THURSDAY, JULY 30, 1908.

A TREATISE ON CHEMISTRY.

A Treatise on Chemistry. By Sir H. E. Roscoe, F.R.S., and C. Schorlemmer, F.R.S. Vol. ii., The Metals. New edition, completely revised by Sir H. E Roscoe and Dr A. Harden. Pp. xvi+1436. (London: Macmillan and Co., Ltd., 1907.) Price 30*s* net.

SIR HENRY ROSCOE is to be congratulated on having completed a new edition of that portion of Roscoe and Schorlemmer's well-known "Treatise on Chemistry" which deals with the metals. In the first edition the metals were described in several separate parts, which are now included in the present stout volume of more than 1400 pages, forming the second volume of the new edition of the "Treatise." The characteristics of this treatise are well known to English chemists. It constitutes a half-way house between a complete *catalogue raisonné* of chemical facts and principles of which Gmelin's handbook is the last great example and the modern dictionary and treatise in which only important facts are recorded, and then in the briefest possible manner, historical allusions being either altogether omitted or reduced to their simplest terms.

The present volume presents an orderly and readable account of the metals and their compounds, due regard being paid to the history of their discovery. The volume opens with a general discussion of the metals, which might with advantage be expanded. Then follow clear accounts of the methods used in the determination of atomic and molecular weights, of valency, including a brief description of Werner's view of valency, of the classification of the elements, in connection with which it may be noticed that the system of classification adopted in the volume is that of groups of natural families, which is undoubtedly still the most convenient for the purposes of description—and description is the key-note of the present treatise. Atomic weights are given both in relation to hydrogen and to oxygen as unity. The physical properties of metals and the constitution of salts follow next, and here it is interesting to notice that electrolytic dissociation is accepted without comment, although little use is made of the hypothesis throughout the book, and the older type of chemical equation is preserved. No fewer than thirty-four pages are devoted to spectrum analysis, a section which might well be considerably condensed. More than forty pages are given to crystallography, another special subject of great importance. In view of the unwieldy size of the present volume, it is a question whether both these special subjects should not receive less detailed treatment in a treatise on the metals. The remainder of the volume relates to the description of the metals and their compounds, to which 1177 pages are devoted.

It must be confessed that, without changing the readable type in which the book is printed, and without omitting the historical notices and descriptions of metallurgical and manufacturing processes which form the most valuable feature of the "Treatise," there is room for very considerable condensation both in form and substance. Critical revision, both from a literary and a chemical standpoint, would lead to many changes for the better, and a reduction of the volume to nearly half its present dimensions without at all impairing its value. Nearly five pages are devoted to gunpowder of the old type, with voluminous tables relating to explosive processes and products, taken from the work of Noble and Abel of thirty-five years ago. Several pages are given to a description of processes of preparing alum which have long since been abandoned, yet in this account there is no allusion to the industry which once flourished on the Yorkshire coast, although alum manufacture in Italy and Asia Minor is mentioned. It would be easy to multiply instances of this kind and to point out many cases in which the exercise of a more critical judgment would have been beneficial, not only in eliminating unessential or unimportant material, but also in restricting a too luxurious licence in the use of words.

The historical information included in the volume is generally of great interest to the chemist as well as to the less technical reader, but here again much is recorded which is of doubtful value. The derivation of magnetite from Magnesia, a town in Lydia now known as Manisa, is at least plausible, but to urge in its support that Plato and Theophrastus called the mineral the "Heraclean stone," Heraclea being another name for Magnesia, is not likely to commend itself to anyone with knowledge of the subject. Magnetite is common throughout this country. Heraclea was probably a different town from Magnesia, and magnetite was probably found near both. One turns with interest to magnesium and manganese for information as to the origin of these words and their connection with magnetite, but the subject is left in confusion. It is a curious coincidence, if nothing more, and one of interest to the philologist, that the soil in the neighbourhood of Magnesia is particularly rich in the earth of that name.

The statement that "an alcoholic solution of ferric chloride was formerly employed as a quack medicine of repute, known by the name of Lamotte's golden drops," might well have been supplemented by the information that this solution is included in the British Pharmacopœia, and is still well known as "tincture of steel."

