reference on this occasion to the important principle—a principle he has conceded already more than once—that higher education, especially in science, is primarily a national charge. As was pointed out in the issue of NATURE for March 16, the present State grant to the University of Birmingham is 4500*l.*, an amount which compares unfavourably with the sum voted by the local city authority. Presiding at the annual meeting of the court of governors of the university on February 6 of this year, Mr. Chamberlain remarked:—

"I may say in passing that the liberality of the local contribution is a ground for the claim which we make for some further State support. It is something that we have found that the Government are becoming alive to our needs and to our deserts, and that they have been able to double the sum previously given for university education. But we may bear in mind at the same time that the present Chancellor of the Exchequer has promised to double it again in his next Budget, and, therefore, I anticipate that from that source we shall receive a very considerable addition. I do not at all accept it as in any way a satisfaction of our demands, because it is my conviction that public opinion will soon insist upon larger sums being devoted to this purpose. When I think that we are spending thirteen millions a year at least on primary education I say the sum now given for the purpose of the highest education, the most profitable of all the investments we can make in that direction, is altogether inadequate."

If it were necessary many similar quotations could be made from Mr. Chamberlain's speeches, for he has always maintained enthusiastically the value of higher education, and recognised, at least in theory, the duty of the State to provide for it adequate financial assistance. It is noteworthy, indeed, that on the part of our leading statesmen there is an almost complete unanimity of opinion as to the paramount importance of higher scientific training for the citizens of a nation which expects to occupy a foremost place in the industrial and commercial pursuits of the world. The Lord Chancellor said in speaking to the undergraduates at Birmingham on Saturday last, that in his judicial capacity he has noticed that "the number of patents invented in Germany and brought over to England is very large indeed; the German Government has contemplated the improvement of its national resources by physical, chemical, and other scientific research, and has established places for physical investigation." Lord Halsbury might also have pointed out the amount of State aid to universities afforded in Germany. The yearly sum, found chiefly by the State, for the upkeep of the University of Berlin is 130,000*l.*, and six other universities each receive from the same source annual sums varying from 56,000*l.* to 37,000*l.*

It will be remembered that Sir Norman Lockyer said in his address in 1903, as president of the British Association, that the State does really concede the principle that higher education should be a national responsibility, by its contribution to our universities and colleges. Since that address was delivered the grant to university colleges has been increased, and it may now be said that the Treasury provides for higher education of the whole country something like the amount that is given by the State to the University of Berlin alone.

But in face of the fact that we have the concession by the Government of the principle we have maintained consistently in these columns, that university education, of the modern kind at least, should be provided by the State; and that our statesmen profess to appreciate the value of higher scientific study so far as our national welfare is concerned, and to trace to their colleges and laboratories for research the success of other nations competing with us in the struggle for national existence; no serious and statesmanlike action is taken by our Government to place our system of higher education upon a broad and generous foundation. Despite years of earnest advocacy by men of science, and repeated object lessons abroad of the advantages which early follow national sacrifices on behalf of education, little progress is made by us in the direction of supplying means to provide trained intelligences to perform the work of the country in the world's markets and manufactories. Yet, unless something in the direction adumbrated is done, knowing the earnest work which is being accomplished elsewhere, this country must, so far as industrial and economic prosperity are concerned, expect soon to take a third or fourth place in the competition of the nations.

A statesman imbued with the modern spirit, aware of present-day tendencies, possessed of the power of persuasion and clear exposition, would have little difficulty—if he really desired the best interests of the nation—in carrying the country with him by insisting that an adequate provision of higher education for those who will manage and control its industrial activities must be made a national charge.

## *MEETING OF THE BRITISH ASSOCIATION IN SOUTH AFRICA.*

THE seventy-fifth meeting of the British Association, to be held in South Africa, under the presidency of Prof. G. H. Darwin, in August, promises to be of an unusually interesting character. Though on two previous occasions the association has met in the "British Dominions beyond the Seas," this is the first on which it will hold its annual meeting in the southern hemisphere and in a part of the British Empire so remote from its headquarters.

As early as the year 1900, the possibility of holding such a meeting was discussed by the council of the British Association in consultation with Sir David Gill, who, however, pointed out that the local circumstances were at that time unfavourable. Two years later, however, Sir David Gill informed the association that he was empowered to transmit an invitation to visit South Africa in 1905 on behalf of the various Governments, municipal, scientific, and commercial bodies in South Africa. Arrangements have now so far advanced as to enable us to give a preliminary account of the general features of the meeting and its probable character.

The invitation was issued on behalf of the above-mentioned bodies, and substantial financial assistance has been rendered by the South African Governments. The various centres to be visited are also making extensive progress, both financially and by way of private hospitality, to render the arrangements workable and adequate.

A central organising committee, under the chairmanship of Sir David Gill, has been formed to see to the general arrangements and coordination of the

work of the different centres to be visited by the association, and by means of correspondence, circulars, &c., to keep them in touch with each other and with the executive in England.

The centres, which are seven in number, are as follows :—Cape Town, Durban, Pietermaritzburg, Johannesburg, Bloemfontein, Kimberley, and Bulawayo. Influential local committees have been formed at all these places, the municipal authorities of which have taken a prominent part both in making general arrangements and in affording financial support. Subcommittees for finance, publications, excursions, and hospitality have been formed at the two chief centres (Cape Town and Johannesburg), and are now engaged in the respective parts of the work allotted to them. At the other centres where a stay of only a day or two is contemplated, special committees have also been formed. Details are as yet uncertain, but the following may be mentioned, though some of them are subject to slight revision.

The officers of the association and invited guests to the number of 200, along with ordinary members, will arrive by the *Saxon* at Cape Town on August 15, though a number have already booked their passage by steamers arriving at an earlier date. The presidential address will be delivered on the evening of the same day in the large new Town Hall, which has been placed at the disposal of the British Association by the municipal authorities of Cape Town, not only for this purpose, but also for the accommodation of the various sections should it prove suitable.

The sections will meet for the purpose of reading papers and for discussion on Wednesday, Thursday, and Friday, August 16, 17, and 18. The afternoons of these days will be partly devoted to excursions to places of interest, such as Table Mountain, Hout Bay, Simons Town, and Royal Observatory. The whole of Saturday, August 19, will be devoted to excursions.

The evenings will probably be devoted to a reception by the Mayor, and two lectures, one by Prof. Poulton on Burchell's work in South Africa, and another by Mr. C. V. Boys on physics.

On Saturday night, August 19, visitors will leave by a special steamer for Durban. In Natal an influential general committee has been formed by the Government, with local committees at Durban, Pietermaritzburg, and Ladysmith. On the evening of August 20 a lecture will be delivered at Durban and another on August 24 at Pietermaritzburg. As the reading of papers, discussions, receptions, &c., in Cape Colony will fully occupy all the time of the visitors, it is intended to afford as much facility as possible for independent action on the part of visitors in Natal, and special arrangements will be made by the Natal committee for visiting the battlefields and other places of interest.

The sectional work will be again resumed on arrival of the party at Johannesburg on Monday, August 28. There, as at Cape Town, a large and influential local committee has been formed, with subcommittees for finance, hospitality, publication, and excursions. The first-named subcommittee has already met with a ready response, both from the municipal authorities and from private sources, and the other committees are in capable hands. While the natural facilities for excursions to be found near the Cape peninsula are not to be met with here, the interest of the mining operations and gold extracting processes will be an adequate compensation, and a Friday's visit to Pretoria will be of special interest.

The proceedings will be begun at Johannesburg on Monday evening, August 28, and the presidential address there will be delivered on the Wednesday evening. In addition to sectional papers and discussions, there will be two lectures delivered at Johannesburg, one on distribution of power by Prof. Ayrton, another on steel as an igneous rock by Prof. Arnold, and one at Pretoria by Prof. Porter on mining.

Bloemfontein will be visited on Saturday, September 2. There also an influential local committee has been formed, and preparations are being made for the reception of visitors. A lecture will be delivered there on the Saturday night by Mr. A. R. Hinks on an astronomical subject.

At Kimberley, which will be reached on Tuesday, September 5, a large local committee has been formed, with subcommittees for special objects. Two lectures will probably be delivered here, one on a zoological subject by Mr. A. E. Shipley, and one on diamonds by Sir William Crookes. The De Beers Company has naturally taken a prominent part in the preparations, and will probably make this visit one of the most interesting.

Through the kindness of the Chartered Company a limited number of members of the British Association will be enabled to proceed from there to the Zambezi, where the Victoria Falls will be visited, and facilities will be afforded for the visit of a select party of specialists to the ancient ruins of Zimbabwe. A special committee at Bulawayo has been formed to make preparations there for the visit.

Special attention will be directed to certain interesting problems connected with the geological formation at the Victoria Falls, and Mr. G. W. Lamplugh, who will go out in advance to study this subject, will probably be able to give the results of his observations in an afternoon address to Section C.

Though this meeting of the association will be characterised by the number and variety of the places visited, a special feature will be the study of local scientific problems and discussions of a general nature such as fossil reptiles, Antarctica, &c. With this in view the South African Association for the Advancement of Science, with the support of the various Governments, is preparing a handbook, which will be a general review of the various branches of scientific activity in South Africa, the articles being contributed by actual workers in these subjects in the country. The book is now in an advanced stage of preparation, and a copy will be presented to each member of the association before leaving England.

## *SIR BERNHARD SAMUELSON, P.C., BART., F.R.S.*

SIR BERNHARD SAMUELSON, F.R.S., who died on May 10 in his eighty-fifth year, will be remembered as one of the pioneers of the Cleveland iron trade, and a strenuous advocate of technical education. He exerted a great and formative influence upon an industry which owes its progress largely to the application of scientific methods, and the extension of facilities for technical education is largely due to his efforts.

Sir Bernhard Samuelson was born on November 22, 1820, and began in 1853 the business which speedily made the Cleveland district the greatest iron-producing centre in the world. Blast furnaces were erected near Middlesbrough, and in 1872–1880 collieries and ironstone mines were added. Not content with making pig-iron, the manufacture of finished iron was undertaken on an extensive scale, and no less than 25,000*l.* were spent in preliminary experiments in steel-making. The Britannia Ironworks at Middlesbrough, covering an area of twenty acres, have grown out of this enterprise.

He was the author of several reports on technical subjects to the House of Commons, including one on technical education of artisans at home and abroad.

This report was undertaken by Sir Bernhard Samuelson in 1867 at the request of the vice-president of the Committee of Council, and for the purpose of obtaining particulars he visited the principal manufacturing centres of Great Britain and the Continent. The report was published as a Parliamentary paper, and the *Times* records that it was for years referred to in all debates on technical education. He followed up this report by a Parliamentary inquiry into the education of the workmen of our manufactories in 1868, and was chairman of the committee, the report of which was adopted by the House of Commons. He was a member of the Duke of Devonshire's Royal Commission on Scientific Instruction, which issued a valuable report, and also of the Royal Commission on Elementary Education, presided over by Viscount Cross.

Sir Bernhard Samuelson was appointed chairman of the Royal Commission on Technical Instruction, the labours of which extended over the years 1882, 1883, and 1884, and embraced an examination into the systems in use in all parts of the United Kingdom and a great portion of the Continent of Europe. The exhaustive report of the Commission has become the standard authority upon the questions with which it deals. In 1888 he was appointed a member of the Parliamentary Committee for inquiring into the working of the Education Acts.