By far the most valuable sections of the book for the chemist will be the descriptions of modern metallurgical and manufacturing processes, which have been brought well up to date. More attention might have been given to the revision of the paragraphs relating to the occurrence of metals. The new source of tin in the highlands of West Africa, from which an appreciable output of the metal is already being obtained and which promises to have a great future, is not alluded to; whilst the occurrence of tungsten as wolframite with the tin ore of the Malay States is not mentioned under tungsten, although the separation of tungsten from tin is alluded to in connection with the metallurgy of tin.

The metallurgy of iron and steel is well described, but the discussions of the constitution of steel and of the rusting of iron leave much to be desired.

With all its imperfections, the "Treatise" is of great interest and value. As has been said, its strength lies in its descriptions of facts, which are usually accurate and clear. Criticism and generalisation are both weak points in the work. The chemist will, however, be thankful for a generally readable account of the subject, and even grateful to the author, who has not been deterred from his task by the appalling number and complexity of the facts of chemistry, a circumstance which is chiefly responsible for the calamity that the most notable treatise on chemistry written in English in recent times, notable alike for its grasp of detail, its power of generalisation, and not least for its extraordinary clearness in brief description, never got beyond that first volume, which astonished the chemical world nearly half a century ago.

PRACTICAL PHYSICS.

Practical Physics: a Laboratory Manual for Colleges and Technical Schools. By W. S. Franklin, C. M. Crawford, and Barry MacNutt. Vol. i., Precise Measurements. Measurements in Mechanics and Heat. Pp. vii+173. Price 5*s.* net. Vol. ii., Elementary and Advanced Measurements in Electricity and Magnetism. Pp. vii+160. Price 5*s.* net. Vol. iii., Photometry. Experiments in Light and Sound. Pp. vii+80. Price 4*s.* net. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1908.)

THIRTY years ago Prof. E. C. Pickering published his "Physical Manipulation." The whole aim of the book, he told his readers, was to show how work in the physical laboratory might be made to teach a student to think for himself and to investigate; and in order to aid the instructor in the cultivation of originality he added to the 200 experiments described a hundred experimental problems as suggestions of what the student might with advantage be set to do.

In the book before us Pickering's aim has been completely lost sight of. The authors regard a laboratory course for undergraduates as

"having a two-fold purpose. On the one hand it serves to illustrate the principles of physics and their application to actual problems. . . . On the other hand it is intended to cultivate the power of accurate observation, to familiarise the student with methods of measurement, to give him skill and facility in the use of measuring instruments, and to develop in him the judgment necessary for the making of measurements in a manner adequate to the requirements of science, engineering and commercial work."

The character of the book is in close accord with the authors' conception of the educational utility of a laboratory course.

(1) The discussions by which most of the experimental exercises are introduced, while sufficient possibly for the objects in view, are in general quite insufficient to give the student an intelligent command of the methods involved. He is accordingly assumed not to have acquired it. There is some discussion, *e.g.*, of the balance and the barometer, and of the corrections which observations made with them may require, but the student is not trusted, in exercises in which these instruments are used, to settle the question of corrections for himself. He is told whether or not he is to apply any, and if any, which.

(2) The student is encouraged to make unintelligent use of formulæ. For example, he is given the expressions for the probable errors of an average and of a single observation, with a statement of their significance so short as to have a probable error of its own, and he is then directed in exercise after exercise to compute their values. He is not expected, apparently, to make any use of the results of his computations.

(3) Correct procedure being essential to the acquisition of skill in measuring, the student gets full directions as to what he is to do. Thus in the case of the Kelvin double bridge there is no general discussion of the arrangement, but a cut of a particular form of the bridge is given, and the student is even told to which binding-posts he must connect the terminals of his resistances and his galvanometer. The directions are not so detailed as this in all cases; but the course to be taken is in general fully pointed out.

(4) The student is in no case set to the serious investigation, or even testing, of physical laws. Perhaps the nearest approach to work of this kind is the study of the compressibility of air, and the following is a slightly condensed extract from the directions to the student:—

"Tabulate the values of $v(b \pm h)$ along with the values of v and $(b \pm h)$,—the positive or negative sign to be used according as the pressure of the entrapped air is greater or less than the pressure of the outside air. Determine the mean of the tabulated values of $v(b \pm h)$, and tabulate the differences between this mean and each of the tabulated values of $v(b \pm h)$. These differences represent errors of observations. Plot the pairs of values of v and $b \pm h$, using values of v as abscissas and values of $b \pm h$ as ordinates, and draw a smooth curve among the points so plotted."

There is little scope for the student's initiative here.

As to extent, the book contains 132 selected experiments. It does not claim to be exhaustive. In the selection the needs of the technical student have been kept in view, and the advanced electricity and the photometry are especially technical in their character. Among somewhat unusual things which are included are the Venturi water-meter, flash-point determinations, decomposition voltages, mean horizontal candle-power, and integrating photometry. Among important things omitted are thermoelectric and resistance thermometry, ice and steam calorimetry, quadrant electrometers, differential galvanometers, Newton's rings, and cardinal points of lens systems.

The book has minor defects due to insufficient editing of the laboratory direction papers on which it appears to have been based. There are dreary repetitions of similar, sometimes identical, directions. Unusual terms such as abampere are employed without definition. There are references to "the instructor" which should have been replaced by references to

published works :—" If the interferometer is not in adjustment, see instructor," for example. On the other hand, there are few slips, though Joule's experiment is credited to Thomson and Joule, and few typographical errors, though proper names are badly mangled.

The great defect of the book as a book for students is due to the fact that its aim is low. As hard thinking and independent thinking are essential features of any college discipline worthy of the name, a book the chief aim of which is to enable students to acquire skill in making measurements, though it may be useful for certain classes of technical students, could not be made a good book either for students generally or for the higher grades of technical students.

The chief merit of the book is the excellence of the advice it embodies as to the details of laboratory practice. From the authors' point of view procedure is of prime importance; and as a reference book on points of procedure their manual will be found useful even in old-fashioned laboratories which still aim at Pickering's ideal.

A STUDY OF THE MOON.

La Terre et la Lune: Forme extérieure et Structure interne. By P. Puiseux. Pp. 176. (Paris: Gauthier-Villars, 1908.) Price 9 francs.

A BOOK which seeks to throw light on terrestrial evolution from a study of the moon must possess considerable interest to both geologists and astronomers. But we may prophesy that this book will be more welcomed by geologists than by astronomers, or, at any rate, by mathematicians. For M. Puiseux, disregarding somewhat lightly the weighty dynamical reasons which have been brought forward by Kelvin and Sir George Darwin, among others, in favour of a solid interior to the earth, throws in his lot with those geologists who support the theory of a thin crust surrounding a liquid interior. He bases his argument partly upon purely terrestrial phenomena—and here we must frankly admit that we do not find his reasons convincing—and partly upon analogy from the moon. M. Puiseux points out many interesting points of resemblance between the general configuration of the earth and some of the principal features of the moon's surface; and his argument that the moon's surface, having suffered but slightly from the action of water, can throw light on a stage of development through which the earth has passed has much to recommend it. But we fail to follow him in the further arguments that he brings forward to prove that it is only the reaction of a liquid interior on a gradually thickening crust which can have produced the effects which are now to be seen on the moon's surface.

M. Puiseux is on less controversial ground when he discusses the order of development of the various types of marking on the lunar surface. The careful study which he has made of the face of the moon compels special attention to be paid to his views on this subject, and many of his conclusions command the reader's assent. The probable origin of the lunar craters is particularly well discussed, a strong presentation of the case for volcanic origin being given. In this connection we cannot forbear to quote the delightful sentence with which M. Puiseux closes his discussion of the question. Speaking of two humps, survivors of what in his view was the primitive form of the crater, he says :—

" Il semble que l'on doive regarder ces rares témoins d'image disparu avec un peu de cette vénération que les archéologues ressentent en face des médailles antiques."

The discussion of the past history of the moon's surface and of the relations between the different types of markings is illustrated by a fine selection of enlargements of the Paris photographs of the moon; these help materially to emphasise M. Puiseux's contention that the photographic method is markedly superior to the older methods of studying the moon's surface. Perhaps we may suggest that it would render the photographs more useful to the general reader if the special features of interest which they present, and to which attention is directed in the text, were more clearly marked.

Each of the subjects dealt with in the book contains an interesting historical account of the theories and speculations that have from time to time been put forward. The older speculations are fully discussed, but there are several notable omissions of recent work. For instance, the discussions on the pear-shaped earth by Profs. Jeans and Sollas surely deserve consideration quite as much as Lowthian Green's tetrahedron. Again, Prof. Love's spherical harmonic analysis of the earth's surface should also be considered in any complete account of speculations on the figure of the earth, while some reference surely ought to have been made in the book to the planetesimal hypothesis of Profs. Moulton and Chamberlin.