For his scientific work, Sir Bernhard Samuelson was elected a Fellow of the Royal Society in 1881, and for his many public services he was created a baronet in 1884, and was afterwards made a Privy Councillor. He was a member of the Institutions of Civil and Mechanical Engineers, and was the recipient, in 1871, of the Telford gold medal for a paper on improvements in iron manufactures. He was a member of the council of the Iron and Steel Institute, of which he occupied the presidential chair for two years. At the annual meeting of the institute held last week, the following resolution was unanimously adopted:—"The council have received with the deepest regret the intimation of the death of their esteemed colleague the Right Hon. Sir Bernhard Samuelson, Bart., past-president, P.C., and one of the founders of the institute, and they desire to convey to Lady Samuelson and his family an expression of sincere sympathy in their bereavement. The council feel that it would be difficult to over-rate the services that Sir Bernhard rendered to the Iron and Steel Institute in the promotion of the objects for which it was formed, and they will ever remember with gratitude his constant readiness to devote his time and energies to the advancement of those objects."

## *DR. OTTO VON STRUVE.*

THE announcement of the death of Dr. Otto von Struve does more than awaken a profound regret. His name recalls a period of past history, and summons up before us the memory of times when astronomy occupied a different position from that it assumes to-day, when it had fewer objects of interest wherewith to attract, and offered fewer problems for solution. Fifty-five years have gone since Otto von Struve received at the hands of the late Astronomer Royal the medal of the Royal Astronomical Society for his paper on precession and solar motion, and sixty-five since the paper was published. Seeing that Struve was born in 1819, he early came into prominence as an astronomer, and the value attached to the results and the confidence inspired by the paper are not a little remarkable, for there were some very obvious objections which might have been taken to the conclusions stated, or at least it appears so when viewed from a later standpoint. Accompanying the paper was also a discussion of the amount and direction of the solar motion. Only four years had elapsed since Argelander had published his paper assigning with some precision the place of the solar apex, and thus perhaps settling a doubt which had long divided astronomical thought. Prevost and Klugel had taken one side of the question, and Burckhardt and Lindenau led the party who were unwilling to accept the evidence. Men's minds were certainly divided as to the possibility of detecting the sun's motion, and Struve's paper came at a fortunate moment and strengthened the evidence produced by Argelander, for, based on very different material, Struve's position scarcely differed two degrees from that assigned by the Abo astronomer. Also, Struve was fairly fortunate in fixing the annual amount of the solar motion at about twice that of the radius of the earth's orbit. Later investigations have shown that a greater velocity is probable, but he was certainly correct in asserting that the linear motion of the sun appeared to be less than that of stars in general.

But it was in the domain of double stars that Otto von Struve won his reputation, and it was in this direction that he exhibited untiring industry. His father at Dorpat, and later at Pulkova, had not only devoted himself with great energy to this branch of astronomy, but had introduced a degree of accuracy into the observations that up to his time had been wanting. Otto von Struve, anxious to uphold the family reputation, was as diligent to detect these objects and as accurate in his observations as was his father before him, though he laboured under some peculiar difficulty as an observer, and was obliged to remove a systematic error which affected his observations by introducing a correction depending upon the distance of the component stars—a correction investigated with great care by means of artificial double stars.

From 1861, on the failing health of his father, Otto von Struve became the director of the Imperial Observatory at Pulkova, and in every department maintained the reputation for accuracy the observatory had won. In meridian places of stars, in cometary observations, in geodesy, in spectroscopy, the activity and efficiency of the institution have been everywhere acknowledged. In expeditions, whether for the transit of Venus or for eclipse work, the observatory has displayed its zeal and its desire to cooperate with similar work carried on elsewhere. Instruments have been renewed as needed, and the erection of the 30-inch refractor testifies to the determination to keep the observatory on a level with those best equipped. Under the care of the late director, splendid laboratories have arisen devoted to spectroscopic inquiries, and it is not too much to say that his direction of a world-famous observatory has been of a most enlightened and beneficent character. The recipient of many honours, he retired from the observatory in 1893 to enjoy the repose to which he was so well entitled amid the society of his many friends.

## *NOTES.*

THE Croonian lecture of the Royal Society will be delivered by Mr. W. B. Hardy, F.R.S., on Thursday next, May 25, on "The Globulins."

BY the creation of the Committee of Defence, the functions and views of which were described by Mr. Balfour in the House of Commons on Thursday last, an expert advisory body has been introduced into the councils of the Government. In the discussion which followed the speech of the Prime Minister, Mr. Haldane remarked that millions of money uselessly expended would have been saved to the

country if such a committee had existed years ago. The idea underlying the formation of the committee is that for the handling of great national problems the Government must have expert assistance on a scale departmental inquiry cannot supply. Mr. Haldane suggested that it would be to the advantage of the nation if the principle of consultative committees were applied to the scientific organisation of the whole of our executive Government. "We shall never get the best service for the State until we cease to assign it merely to departments, until we can find some body to which it can be assigned that will be working under the head of the State himself. The work of the Committee of Defence illustrates the application of a new principle which will be a very familiar one before the country is much older."

THE Jacksonian prize of the Royal College of Surgeons of England has been presented to Mr. Herbert J. Paterson.

THE Elisha Kent Kane medal of the Geographical Society of Philadelphia has been awarded to Prof. William B. Scott, of Princeton University.

THE seventy-seventh annual meeting of the Society of German Naturalists and Physicians will be held this year at Meran on September 24–30.

THE Prince of Wales, as honorary president of the Royal Statistical Society, has consented to attend the opening meeting of the tenth session of the International Statistical Institute, which is to be held this summer in London.

THE Hanbury gold medal of the Pharmaceutical Society has this year been awarded to Prof. Ernst Schmidt, professor of pharmaceutical chemistry to the University of Marburg. This medal is awarded biennially for high excellence in the prosecution or promotion of original research in the chemistry and natural history of drugs, and Prof. Schmidt is the thirteenth man of science to whom the medal has been awarded. He is the first to receive, with the medal, the sum of 50*l*., which is presented to the medallist by Sir Thomas Hanbury, K.C.V.O.

WE have been requested by the council of the Society of Arts to give publicity to the following resolution passed at a meeting held on May 8:—"In view of the feeling which appears to have been aroused amongst some of the proprietors of the London Institution with regard to the proposed amalgamation with the Society of Arts, and the consequent probable difficulties of effecting a harmonious fusion of the two corporations into a single institution, the council of the Society of Arts have decided not to take any further action in the matter, and hereby discharge the committee which, at the instance of the board of managers of the London Institution, they appointed to consider the scheme for amalgamation."

THE programme has been issued of the optical convention to be held at the Northampton Institute, Clerkenwell, E.C., from May 30 to June 3, under the presidency of Dr. R. T. Glazebrook, F.R.S., director of the National Physical Laboratory. The list of papers to be read and discussed includes many of great scientific interest and practical value. Among the subjects and authors we notice:—the spectroscope in astronomy, Mr. H. F. Newall, F.R.S.; spectroscopic optics, Prof. Schuster; polishing of glass surfaces, Lord Rayleigh; parallel plate micrometer, Prof. Poynting; early history of telephotography, Major-General Waterhouse; tri-colour photography, Mr. A. J. Bull; and some directions of progress in optical glass, Mr. W. Rosenhain. The opening ceremony, presidential address, and conversazione will be held on Tuesday, May 30. A special lecture will be given by Prof. S. P. Thompson on "The Polarisation of Light by Nicol Prisms and their Modern Equivalents" on Thursday, June 1.

ON May 20 Dr. J. G. Frazer will deliver at the Royal Institution the first of two lectures on "The Evolution of the Kingship in Early Society," and on Thursday, May 25, Prof. J. A. Fleming will deliver the first of three lectures on "Electromagnetic Waves." These are the Tyndall lectures. On Saturday, June 3, Mr. A. H. Savage Landor will begin a course of two lectures on "Exploration in the Philippines." The Friday evening discourse on May 26 will be delivered by Prof. J. W. Brühl on "The Development of Spectrochemistry," on June 2 by Mr. George Henschel on "Personal Recollections of Johannes Brahms," and on June 9 by Sir William H. White on "Submarine Navigation."

THE *Times* announces the death of Lieut.-Colonel L. H. L. Irby at sixty-nine years of age. Throughout his life Colonel Irby took an intense interest in all branches of natural history, ornithology being his favourite subject. In 1875 he published a work on the "Ornithology of the Straits of Gibraltar" (south-west Andalucia and northern Morocco), a second edition of which appeared in 1894; and in 1887 appeared his "Key List of British Birds," which has proved to be of great utility to all lovers of birds. He was for many years a member of the council of the Zoological Society. He assisted in the formation of the life groups at the British Museum (Natural History), and some of the most remarkable of the cases of British birds there bear his name.

THE deaths are announced of M. Fernet, general honorary inspector of public instruction, and Prof. Victor René Muller, of Le Puy, both physicists.

OF the many valuable instruments bequeathed to the French Physical Society by the late M. Félix Worms de Romilly, the most interesting is the telescope bearing on the glass of its mirror the signature of M. Foucault. An account of this historic instrument is given by M. Cotton in the Bulletin of the French Physical Society (No. 226). The mirror has a diameter of 15·2 cm. and a focal length of 68 cm., giving a numerical aperture of about $f/4{\cdot}5$. The resolving power is 200,000, giving an angular separation of 1″. This is the only instrument constructed by Foucault with such a large aperture, and it is to be placed in the Paris Observatory after being re-silvered and adjusted by M. Cotton.

A BANQUET in aid of the funds of the London School of Tropical Medicine took place at the Hotel Cecil on May 10. Mr. Chamberlain, who presided, in proposing "The London School of Tropical Medicine," said he could not conceive of any subject of scientific research and philanthropic enterprise which was more interesting than tropical diseases, and it was a duty which we owed to the Empire, a duty which had increased in recent years with the continual extension of our territory. He thought we owed first to Sir Patrick Manson the idea of a tropical school. Almost abreast of him, if not before, came the promoters of the Liverpool School. There was room for all in this work, and they congratulated the Liverpool School on the success it had achieved. There was only one thing he envied them, and that was the liberality and energy of their citizens. He wished that in every other institution they could have a man as energetic, as devoted as Sir Alfred Jones. The London School now had accommodation for 40 students, and since its foundation six years ago 503

students had passed through it. They had to thank Sir John Craggs for founding a scholarship and prize, and Mr. Bomanji Petit, a Parsee gentleman, for a contribution of 7000*l*. The committee now asked for the sum of 100,000*l*. for endowment, which amount was a mere drop in the bucket in comparison with the Liverpool subscriptions. The other speakers were Sir P. Manson, Mr. Alfred Lyttelton, M.P., Lord Strathcona, and the Duke of Marlborough, and among the 400 guests were Lord Rothschild, Sir Douglas Powell, Sir T. Barlow, the Hon. Sydney Holland, Sir Alfred Jones, Prof. Blanchard, Prof. Dunstan, the Hon. John Cockburn, Major Ronald Ross, Sir A. W. Rücker, Mr. Jonathan Hutchinson, Sir W. S. Church, and Mr. Watson Cheyne. Subscriptions and donations to the amount of more than 10,000*l*. were received.

THE visit of the French doctors to London last summer was so successful that a return visit of their British *confrères* to Paris was arranged, and the party arrived on May 10. The proceedings commenced with an evening reception at the Sorbonne. M. Ziard, president of the university council, and Dr. Bouchard, Sir William Broadbent, chairman of the London executive committee, Prof. Clifford Allbutt, of Cambridge, and Dr. George Ogilvie, senior physician to the French Hospital, London, exchanged mutually congratulatory speeches. The extensive and beautiful university buildings were thrown open, and were much admired. On Saturday the visitors attended a reception at the Pasteur Institute. Dr. Roux, the director of the establishment, welcomed the visitors in a short speech, in which he recalled the great services rendered to Pasteur by Lister. In the crypt of the institute, the dean of the medical faculty of the University of London, Dr. J. K. Fowler, laid a wreath upon Pasteur's tomb bearing the following inscription:—"A ce grand Pasteur, le bienfaiteur de la race humaine." In the course of his address Dr. Fowler is reported by the Paris correspondent of the *Times* to have said:—"We desire to offer a tribute of our profound admiration for the great Frenchman whose noble life and example will ever be an inspiration to those who, like him, are devoted to the cause of science. The discoveries of Pasteur alone would suffice to give the nineteenth century a preeminent place in the annals of science. Science knows no frontiers; it unites in a common brotherhood all who devote their lives to its service. Those who humbly follow, no matter at how great a distance, in the footsteps of Pasteur help to unite the peoples of the world. We are convinced that the friendship between France and Great Britain will ever continue to increase in cordiality, and that the two nations will work in accord for the advancement of science and will only strive for the attainment of one noble aim, the peace of the world." On Saturday evening a banquet was held under the presidency of Prof. Bouchard, who, after reading a congratulatory telegram from M. Loubet, announced that he had received from the President of the Republic the mission to bestow upon Sir William Broadbent the insignia of the rank of Commander of the Legion of Honour.

A REUTER telegram from Berlin reports that in the course of excavations in the neighbourhood of Breslau 400 graves and 150 prehistoric dwelling places were brought to light. The oldest of the graves contained bones dating from a period previous to the Bronze age, and in another grave near by were found urns showing that they had contained bodies interred five centuries later. The excavators have been able to trace the site of a village of the Bronze age. About a dozen huts are clearly recognisable. A whole collection of spinning and weaving appliances has also been dug up.

PROF. F. A. FOREL, writing from Morges, directs our attention to an earthquake which occurred on April 29 last. The centre of the seismic disturbance appears to have been in the neighbourhood of Martigny, Argentière, and Chamonix, and its intensity at the centre was viii. on the Rossi-Forel scale. The time of the principal shock was April 29, 1h. 45m. Greenwich time. The seismic area was of 250 kilometres radius, and included 200,000 square kilometres, comprising Valais, western, central, and eastern Switzerland, upper Italy, and western France. Further shocks were experienced at Martigny and Chamonix on May 1 at 19h. 22m. and 21h. 53m.; on May 2 the movements were very slight, and on May 6 a shock occurred at 4h. 45m.

REUTER'S Agency is informed that Mr. W. Champ, the leader of the expedition which is being dispatched to Franz Josef Land to rescue the twenty-six American explorers who have been in the Arctic for the past two winters with their ship, the *America*, left England on Saturday for Bergen. He was accompanied to Norway by Dr. Oliver L. Fassig, who has been dispatched by the United States Weather Bureau and the National Geographic Society of Washington to be their representative on the second relief ship, which will be dispatched from Norway to the east coast of Greenland. The main relief expedition, of which Mr. Champ is in command, will leave Tromsö in about a fortnight on board the *Terra Nova*, and will make straight for Cape Flora, Franz Josef Land, where it is expected that records will be found, and probably also some of the explorers who, under Mr. Fiala, the leader of the expedition, have been cut off from all communication with the outside world since July, 1903.

MESSRS. FRIEDLÄNDER AND SON, of Berlin, have sent us a copy of a catalogue of books and pamphlets dealing with the anatomy and physiology of invertebrates.

TO the April issue of our Scandinavian namesake, *Naturen*, Dr. H. Magnus contributes the final instalment of his account of South Polar expeditions.

THE birds of the Isle of Pines (about 60 miles south of Cuba), by Messrs. Bangs and Zappey, and the fifth instalment of Dr. B. M. Davis's studies on the plant-cell, constitute the contents of the April number of the *American Naturalist*.

NO. 3 of the "Cold Spring Harbour Monographs," by Miss Smallwood, is devoted to the Salt-Marsh amphipod *Orchestia palustris*, a species showing more decidedly terrestrial habits than its immediate relatives, and therefore, presumably, a more specialised type.

THE two plates issued in No. 3 of vol. xxv. of *Notes from the Leyden Museum* illustrate papers on molluscs. In the first of these Mr. M. M. Schepman describes a new species of Trochus from the Indian Ocean, and the adult condition of *Bathybembix aeola*, a Japanese form originally described from an immature specimen collected during the voyage of the *Challenger*. In the second Dr. H. F. Nierstrasz reviews the collection of chitons in the Leyden Museum, describing new species.

THE hereditary relations of plants to the diurnal and seasonal periods of their environment form the subject of an instructive article by Dr. R. Semon in *Biologisches Centralblatt* of April 15. In the same issue Dr. Wasmann

continues the account of his researches into the development of slavery among ants. It is interesting to note that the various local races of the widely distributed *Polyergus rufescens* respectively possess different types of slave-ants, which are for the most part subspecies of *Formica fusca*, although in one case the enslaved species is *F. nitidiventris*.

IN connection with the latter part of the preceding paragraph, it may be mentioned that the April number of *Himmel und Erde* (Berlin) contains an illustrated popular account of the "flower-gardens" made by ants in the crowns of trees in Amazonia and Peru, as discovered and described by Mr. E. Ule. These "gardens," or perhaps we might rather say "baskets," are shown in various stages of growth, from the time when the plants are just budding until the long slender leaves of *Streptocalyx angustifolius*, which appears to be the favourite species, are fully developed. All the plants cultivated appear to have very minute seeds, or spores, which seem to be sown by the ants in their nests.

MR. L. M. LAMBE has sent us a copy of a paper by himself from the *Ottawa Naturalist* (vol. xix., part i.) on a large new species of sponge of the genus Esperella from the Pacific coast of Canada. We have also received a pamphlet on the life-history of the pear-midge (*Diplosis pyrivora*), by Mr. W. E. Collinge, published by Cornish Brothers, Ltd., Birmingham, as No. 2 of "Reports on Economic Zoology." It contains good figures of the various stages of the development of this pernicious insect, showing the manner in which it destroys young pears.

AMONG other articles in *Naturwissenschaftliche Wochenschrift* for April 30 is one by Dr. J. Meisenheimer summarising the results of recent investigations with regard to the origin and formation of pearls. Several illustrations indicate the positions in which pearls are usually found in shell-fish, while others show their internal structure, and others, again, the parasites usually constituting the nucleus. The researches of Mr. H. L. Jameson and of Messrs. Herdman and Hornell form the basis of a large portion of the paper.

IT has been repeatedly noticed that when a pair of rooks attempt to build apart from the rest in a tree previously unoccupied, the other members of the colony not unfrequently set to work to destroy the nest. An event of this nature is recorded in the *Craven Herald* of April 28 as having taken place in the churchyard of Christ Church, Skipton. In this instance a pair of rooks had built in a tree overhanging Cross Street, and the female was incubating her eggs. While thus engaged she was attacked by the other rooks, who pecked her to death, throwing the body, together with the broken eggs and the ruined nest, to the ground. The attack was witnessed by many persons.

ACCORDING to Mr. E. E. Green, in the March number of *Spolia Zeylanica*, the elephant-mosquito (*Toxorhynchites immisericors*) differs from Anopheles and many other members of the gnat family in that the larva is carnivorous. This carnivorous habit was suggested by the structure of the head of the larva, and observation showed that these larvæ prey upon one another as well as upon those of other gnats. In fact, but a single survivor was eventually left when a number of larvæ were placed in the same receptacle. In a second article Mr. A. J. Chalmers records the species of Anophelinæ found in Ceylon, while in a third Mr. H. Schoutenden contributes notes on Ceylonese aphides, with descriptions of new forms. Considerable interest attaches to a note by J. Hagenbeck in the same issue on an incubating python which safely brought off a number of young snakes.

IN the *Zeitschrift für wissenschaftliche Zoologie*, vol. lxxix., part i., Mr. O. Schroeder, of Heidelberg, discusses the abdominal sense-organ, or so-called abdominal eye, of the palolo worm (*Eunice viridis*) of Samoa. This organ differs so widely from all definitely known types of eyes that it is difficult to find a basis of comparison. Indeed, whether it is an organ for the perception of light at all is extremely doubtful. The reasons that it has been regarded as such are the presence of nerve-cells, pigment, and a lens; but similar pigment is found in other parts of the creature's body, while the so-called lens would not come under the optician's definition of such an instrument. Pigment and lens-like structures are not unfrequently met with in luminous organs, but the so-called eye of the palolo worm certainly does not come under this category. In no other annelid has a similar organ been detected. The other articles in the same issue include one by Mr. P. Heinemann on the development of the mesoderm and the structure of the tail in the ascidian larva; a second, by Dr. M. Lass, on the histological anatomy of the female dog-flea; and a third, by Mr. A. Rufini, on the existence of an undescribed sheath in the terminal tract of human sensor nerves.

PROF. W. B. BENHAM, writing from the Otago University Museum, Dunedin, comments upon Dr. Alex. Hill's letter in our issue of February 2 on "Can Birds Smell?" Prof. Benham says that several points concerning the structure and habits of the kiwi suggest that its sense of smell is possibly highly developed. The nostrils, instead of being at the base of the beak, are at the extreme tip and on the under surface. The olfactory sacs, with their complex of turbinals, extend so far back as to project into the orbits, the eyes being separated by them instead of by a thin bony interorbital septum. The eyes of the bird are small and inefficient, notwithstanding its nocturnal habits, and observers state that the kiwi seeks its food by its sense of smell or hearing. In searching for food, the bird thrusts its beak into moss, piles of leaves, or into holes in the ground, and assumes an attitude suggestive of trying to obtain evidence of the presence of food either by smell or by listening for the sound of movements made by a worm in its burrow. These statements suggest the probability of a well developed sense of smell by the kiwi, and Prof. Benham hopes to have experiments carried out on the apteryx, oxydromus, and stringops in order to obtain evidence upon the matter.

THE *Century Magazine* for May contains articles by Mr. Brush on the evolution of the arc electric light, by Mr. Holland on the recently discovered white bear of north-western British Columbia, and by Dr. McGee on the Japanese Army medical service. In the last named the organisation is described, particularly the arrangements in force for treating and transporting the large number of wounded from the seat of war, and the sanitary arrangements whereby typhoid and dysentery, the great scourges of armies in the field, are hardly known.

THE April number of the *Bulletin of the Trinidad Botanical Department* contains articles on the phosphoric acid requirement of cacao plants, and on coffee curing for the small settler. The record of the visits paid by the two agricultural instructors to different districts and schools shows that their services are highly appreciated throughout the island.

THE fact is not generally known that species of the cycad Zamia can be artificially multiplied by cuttings. The subject of regeneration in Zamia is treated by Dr. J. M. Coulter and Mr. M. A. Chrysler in the *Botanical Gazette* (December, 1904). As a rule, new growth proceeds from meristematic tissue of the cork, but an instance is mentioned in which a portion consisting only of cortex gave rise to new shoots and root.

THE Department of Agriculture at Nairobi has instituted a series of leaflets which should be most useful to settlers in British East Africa. The first, issued in January, gives the native names in different dialects for the principal crops. A second provides some useful hints for cotton cultivators. Egyptian seed is recommended in preference to Sea Island or upland American, because, so far as experience goes, it has produced heavier crops, and also because it has been less affected by unfavourable conditions of the weather.

WE have received vol. xxvii. of *Aus dem Archiv der deutschen Seewarte*, for the year 1904. This valuable work, like its predecessors, contains some important discussions of meteorological and kindred subjects by well known men of science. One by Dr. W. J. van Bebber, entitled "Barometer and Weather," is of especial interest to meteorologists. He discusses, with reference to Hamburg more particularly, the relations of barometrical conditions to rainfall, temperature, and weather generally for the year, seasons, and months, for a period of twenty-five years. On this subject he brings to bear the special knowledge obtained as chief for many years of the Hamburg weather forecast department.

THE Meteorological Office has issued a circular stating that it will, as before, supply forecasts of weather by telegraph to agriculturists during the coming harvest season, at the cost of telegraphy only. These forecasts are prepared each afternoon from June 1 to September 30, except Sundays; but in view of the suspension of agricultural work on that day the office will, if required, transmit special forecasts on Saturday evening, giving, in very general terms, the prospects of the weather for the ensuing forty-eight hours. In the last published annual report of the office it is stated that many of the recipients of these forecasts keep a record of the weather experienced during the time the forecasts are sent, and return them to the office for the purpose of checking the results. From this comparison it appears that about 50 per cent. of the telegrams were completely successful.

MESSRS. CARL ZEISS, of Jena, have issued a new catalogue (in English) of their photomicrographic outfit for use with ultra-violet light of wave-length 0·275 $\mu$, in addition to several catalogues of new ordinary microscope stands. The whole of the glasses—eye-piece, objective, slips and cover glasses—are of fused quartz, and the source of light is supplied by the current of sparks of a Leyden jar between cadmium electrodes. We notice one correction—dissolving power should be resolving power.

AMSLER'S planimeter is so well known to mathematicians that there is no need to direct their attention to its usefulness. We have, however, just received a small pamphlet by Mr. William Codd (London: E. and F. N. Spon) entitled "Land Area Computation made Easy," the object of which is to show non-mathematical readers how simple is the process of computing areas from maps or plans with this instrument. Mr. Codd has also, we learn, published "land area tables" to facilitate reduction to acres, roods, and perches, thereby saving the tedious calculations which are unnecessary in countries using the metric system.

A SERIES of observations on respiration at high altitudes is described by Prof. Angelo Mosso in the *Atti dei Lincei*, xiv. (1) 6. A special feature of these observations is the effect of carbon dioxide as a remedy for mountain sickness, a property regarding which experiments performed both on human subjects and on monkeys have led to most conclusive results in Prof. Mosso's hands. It is recommended that about 8 per cent. of carbon dioxide should be added to the compressed oxygen carried for use in high balloon ascents, as pure oxygen is not in itself sufficient to remedy the effects of great barometric depressions.

IN the *Transactions of the Institution of Engineers and Shipbuilders in Scotland* (xviii., 5), Mr. John Riekie discusses the various systems of compound locomotive engines, and describes a new form with which he has experimented. In it there are two equal high-pressure cylinders and one low-pressure cylinder of about 1¾ times the volume of the combined pair. It appears to differ from the well known "Webb" compound in that the crank-rods are all connected to a single three-throw crank set at angles of 120°, instead of working on the cranks of the axles of the two different driving pairs. It requires no special starting gear.

THE *Atti* of the Lincei Academy (xiv., 4) contains the announcement of the foundation by the King of Italy of a new international institution of agricultural studies. Among the advantages likely to accrue from the establishment of such an institution, the advancement of our knowledge of the best methods of combating against plant-diseases is specially mentioned. On this latter branch of study an interesting paper occurs in the same number of the *Atti*, by Dr. Vittorio Peglion, on the pathology of *Euonymus japonica*. This shrub, so common in Italian gardens, has been for many years subject to diseases, traceable in the first place to a scale insect, and in the second to a species of Oidium described by Saccardo and Arcangeli under the name of *Oidium evonymi-japonicae*, with which the present paper deals.

FROM a copy of the *Corriere di Catania* received from the Observatory of Catania, we gather some interesting particulars of the sudden eruption of Stromboli which took place about four weeks ago. On April 16, at about 2.9 p.m., a tremendous explosion as of a big cannon was heard, and the whole of the eruptive portion was enveloped in a dense black smoke. A large number of masses about one metre in diameter, and other smaller ones, were projected to a distance of 200 metres, and rolled down the Sciara del Fuoco to the sea, raising clouds of dust in their descent. Four or five minutes later there was a fall of scoriæ, about 5 cm. in diameter, over an area 4 kilometres long and 400 metres broad running E.N.E. of the volcano, in which direction the wind was blowing. A shower of ashes followed, and a quarter of an hour later a slight shower of rain occurred. At the time of the eruption Dr. Schulze was 300 metres to the south of the eruptive cone, where he was wounded in the head and leg by falling stones, fortunately not seriously. According to him, the opening by which this explosion took place is in the centre of the six others; it is known as No. 4. A considerable panic occurred throughout the island, and many of the inhabitants declare that such an eruption has never been witnessed before.

IN the Journal of the Russian Physical and Chemical Society (1904, No. 4) we notice the following papers:—An elaborate sketch and scientific analysis of the work, in organic chemistry, of Prof. Egor Egorovitch Wagner, by

V. V. Lavroff, followed by a full bibliographical index.—Determination of the inner energy of the gas-liquid systems, by A. N. Tschoukareff, with a *résumé* in French. By sealing various liquids in steel "sparklets," capable of supporting considerable inner pressures, the author could thus bring these liquids to high temperatures, above the critical temperature, and thus determine the specific heat of these substances in the critical state.—On the theory of the singing Voltaic arc, a mathematical inquiry by S. Maysel, which brings the author to conclusions opposed to those of Duddell, Janet, and Granqvist.

MESSRS. MACMILLAN AND BOWES, Cambridge, will publish in a few days a small book on "Mendelism," by Mr. R. C. Punnett, Cambridge. The volume will give an outline of Mendel's work on heredity, and its recent developments.

IN the notice of Dr. D. Murray's volumes on "Museums" in our issue of April 13 (p. 554), the reviewer referred to the list of museums in the United Kingdom given in the work as being based on one prepared by the Museums Association. Mr. E. Howarth writes to point out that the list was a reprint of one prepared by a committee of the British Association in 1887, and not by the Museums Association, which did not commence the preparation of a museums directory until 1902.

MESSRS. GEORGE BELL AND SONS have published the second part of the key to the "Elementary Algebra" of Messrs. W. M. Baker and A. A. Bourne.

## *OUR ASTRONOMICAL COLUMN.*

ORBIT OF COMET 1905 *a*.—A graphical representation of the orbit of comet 1905 *a*, according to the elements computed by Miss Lamson, of the U.S. Naval Observatory, is given in No. 5, vol. xiii., of *Popular Astronomy*. From this it is seen that the comet, at its perihelion, passed within 12,000,000 miles of the earth, but the latter body had, about a month before, passed the point where closest proximity was possible. The comet will continue, therefore, to grow fainter, and on May 30, according to Miss Lamson's ephemeris, it will be only 0·3 as bright as when first discovered, and it was only a faint telescopic object then.

PROVISIONAL ELEMENTS FOR JUPITER'S SIXTH SATELLITE.—Whilst awaiting more definite information from Lick, Mr. Crommelin has computed provisional elements for Jupiter's sixth satellite from the data already available. These data are not sufficient to decide the eccentricity of the orbit, so a circular form has been assumed. Although the Lick observers have now stated definitely that the "retrograde" in their first telegram did *not* refer to the orbital motion, the observations yet made have not settled the question of direction, and Mr. Crommelin has therefore computed elements both for "direct" and "retrograde." He finds the distance from the parent planet to be about 6,200,000 miles, and a comparison of this with the observational data favours a "direct" orbital motion, although, of course, much uncertainty exists. The inclination of the satellite's to the planet's orbit is 23°·8 or 23°·9, according to whether the motion is "direct" or "retrograde," whilst the inclination of the orbit to Jupiter's equator is either 26° or 24°·7. This inclination is unusually large as compared with other satellite orbits in the solar system, and according to the reports so far received the orbit of the seventh satellite has a still larger inclination.

According to the "direct" hypothesis, the pole of the sixth satellite's orbit is only about 1°·5 from our own North Pole, so that the major axis will always point nearly due east and west. A determination of the position angle next July, when it again reaches western elongation, should decide the question of the satellite's motion. The semi-minor axis of the apparent ellipse on December 25 (W. elongation) was 4′·96, and from this it is deduced that the inclination of the orbit plane to the line of sight on that date was 5°·7 (*Monthly Notices*, vol. lxv., No. 5).

WINTER FIREBALLS IN 1905.—In No. 357 of the *Observatory* Mr. Denning summarises the accounts of fireball observations, during January and February, which have been forwarded to him. Quite an unusually large number of these objects were observed. One slow meteor seen on January 27 at 11h. 59m., and another seen on February 28d. 12h. 10m., were at least as bright as the full moon, whilst one on January 14 at 10h. 16m., which was brighter than Venus, was noted by one observer as being followed by a slight rumbling noise at an interval of 2½ minutes. The probable radiant of this object was 119°+3°, and it travelled from a height of 60 miles to a height of 29 miles, along a path of about 55 miles, with a velocity of 15 miles per second. A meteor seen at 10h. 15m. on February 28 from a radiant at 220°+40° divided into two parts at disappearance, whilst the last named of the eighteen objects mentioned in Mr. Denning's report, seen at 9h. 10m. on March 18, swelled out and exploded three times with lightning-like flashes during its four seconds' flight.

OBSERVATIONS AND LIGHT-CURVES OF SEVERAL VARIABLE STARS.—In No. 4011 of the *Astronomische Nachrichten* Dr. L. Terkán, of the O-Gyalla Observatory, publishes the results of a series of observations, and some light-curves, of several important variable stars. The observations were made during 1904 with a Zollner photometer, and the results are compared with the various published elements of each object. The stars dealt with are S Sagittæ, T Vulpeculæ, δ Cephei, η Aquilæ, β Persei, and λ Tauri.

OBSERVATIONS OF "$D_3$" IN THE SOLAR SPECTRUM.—In No. 4012 of the *Astronomische Nachrichten* Dr. H. Kreusler, of Berlin, records two observations in which he saw the helium line, $D_3$, as a dark line in the spectrum of the region about a sun-spot. The first observation was made between noon and 2 p.m. on June 12, 1904, the second on the following day, and on both days the faculæ surrounding the spot were exceptionally bright. Dr. Kreusler suggests that, as it was near a maximum epoch of solar activity when Prof. Young recorded a similar observation in 1870, this phenomenon may be a characteristic of sun-spot maxima.

BRIGHTNESS OF JUPITER'S SATELLITES.—In an attempt to settle the question of the variability of Jupiter's four brightest satellites, Prof. Wendell, of Harvard, made a series of photometric comparisons of them with a polarising photometer attached to the 15-inch telescope. The satellites were compared, for brightness, among themselves, and a large number of "settings" was made in such a manner as to eliminate accidental errors. The order of brightness was always iii., i., ii., iv., and the results afford no evidence for any variability during the period over which the observations extended, viz. from J.D. 2416900 to J.D. 2416928 (Circular No. 95 of the Harvard College Observatory).

VARIABLE STARS IN THE SMALL MAGELLANIC CLOUD.—Some time ago it was reported in these columns that Miss Leavitt had newly discovered 57 variable stars in the small Magellanic cloud. In order to provide material for a closer study of the light-curves of these objects, sixteen negatives were taken at Arequipa with the 24-inch Bruce telescope, with exposures varying from two to four hours each. When the plates arrived at Cambridge (U.S.A.) in January, Miss Leavitt was greatly surprised to find that in this same region there were hundreds of variables which had not been seen on the previous inferior plates. In Circular No. 96 of the Harvard College Observatory the number in each half-degree square of the region is given, and, including the 57 previously announced, there are 910 new variable stars in all. This means that within the limits of the clouds there is one variable to every 308 stars, whereas of the 40,000 stars in the surrounding region shown on the plates only one in 3300 is apparently a variable, although all have been examined with equal care.

During the examination of the plates it was found that a thirteenth magnitude star, the position of which for 1900·0 was R.A.=1h. 6m. 1s., dec.=−72° 45′·5, has a large proper motion amounting to +0·13s. in R.A., +0″·42 in dec., and 0″·73 in a great circle.

## SANITATION IN THE TROPICS.[1]

PROF. BOYCE and Messrs. Evans and Clarke, of the Liverpool School of Tropical Medicine, recently returned from a journey to the west coast of Africa, the object of which was to study the present sanitary condition of, and anti-malarial measures practised at, Bathurst, Conakry, and Freetown, to investigate how far the teaching of Ross has there been accepted and acted upon, and if, as a consequence, the health of these communities has improved during the last four years. This report embodies the results of their observations, together with suggestions for the further development of tropical hygiene in the future.

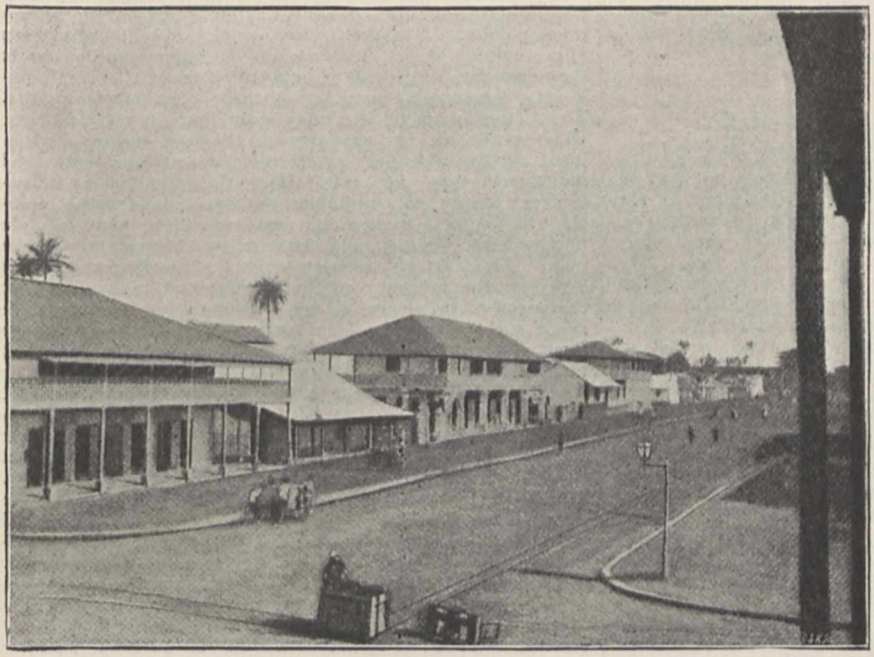

FIG. 1.—Principal Boulevard in Conakry, showing factories and Decauville rails. The main drain is under the footpath on the left.

At Bathurst sanitation is clearly of no low order, the town is well laid out, the streets are drained, and earth closets are the rule in the European quarters; but in the native compounds there are many cess-pits which tend to foul surface-wells, of which there are a number still in use, though there is a good public supply from deep wells. Anti-mosquito measures have been in force since 1902, consisting of the removal of old tins and rubbish, levelling and clearing of roads, examination of wells and water receptacles for larvæ, &c., and the more regular use of the mosquito net by Europeans. These precautions have made people think and be more careful, and the Europeans, it is stated, have been more free from malaria than formerly, but Culex mosquitoes still abound.

Conakry, in French Guinea, is a comparatively new town, well planned and laid out. There are no cess-pits of any kind, the pail system being in use, and a pure water supply is brought from watercourses 41 kilometres distant. In consequence, the private wells have fallen into disuse, but they have not been closed or filled up, and therefore serve as breeding grounds for mosquitoes. Anti-malarial measures do not seem to be carried out, mosquito nets are not made use of to any extent, and malaria is still very rife. The authors remark that (p. 20) "With model water supply under the control of the authorities, no streams, a good porous soil, and perfect sanitation mosquitoes should be got under control, and the freedom of the Europeans and of the natives from malaria guaranteed."

Freetown, in Sierra Leone, is not well laid out, and cess-pits are the rule. Of these there were 2650 in 1897, and their number has since increased, while more than 2000 of the inhabitants have no sanitary accommodation of any kind. The street drainage is still imperfect, and numerous opportunities exist for Anopheles mosquitoes to breed; but this condition of things is undergoing gradual improvement, and mosquito nets are in general use. The authors think that the health of the Europeans has in consequence improved, but evidently no striking result has yet been achieved. On the whole, we are disappointed that more definite results cannot be chronicled as the outcome of the health propaganda so ably preached by the Liverpool School and its energetic staff, but obviously such success as has been attained should prove a stimulus for further effort, and not lead to any relaxation of present measures. The authors formulate a number of suggestions for the improvement of the health of the districts visited, of which the principal are:—(1) the

FIG. 2.—A street in Freetown consisting of rock surface, in which there are innumerable pools breeding Anopheles (Rainy season).

[1] "Report on the Sanitation and Anti-malarial Measures in Practice in Bathurst, Conakry, and Freetown." By Prof. Rubert Boyce, M.B., F.R.S., Arthur Evans, M.R.C.S., L.R.C.P., and H. Herbert Clarke, M.A., B.C. (Cantab.), Liverpool School of Tropical Medicine. Memoir xiv. (Liverpool: University Press. London: Williams and Norgate, 1905.)

instruction of newcomers in the part played by mosquitoes in conveying malaria, and in the habitual and proper use of mosquito nets; (2) the segregation of the native population away from the European quarters; (3) the total abolition of cess-pits; (4) the rational and systematic use of anti-malarial measures; (5) the public control of drinking water; and (6) the establishment of laboratories on the spot for the study of health problems. R. T. HEWLETT.

## IRON AND STEEL INSTITUTE.

THE annual meeting of the Iron and Steel Institute was held at the Institution of Civil Engineers on May 11 and 12, and was very largely attended. The report of the council, read by Mr. Bennett H. Brough, the secretary, shows that the institute continues to make satisfactory progress. The membership now amounts to 2000. The proceedings began with the adoption of a resolution of regret at the death of Sir Bernhard Samuelson, Bart., P.C., F.R.S., past president, referred to elsewhere (p. 61).

After the usual routine business, the retiring president, Mr. Andrew Carnegie, inducted into the chair the president-elect, Mr. R. A. Hadfield, whose first duty was to present the Bessemer gold medal to Prof. J. O. Arnold (Sheffield).

Mr. R. A. Hadfield then delivered his presidential address. It dealt chiefly with the history of metallurgy and with those branches of the subject to which his attention had been directed, more especially with the alloys of iron with other elements. He urged the necessity for constant research. In progressive manufacture, the complexity of which increases year by year, there is, in addition to the many ordinary difficulties met with, that of the solution of new problems which constantly present themselves. This can only be done by research, which should form an actual part of industrial operations, and demands almost as much attention as is devoted to the manufacturing side. It is more than ever necessary not to rest satisfied with the knowledge of to-day, or to think that this will satisfy the needs of to-morrow. Rapid and great changes are constantly occurring in metallurgy as in other branches of scientific knowledge. The thanks of the meeting for the address were expressed by Sir E. H. Carbutt and Sir William White, K.C.B.

Mr. S. Surzycki (Czenstochowa) submitted results obtained with the continuous open-hearth steel process as carried out in fixed furnaces in Poland. The process, which has proved eminently successful, is based on the principle of the Talbot process, with the essential difference that it can be carried out in any fixed furnace of not less than 25 tons capacity. The advantages do not consist solely in the continuity of the process, but in the longer life of the furnace, the higher production and yield, the lessened fuel consumption, and the simplicity of the plant.

A very elaborate paper was read by Mr. R. A. Hadfield, the president, describing some experiments relating to the effect produced by liquid-air temperatures on the properties of iron and its alloys. About eleven hundred specimens were tested. The bars, which were prepared with great care, were submitted to various heat treatments, the exact temperatures being recorded, and then forwarded to Sir James Dewar's laboratory at the Royal Institution. The tests were carried out on a small hydraulic testing machine, to which the necessary arrangements could be readily applied for immersing the specimens in liquid air. The results showed that, with certain exceptions, the effect of low temperatures is to increase in a remarkable degree the resistance of iron and iron alloys to tensile stress, and to reduce the ductility from the highest point to practically nil. The changes take place even in the softest wrought iron. The absence or presence of carbon in ordinary carbon steel in which other special elements are not present has little influence. Subjected to Brinell's hardness ball test, a specimen of Swedish charcoal iron at normal temperature had a hardness number of 90, whereas when tested at about −182° C. this increased to no less than 266, or about equal to the hardness of 0·80 per cent. carbon steel at normal temperature. This almost seems incredible when it is remembered that this iron shows by analysis 99·82 per cent. of iron, and normally has only 20 to 22 tons tenacity with 25·30 per cent. elongation. This iron becomes brittle to an extraordinary degree under the influence of the low temperature −182° C., whereas nickel tested at the same low temperature has improved rather than deteriorated, not only in tenacity, which iron also does, but in ductility, in which latter quality iron entirely breaks down. If nickel, therefore, is present in an iron alloy containing but little carbon or comparatively low in that element, it acts as a preventive of brittleness, or is a very considerable modifier of that objectionable quality. This action of nickel is simply marvellous in certain of the alloy specimens, for example, in the case of an alloy of iron, carbon 1·18 per cent., nickel 24·30 per cent., and manganese 6·05 per cent. Here the ductility is extraordinary at not only ordinary but low temperatures, probably the highest known for any iron alloy, and certainly for an alloy having such tenacity as 84 tons per square inch. There is still present in this alloy 68 per cent. of iron, yet the tendency of the latter metal to wander into the paths of brittleness is not only entirely checked at the liquid air temperature—and this brittleness, as shown so clearly in this research, occurs to an extraordinary extent in pure iron cooled to −182° C.—but the elongation or ductility, already so great, is considerably increased, namely, from 60 per cent. to 67½ per cent. There is also an increase of tenacity in both cases, namely, a rise of from 10 per cent. to 38 per cent. Thus the nickel present enables the bar under this high tension and at −182° C. to remain far more ductile than the very best of ductile iron of one-third the tenacity. Although the action of nickel has been specially referred to, it must not be overlooked that in this alloy there is also present 6 per cent. of manganese, which in its ordinary combination with iron, that is, with no nickel present, would confer intense brittleness upon the iron and render it more brittle than if not present. This treble combination of nickel-manganese with iron appears to reverse all the known laws of iron alloys.

Mr. J. H. Darby (Brymbo) and Mr. George Hatton (Round Oak) summarised the recent developments in the Bertrand-Thiel process of steel manufacture. This process, which was first used in Bohemia in 1894, consists in carrying out the preliminary refining in an upper open-hearth furnace, and the steel-making is completed in a secondary open-hearth furnace. The original plan of having furnaces at different levels has not proved so satisfactory as having the furnaces arranged in line with a mixer at one end. Pig iron of almost any ordinary composition may be used. At Brymbo, with a highly phosphoric pig iron, seven 20-ton charges per day have been attained, and at the Hoesch works in Dortmund ten charges per day have been regularly produced.

At the New York meeting of the Iron and Steel Institute, the paper read by Mr. James Gayley on the application of the dry air blast created quite a sensation in the iron industry. Mr. Gayley now gives, in a supplementary paper, a record of operations of the Isabella furnaces at Pittsburg from November, 1904, to March, 1905, showing that the increased iron output and the decreased coke consumption derived from the use of dry air were well maintained.

The rapid development of the gas engine of recent years has given special value to the gas escaping from the blast furnace, previously often described as waste gas. The gas leaving the blast furnace carries with it a varying amount of gritty dust, which has proved a serious obstacle to the successful operation of large gas engines. The various methods of cleaning the gas were described in the paper submitted by Mr. Axel Sahlin, who has designed a slowly revolving apparatus for the purpose.

Dr. O. Boudouard (Paris) submitted a lengthy account of experiments made to determine the fusibility of blast-furnace slags. He gave a chart enabling metallurgists to determine the fusion temperature of a given alumino-calcic silicate. The information given in this lengthy paper is of great value, inasmuch as one of the most important considerations in the satisfactory running of a blast furnace is a knowledge of the degree of fusibility of the slag.

Mr. Sidney A. Houghton contributed a note on the failure of an iron plate through fatigue. The plate was

from the boiler of a portable engine about twenty years old. Microscopic examination showed that the effect of fatigue stresses on the plate had been to form cracks commencing as a rule from irregularities on the inner surface, which cracks were due to weakness in the cleavage planes of the crystals from continual slipping, and to a less degree to some loss of adhesion between the crystals. Some of the crystals appeared to have been broken up, and the slag flaws seemed to have a restraining effect on the progress of the cracks.

Mr. B. H. Thwaite (London) directed attention to accidents due to the asphyxiation of blast-furnace workmen, and described an apparatus for the rapid detection of the presence of carbon monoxide in air.

Prof. F. Wüst and Mr. F. Wolff (Aachen) submitted a paper on the behaviour of sulphur in the blast furnace. They showed that, contrary to the generally held opinion, the sulphur in the coke does not reach the level of the tuyeres of the blast furnace without undergoing alteration, but a great portion of it is previously volatilised by the ascending gases. It is then largely absorbed from the gases by the descending charge, and in this condition arrives in front of the tuyeres. Up to 800° the sulphur is principally absorbed by the oxides of iron from the sulphur-laden gases, while from 800° upwards the position is reversed, and the lime becomes the chief absorbent of the sulphur.

Reports of research work carried out during the past year by Dr. H. C. H. Carpenter (National Physical Laboratory), by Mr. J. C. Gardner (Birmingham), by Mr. F. Rogers (Cambridge), and by Mr. Gunnar Dillner and Mr. A. F. Enström (Stockholm), holders of the Carnegie research scholarships, were submitted. Dr. Carpenter dealt with the types of structure and the critical ranges on heating and cooling high-speed tool steels under varying thermal treatment.

In the light of the author's experiments the rationale of the advantageous presence of tungsten and molybdenum in high-speed tool steels appears fairly evident. The action of either of these elements consists in hindering, under certain conditions, and in altogether preventing, under suitably chosen conditions, changes in iron carbon alloys which would have for their result the softening of the material and its consequent unfitness for tool steel use. By suitable heat treatment it is possible to arrest the softening process at any desired stage, and thus obtain an alloy of any desired hardness. The metallographical results of the investigation are extremely interesting. They show that in spite of comparatively large percentages —up to 17 per cent. or 18 per cent.—of special elements, iron and carbon still remain as the all-important factors in determining the types of structure of high-speed tool steels. Except that the polyhedral or "austenitic" type of structure has never been obtained alone in a pure carbon steel, the types of the high-speed tool steels might all be obtained from pure iron carbon steels by appropriate thermal treatment. The austenitic structure appears to be that of the nose of the tool in actual use. Put briefly, the hardening of rapid tool steels at the present time appears to involve two factors, viz. (1) the widening, splitting, or lowering of the critical ranges by the special alloy element, and (2) the complete, or practically complete, suppression of the widened, split, or lowered range by a mild quenching, *e.g.* in an air-blast.

Mr. G. Dillner and Mr. A. F. Enström dealt with the magnetic and electric properties of sheet steel and steel castings. The results obtained have rendered it possible to make some comparisons as to the relative suitability of the different methods for producing a soft steel for electrotechnical purposes (sheet material). It has appeared that Bessemer steel has a lower magnetic quality than open-hearth steel. On comparing basic and acid open-hearth steel, the basic steel has been found to be preferable and scarcely inferior to Lancashire iron. The reason why the Bessemer material is inferior in quality to the open-hearth sheets may possibly be that the Bessemer steel has a greater opportunity of dissolving gases when the air is passed through the bath of molten metal. In general, basic steel does not contain such large quantities of silicon and manganese as acid steel, and at the same time it is possible to get a lower percentage of carbon in the first mentioned metal; these facts may cause the hysteresis loss to be lower in basic than in acid steel.

Mr. J. C. Gardner dealt with the effects caused by the reversal of stresses in steel, and Mr. F. Rogers submitted memoirs on troostite and on the heat treatment of steel.

It was announced that Andrew Carnegie research scholarships for this year, of 50*l.* each, were awarded to P. Breuil (Paris), Dr. H. C. H. Carpenter (National Physical Laboratory), E. G. L. Roberts and E. A. Wraight (London), and W. Rosenhain (Birmingham), and that scholarships, each of the value of 100*l.*, were awarded to H. C. Boynton (Cambridge, U.S.A.), L. A. Guillet (Paris), and W. H. Hatfield (Sheffield).

The council carefully examined the reports of the research work carried out by the holders of the Carnegie research scholarships during the past year, and decided that the report prepared by Dr. H. C. H. Carpenter (National Physical Laboratory) was deserving of the gold medal. The council also decided that special silver medals should be awarded for the research carried out conjointly by Mr. Gunnar Dillner and Mr. A. F. Enström (Stockholm). The researches submitted by Mr. Gardner and Mr. Rogers were highly commended. The medals were presented by Mr. Carnegie at the banquet on May 12 at the Hotel Cecil, when 500 gentlemen were present.

During the meeting it was announced that Mr. Carnegie would give to the institute a further sum of 5000*l.* to cover the cost of printing the reports submitted by the Carnegie research scholars.

## *HIGHER EDUCATION IN LONDON.*

RECENT events inspire hope in the future of higher education in London. The report presented by Sir Arthur Rücker, F.R.S., principal of the University of London, at the celebration of presentation day on May 10, and the speech of Lord Londonderry in proposing "The Institution of Mining and Metallurgy" at the annual dinner of its members, are both highly encouraging and indicative of the growing importance attached in the metropolis to education of university standing, especially in science and technology.

Sir Arthur Rücker, in the course of his report, dealt in detail with the operations of the University of London, and was able to show that some of the preliminary work done since the re-organisation of the university has begun to bear fruit in the academic year now approaching its termination, and that the activity of the university has been extended in several directions. The question of the conditions of entrance to universities has been prominently before the public during the year, and a very important step has been taken by the Universities of Oxford, Cambridge, and London, which have agreed upon a scheme for the mutual recognition of the certificates given for their respective entrance examinations. Already twenty-five persons have been matriculated as students of London University under this agreement. Considerable progress has been made, also, with the project for the concentration of the teaching of the preliminary and intermediate studies of medical students in a few centres under the control of the university. Arrangements are in progress under the auspices of the university for establishing centres at University and King's Colleges, and Mr. Alfred Beit has given a munificent donation of 25,000*l.* in aid of the scheme for the establishment of a third centre on the South Kensington site. It is much to be hoped that this generous gift will be supported by other large subscriptions. It is a matter of vital interest to the public that the unique opportunities for medical education afforded by the great metropolitan hospitals shall not be wasted, and, if they are to be utilised, it is essential that the whole curriculum of medical education shall be easily accessible to London. It is necessary, continued Sir Arthur Rücker, that medical education shall receive public help similar to that which is ungrudgingly given to engineering. It is not too much to say that medical men do more unpaid work for the public than do the members of any other profession, and that, in return, less help has been given by the public to medical education, in London at all events, than to any other of the principal branches of applied science. Large as the gifts to the university are,

it is unfortunately true that much money is needed to make up for the neglect of university teaching in London in the past. Though the increase in the Government grant to university colleges will be of great value, the equipment of both University and King's Colleges needs improvement, and the salaries of the professors are quite inadequate. The whole question of retiring pensions, to which a private donor has just devoted 2,000,000*l.* in America, is untouched in London.

After the presentation for degrees at the University of London, there was a reception at Bedford College. The occasion is always one for the assembling of the friends of the higher education of women in London, and about five hundred guests were received by the principal, Mrs. James Bryce, and Mrs. Leonard Darwin. The students who were presented at the university included eight for science degrees. The college authorities are contemplating a great re-building scheme, for the lease of the present premises in Baker Street is almost on the point of expiring, and an appeal is being made for a quarter of a million sterling, of which 100,000*l.* would be devoted to endowing a college capable of accommodating five hundred students.

Lord Londonderry, in his speech at the annual dinner of the Institution of Mining and Metallurgy, referred to the work of the committee appointed by the Government to consider the coordination of the Royal College of Science at South Kensington with other institutions for higher scientific and technological instruction in London. An interim report has been presented by the committee. The Government has definitely informed the committee that, provided satisfactory arrangements can be arrived at for the due coordination of the work of the various higher scientific teaching institutions in London and elsewhere, and provided that guarantees are obtained for the adequate management of what will practically be a congeries of highly organised technical courses, and for the provision of a thoroughly satisfactory annual income for the upkeep of a great centre for this higher work, the Government is prepared to entrust the management of the Royal College of Science, including the Royal School of Mines, to a committee to be newly established for the purpose. This procedure, it is expected, will bring the work of the Royal College and School of Mines into the closest possible relations with that of the other higher teaching institutions, so that a higher degree of cooperation and coordination may be attained in this important portion of the educational field. Lord Londonderry announced that he has good grounds for believing that the Chancellor of the Exchequer has been considering the financial aspect of the new condition of things that will be brought about in regard to the Royal College of Science if the changes outlined actually take effect, and that a reasonable increase in the sums at present annually devoted towards the expenses of the Royal College of Science will be made. Thus the Royal College, in its immensely enhanced possibilities of usefulness owing to its large new buildings, will be able to bring to the common aim, not only its fabric and its excellent equipment, and, of course, its good will and prestige, but also a satisfactory annual income as a substantial contribution to what must be the heavy annual expenditure involved in the great work to be carried on for higher scientific and technological education in the metropolis.

As Mr. Haldane, the chairman of the committee referred to by Lord Londonderry, said on the same occasion, there is now a prospect of the establishment of such a school of mining and metallurgy as will make London the first city of the Empire in point of education in these matters.

## *UNIVERSITY AND EDUCATIONAL INTELLIGENCE.*

CAMBRIDGE.—Some five or six years ago a special committee was called together at Cambridge, and an effort was made to obtain the cooperation of the colleges and the town and county councils in a scheme for the improvement of the milk supply of Cambridge. The committee had as its primary object the eradication of tuberculosis, beginning with bovine tuberculosis, from the county of Cambridge. Concurrently it took up the question of the housing of cattle, the sterilisation of milk, the methods of storage and distribution of milk, and the question of what milk should be refused by the colleges and by private purchasers. All these points were considered, not only with regard to tuberculosis, but also in connection with other infectious diseases, *e.g.* diphtheria, scarlet fever, and typhoid fever. The Cambridge Town Council undertook to pay the expenses of a veterinary surgeon, and the following colleges undertook to consider the matter favourably, and in most cases offered a certain annual subvention:—Gonville and Caius, Trinity Hall, King's, Christ's, Sidney, Emmanuel, Downing, and Girton, but the larger colleges stood out, and the scheme fell through.

Prof. Woodhead, in an interesting article in the *Cambridge Review* of last week, raises the question whether some such scheme should not be revived, and points to the recent outbreak of scarlet fever, which was especially prevalent in one or two colleges, as an instance of a disease which might easily have been avoided if the community had taken proper precautions.

It is proposed to erect a building containing examination rooms on a site on the north-east corner of the museum grounds. At present the university is put to great cost in hiring rooms which, apart from their expense, are not well adapted for examinations. The syndicate appointed to consider this question estimates that for a sum of 7500*l.* it could provide for all examinations held in the university throughout the year, except, perhaps, for a week or two in June and December.

The Vice-Chancellor announces the generous offer of the Drapers' Company to find the sum of 5000*l.* towards the cost of a building for the department of agriculture provided that a further sum of 5000*l.* is raised by voluntary subscriptions by the end of the current year.

The long vacation course in pathology, public health, and pharmacology will begin on Monday, July 3. Special courses of lectures have been arranged on phagocytosis, by Prof. Woodhead, with the assistance of Mr. W. Malden; on illness caused by unsound food, by Mr. H. E. Durham; on diphtheria, agglutinins, precipitins and hæmolysins, by Mr. G. S. Graham-Smith; and on protozoa and protozoal diseases, by Dr. Nuttall. Further information about these courses may be obtained by writing to Prof. Woodhead, The Museums, Cambridge.

Special courses on physiology, osteology, human anatomy, and histology will be given during the long vacation by Mr. Barcroft and Mr. Cole, Dr. Barclay-Smith, Dr. A. Hill, and Mr. Manners-Smith. These will begin on July 5.

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THE jubilee of Cheltenham Ladies' College was celebrated on Saturday last, and a new science wing was declared open. The new laboratories and lecture-rooms have been erected at a cost of 18,000*l.*, and include rooms well equipped for the teaching of physics, chemistry, and botany.

THE following resolution was carried at a meeting of the council of the Royal College of Surgeons of England, held on Thursday last:—"That it be referred to the Committee of Management to consider and report as to the desirability of treating chemistry, physics, and biology as subjects of preliminary education, and of requiring that an examination in them should be passed before the recognition of the commencement of medical studies, and to report further as to the desirability of the two colleges approaching the Universities and other examining bodies with the view of adopting a five years' curriculum of professional study from the date of passing the Preliminary Science Examination."

AN entrance scholarship in science, value 48*l.* for three years, will be awarded by the council of Bedford College for Women (University of London) on the result of an examination to be held June 28–30. Full particulars can be obtained from the principal, and forms of entry must be received by June 12. The council, on the recommendation of the Reid trustees, will award the Reid fellowship in June to a graduate of the University of London who is also an associate of Bedford College. Applications should

be received by the hon. secretary of the Reid trustees by May 30. Miss Alice Ravenhill is to begin a course of lectures on May 18, at 4.30 p.m., on the "Teaching of Hygiene."

## SOCIETIES AND ACADEMIES.

### LONDON.

**Chemical Society**, May 4.—Prof. R. Meldola, F.R.S., president, in the chair.—Notes on sodium alum: J. M. **Wadmore.** The author has confirmed the observations of Augé, Zellner, and Dumont as to the existence and certain of the properties of sodium alum.—Camphoryl-*pseudo*-semicarbazide: M. O. **Forster** and H. E. **Fierz.** This compound was obtained by reducing camphorylnitroso-*pseudo*-carbamide with zinc dust in dilute acetic acid; it condenses readily with aldehydes and ketones, yielding products characterised by high specific rotatory powers.—Some derivatives of anhydracetonebenzil: F. R. **Japp** and J. **Knox.** Descriptions of the condensation products of benzil with certain unsaturated ketones are given.—The dihydrocyanides of benzil and phenanthraquinone, part ii.: F. R. **Japp** and J. **Knox.**—A condensation product of mandelonitrile: F. R. **Japp** and J. **Knox.** It is shown that Minovici's compound, $C_{16}H_{12}ON_2$ (*Ber.*, 1899, xxxii., 2206), obtained by saturating mandelonitrile in dry ether with hydrogen chloride, is identical with the substance obtained by Japp and Miller by the action of hydrogen chloride on a solution of benzil in alcoholic hydrocyanic acid (*Trans. Chem. Soc.*, 1887, li., 29).—Action of hydrazine on unsaturated γ-diketones: F. R. **Japp** and J. **Wood.** The authors have used Paal and Schulze's reaction to distinguish the configurations of certain analogous unsaturated diketones. By this means they have obtained confirmatory evidence for the configuration assigned by Japp and Klingemann to the two modifications of αβ-dibenzoylstyrene and of dibenzoylstilbene.—The synthesis of substances allied to adrenaline: H. D. **Dakin.**—Methylation of *p*-aminobenzoic acid by means of methyl sulphate: J. **Johnston.**—The atomic weight of nitrogen: R. W. **Gray.** By the examination of (1) the relative densities and compressibilities of nitric oxide and oxygen, and (2) the decomposition of nitric oxide with finely divided nickel, a mean value of 14·006 (which is regarded as possibly too low) was found for this constant.—The methylation of gallotannic acid: O. **Rosenheim.** A penta-methyl-derivative was obtained, by methylation with methyl sulphate, and this on hydrolysis furnished a mixture of trimethyl- and dimethyl-gallic acids.—The interaction of hydrogen sulphide and sulphur dioxide: W. R. **Lang** and C. **Carson.** An investigation of Wackenroder's solution showed that the action of hydrogen sulphide produces first sulphur and water, and that by the further action of sulphur dioxide on sulphur polythionic acids are produced.—The formula of cyanomaclurin: A. G. **Perkin.** It is now found that the formula $C_{15}H_{12}O_6$ is to be preferred in place of $C_{15}H_{14}O_6$ formerly used.

### PARIS.

**Academy of Sciences**, May 8.—M. Troost in the chair.—The increase of the rotatory power of fatty molecules in passing to the state of cyclic compounds: A. **Haller** and M. **Desfontaines.** A comparison is given of the rotatory powers of alkyl esters of β-methyladipic acid with the esters of the corresponding β-cyclopentanonecarboxylic acids, the rotations of the latter being found to be about thirty times those of the former. The densities and boiling points of the various esters under examination are also given.—On a new synthesis of oxalic acid: H. **Moissan.** It has been shown in a previous paper that whilst perfectly dry carbonic acid is without any action upon potassium hydride, in the presence of a minute trace of water the two substances react with the quantitative formation of potassium formate. It is now shown that if this reaction is allowed to take place at a higher temperature, 80° C., a mixture of potassium formate and oxalate is produced. The oxalic acid formed was separated, and its identity proved by analysis and numerous reactions.—Endoglobular pseudo-hematozoa: A. **Laveran.** As some of the normal elements of blood, more or less modified in their appearance, have on more than one occasion been mistaken for endoglobular hematozoa, a detailed account, with diagrams, is given of some of the more common cases leading to this error.—On the magnetic hysteresis produced by an oscillating field superimposed on a constant field: P. **Duhem.** A theoretical investigation completing a former paper on the same subject.—Geodesic and magnetic work in the neighbourhood of Tananarive: P. **Colin.** The triangulation of the rectangular section between the south and west of Tananarive has been completed at sixty-seven points. At the same time magnetic observations have been carried out at twenty-six stations, a tabular view of the results being given.—The oscillations of railway carriages on entering and leaving a curve: Georges **Marié.**—Observations of the Giacobini comet (1905 *a*) made with the large equatorial of the Observatory of Bordeaux: Ernest **Esclangon.**—On Voss surfaces and non-Euclidean geometry: Alphonse **Demoulin.**—On the indeterminate equation $x^a+y^a=bz^a$: Ed. **Maillet.**—On some points in the theory of numbers and the theory of functions: Georges **Rémoundos.**—On a new spectrum observed in gadolinium: G. **Urbain.** The author, having obtained a specimen of gadolina of such purity that twenty successive fractions gave the same value for the atomic weight, has examined the spectrum. There is no absorption spectrum in the visible region, but there are some strong absorption lines in the ultra-violet. The ultra-violet phosphorescence given by this gadolinium in the kathode rays proved to be the same as that attributed by Sir W. Crookes in 1898 to a new element named by him victorium. The author proposes to submit the question as to the identity of gadolinium and victorium to further experiment.—On the triboluminescence of potassium sulphate: D. **Gernez.** The experiments of the author are not in accord with those of Bandrowski on the same subject. The emission of light appears to be the result of breaking up of crystals already formed, and if due precautions against shock be taken, the phenomenon is not observed at the moment of separation of the crystals from their mother liquor.—The specific volume of a liquid in a capillary space: M. **Ponsot.**—On the electrical resistance of metallic wires for high-frequency currents: André **Broca** and M. **Turchini.** The authors have compared the resistances obtained experimentally with those calculated from Lord Kelvin's formula. For non-magnetic metals, copper and platinum, the deviations from the law calculated by Lord Kelvin are small for moderate frequencies. These deviations, however, are greater than the experimental error, and follow a definite law.—A new method of calculating the exact molecular weights of liquefiable gases from the experimental determination of their densities: Philippe A. **Guye.** The method described, the detailed proof of which is reserved for a later paper, has been applied to the cases of carbon dioxide, nitrous oxide, sulphur dioxide, hydrochloric acid, and acetylene. The values for the atomic weights of carbon, hydrogen, sulphur, and chlorine agree very closely with those determined by chemical methods. The value for nitrogen (14·006) is lower than the value deduced from chemical data (14·04), and there is reason to suppose that the latter is too high.—The action of potassammonium upon barium bromide: A. **Joannis.** The reaction has been found to be in accordance with the equation

$$BaBr_2+2NH_3K=2KBr+H_2+Ba(NH_2)_2.$$

—On the colloidal forms of ferric chloride: G. **Malfitano.**—The electrolytic reduction of the nitrocinnamic acids: C. **Marie.** Meta- and para-nitrocinnamic acids give by electrolytic reduction in alkaline solution the corresponding azoxy acids. The position of the nitro or the amino group has a marked influence on the ease with which the hydrogen is added to the lateral chain. Para derivatives give hydrocinnamic compounds much more easily than the corresponding meta compounds.—The action of carbon monoxide upon silver oxide, and its application to the determination of small quantities of carbon monoxide in the atmosphere: Henri **Dejust.** Silver oxide, dissolved in ammonia, is immediately reduced by traces of carbon monoxide. The author proposes a colorimetric method based on this reaction for the estimation of minute traces of carbon monoxide in the air.—On strontium ammonium:

M. **Rœderer.** Strontium ammonium is prepared in a similar manner to the compounds of ammonia with barium and calcium, and has the analogous formula $Ba(NH_3)_8$.—Osmosis through tubes of fused quartz: G. **Belloc.** The passage of gases through quartz tubes appears to be the result of a kind of devitrification caused by moisture and high temperature, the tendency to crystallisation being clearly made out under the microscope.—On a new osmium compound and a new reaction for osmium: Piñerûa **Alvarez.** The process is based on the formation of a green compound of hydriodic acid and osmium iodide of great tinctorial power.—The action of alkalis on aqueous solutions of acetol: André **Kling.** The behaviour of acetol on neutralisation with bases seemed to point to its being a pseudo-acid, and this view was confirmed by a study of the changes in its electrical conductivity.—On the saccharification by malt of artificial starch: Eug. **Roux.**—The action of metal ammoniums on the halogen derivatives of methane: E. **Chablay.** The equation

$$2NH_3Na + 2CH_3Cl = 2NaCl + CH_4 + CH_3.NH_2 + NH_3$$

was found to represent the reaction between methyl chloride and sodium ammonium. The reactions with chloroform and iodoform were more complicated.—On the use of metal ammoniums in organic chemistry: the formation of primary amines: Paul **Lebeau.**—On a new method of characterising the purity of milk based on the estimation of the ammonia: A. **Trillat** and M. **Sauton.** Ammonia should not be present in normal pure milk; its presence is evidence of pollution.—On polymorphic transformations by mechanical action: Fred. **Wallerant.**—On the state of preservation of minerals in arable earth: M. **Cayeux.** In opposition to the views of MM. Delage and Lagatu, the author finds that minerals in an altered state are always present in arable earth.—New species of endophytes of orchids: Noël **Bernard.**—The culture of Morchella: Ch. **Répin.**—The elective action of chloroform on the liver: M. **Doyon** and J. **Billet.**—On the toxicity of the urinary alkaloids: H. **Guillemand** and P. **Vranceano.**—The estimation of the sugar in the blood at the moment of accouchement in the goat without udders: M. **Porcher.**—The influence of sexuality on the nutrition of *Bombix mori* at the later stages of its evolution. The localisation of the glycogen, fat, and soluble albumen in the course of nymphosis: C. **Vaney** and F. **Maignon.**

## DIARY OF SOCIETIES.

*THURSDAY*, MAY 18.

ROYAL SOCIETY, at 4.30.—On Lesage's Theory of Gravitation and the Repulsion of Light: Prof. G. H. Darwin, F.R.S.—The Atomic Weight of Chlorine; an Attempt to Determine the Equivalent of Chlorine by direct burning with Hydrogen: Prof. H. B. Dixon, F.R.S., and E. C. Edgar.—The Flow of the River Thames in Relation to British Pressure and Rainfall: Sir Norman Lockyer, K.C.B., F.R.S., and Dr. W. J. S. Lockyer.—Thorianite, a New Mineral, from Ceylon: Prof. W. R. Dunstan, F.R.S., and G. S. Blake.—A Modified Apparatus for the Measurement of Colour, and its Application to the Determination of the Colour Sensations: Sir William Abney, K.C.B., F.R.S.—Further Observations on the Germination of the Seed of the Castor Oil Plant (*Ricinus communis*): Prof. J. Reynolds Green, F.R.S., and H. Jackson.—On the Efferent Relationship of the Optic Thalamus and Deiter's Nucleus to the Spinal Cord, with Special Reference to the Cerebellar Influx Theory (Hughlings Jackson) and the Genesis of Decerebrate Rigidity (Sherrington): Dr. F. H. Thiele.—On Reciprocal Innervation of Antagonistic Muscles. Eighth Note: Prof. C. S. Sherrington, F.R.S.—The Structure and Function of Nerve Fibres. Preliminary Communication and Addendum: Prof. G. S. Macdonald.—On the Occurrence of *Anopheles* (*Myzomyia*) *Listoni* in Calcutta: Major A. Alcock, C.I.E., F.R.S., and Major J. R. Adie.—On the Chemical Mechanism of Gastric Secretion: Dr. J. S. Edkins.—Contributions to the Physiology of Mammalian Reproduction. Part I. The Œstrous Cycle in the Dog. Part II. The Ovary as an Organ of Internal Secretion: F. H. A. Marshall and W. A. Jolly.

ROYAL INSTITUTION, at 5.—Flame: Sir James Dewar, F.R.S.

SOCIETY OF ARTS, at 4.30.—Plague in India: Dr. C. Creighton.

FARADAY SOCIETY, at 8.—An Application to Electrolytes of the Hydrate Theory of Solutions: Dr. T. M. Lowry.

*FRIDAY*, MAY 19.

ROYAL INSTITUTION, at 9.—The Native Races of the British East Africa Protectorate: Sir Charles Eliot, K.C.M.G.

EPIDEMIOLOGICAL SOCIETY, at 8.30.—Phthisis Rates; their Significance and their Teaching: Dr. A. Ransome, F.R.S.—Demonstration of a New Method for Recording the Incidence of Infectious Disease: C. H. Cooper.

*SATURDAY*, MAY 20.

ROYAL INSTITUTION, at 3.—The Evolution of the Kingship in Early Society: Dr. J. G. Frazer.

*MONDAY*, MAY 22.

SOCIETY OF ARTS, at 8.—The Uses of Electricity in Mines: H. W. Ravenshaw.

VICTORIA INSTITUTE, at 4.30.—Minerals and Metals of the Old Testament: Cavaliere W. P. Jervis.

*TUESDAY*, MAY 23.

SOCIETY OF ARTS, at 4.30.—The Cape to Cairo Railway: Sir Charles H. T. Metcalfe, Bart.

ANTHROPOLOGICAL INSTITUTE, at 8.15.—The Great Zimbabwe: Franklin White.

*WEDNESDAY*, MAY 24.

LINNEAN SOCIETY, at 8.—Anniversary Meeting.

GEOLOGICAL SOCIETY, at 8.—On the Igneous Rocks occurring between St. David's Head and Strumble Head (Pembrokeshire): J. V. Elsden.—(1) The Rhætic and Contiguous Deposits of Glamorganshire; (2) On the Occurrence of Rhætic Rocks at Berrow Hill, near Tewkesbury (Gloucestershire): L. Richardson.

SOCIETY OF ARTS, at 8.—Modern Lightning Conductors: Killingworth Hedges.

*THURSDAY*, MAY 25.

ROYAL SOCIETY, at 4.30.—Croonian Lecture on "The Globulins": W. B. Hardy, F.R.S.

ROYAL INSTITUTION, at 5.—Electro-magnetic Waves: Prof. J. A. Fleming, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Wireless Telegraphy Measurements: W. Duddell and J. E. Taylor.

*FRIDAY*, MAY 26.

ROYAL INSTITUTION, at 9.—The Development of Spectro-chemistry: Prof. J. W. Brühl.

*SATURDAY*, MAY 27.

ROYAL INSTITUTION, at 3.—The Evolution of the Kingship in Early Society: Dr. J. G. Frazer.

## CONTENTS.


| | PAGE |
|---|---|
| The Birds of Central America. By A. N. | 49 |
| Vector Mechanics | 51 |
| Greater Austria. By G. A. J. C. | 51 |
| Economic Science | 52 |
| **Our Book Shelf:—** | |
| "Beiträge zur Physik der freien Atmosphäre."—G. C. S. | 53 |
| Roberts: "The Inventor's Guide to Patent Law and the New Practice."—B. | 53 |
| Ihlseng and Wilson: "A Manual of Mining" | 53 |
| "The Practical Photographer" | 54 |
| Granderye: "Determination des Espèces minérales" | 54 |
| **Letters to the Editor:—** | |
| The Dynamical Theory of Gases and of Radiation.—Lord Rayleigh, O.M., F.R.S. | 54 |
| The Cleavage of Slates.—Rev. O. Fisher | 55 |
| A Relation between Spring and Summer. (*With Diagram.*)—Alex. B. MacDowall | 56 |
| Fictitious Problems in Mathematics.—An Old Average College Don; The Reviewer | 56 |
| Scientific Results of the National Antarctic Expedition. (*Illustrated.*) | 57 |
| The State and Higher Education | 58 |
| Meeting of the British Association in South Africa | 59 |
| Sir Bernhard Samuelson, P.C., Bart., F.R.S. | 60 |
| Dr. Otto von Struve | 61 |
| Notes | 61 |
| **Our Astronomical Column:—** | |
| Orbit of Comet 1905 *a* | 66 |
| Provisional Elements for Jupiter's Sixth Satellite | 66 |
| Winter Fireballs in 1905 | 66 |
| Observations and Light-curves of Several Variable Stars | 66 |
| Observations of "$D_3$" in the Solar Spectrum | 66 |
| Brightness of Jupiter's Satellites | 66 |
| Variable Stars in the Small Magellanic Cloud | 66 |
| Sanitation in the Tropics. (*Illustrated.*) By Prof. R. T. Hewlett | 67 |
| Iron and Steel Institute | 68 |
| Higher Education in London | 69 |
| University and Educational Intelligence | 70 |
| Societies and Academies | 71 |
| Diary of Societies | 72 |