There are one or two further omissions that must be noted. For instance, there is no reference to the need for revision of the present method of naming objects on the moon's surface, such as one not unnaturally looked for from a member of the international committee engaged in considering such a revision. Again, the earlier illustrations of the book would be brought into closer contact with the text if a more detailed account of modern geodetical methods were added. This could be done without overweighting the book.

There remains the never grateful task of pointing out some errors that have slipped into the work. Thus the statement on p. 88 that the physical libration and the elongation of the moon along the axis pointing to the earth have never been determined by observation is inaccurate; it shows neglect of the results obtained by Dr. Hayn. A further statement on p. 91 about libration suggests that the author is confusing the forced physical libration with the free or unforced libration, which has not been surely determined. Again, on p. 100, Sir George Darwin's earlier estimate of the rate of rotation of the earth when the moon separated from it is given instead of his later estimate, 2h. 24m. But these errors can easily be remedied in the second edition, for which the interest of the subjects dealt with in the book must inevitably call.

F. STRATTON.

CANCER AND ITS TREATMENT.

(1) *The Conquest of Cancer: a Plan of Campaign.* By C. W. Saleeby. Pp. xxiv+397. (London: Chapman and Hall, Ltd., 1907.) Price 7*s.* 6*d.* net.

(2) *Cancer: Relief of Pain and Possible Cure.* By Skene Keith and George E. Keith. Pp. ix+155. (London: Adam and Charles Black, 1908.) Price 2*s.* 6*d.* net.

(1) IN the "Conquest of Cancer" Dr. Saleeby gives a full account of the trophoblastic theory of cancer, and of the evidence which led Dr. Beard to suggest the pancreatic enzymes as a rational treatment for the disease.

Briefly stated, Dr. Beard believes that as in the development of lower animals there is an alternation of an asexual and of a sexual generation, so in the higher animals there is an asexual larval stage upon which the embryo proper develops. The larval tissue or trophoblast is transitory, and its germ cells should entirely disappear; but the germ cells may wander widely, and the natural degeneration they should undergo may not ensue. If the latter event happen, the ultimate fate of the aberrant germ cells varies; they may lie quiescent throughout life, or for some reason they may start into active proliferation. Should the latter event occur a cancerous growth is the result.

Now the normal degeneration and disappearance of the trophoblastic tissue coincide, according to Dr. Beard, with the development of the activity of the pancreas, and are due, according to him, to the digestive action of the pancreatic enzymes. If the pancreatic enzymes thus cause the disappearance of the trophoblastic tissue of the embryo, it may be expected that the same injected into a person suffering from a cancerous growth will similarly cause the growth to degenerate. The pancreatic enzymes attack and digest trophoblastic tissue, whether of the embryo or of the cancer, but have no effect on the normal tissues. This in brief is the theory on which the pancreatic enzyme treatment is based.

In the second half of the volume practical details are considered—cancer and surgery, preparation of ferments and details of treatment, claims of the treatment, and results obtained. Dr. Saleeby, of course, is enthusiastic; other accounts by no means support his enthusiasm. Nevertheless, it is to be hoped that the method will have a thorough trial with approved preparations of the ferments.

In the final portion of the book the medical journals which have criticised the enzyme treatment come in for some hard sayings on the part of Dr. Saleeby. NATURE, too, does not escape. Dr. Saleeby says:—

"NATURE is not a medical journal, but the leading scientific journal in this country. It published (December 20, 1906) an adverse comment on my *Pall Mall Gazette* articles, and in its reply to the letter which its remarks drew from Dr. Beard stated that 'the pancreatic enzymes must be injected into the neighbourhood of the growth or used locally; how then could the secondary growths in internal organs be attacked! Until this can be done, no cure for cancer will have been obtained.' Dr. Beard's second letter, correcting this most important and inexcusable error, was not inserted, and the statement was allowed to stand."

The qualifying words "we believe" (which appear before "the pancreatic enzymes," &c., in the original) are omitted from this quotation, and "this inexcusable error" was *not* allowed to stand, but was corrected in NATURE of February 28, 1907, p. 424. If this be a sample of Dr. Saleeby's accuracy, a doubt must arise as to the exactness of some of his other quotations.

(2) In the introduction to the second book, "Cancer," the authors remark, "We gave trypsin a very extensive trial, but were completely disappointed in its use." The treatment advocated is the injection of a mixture of iodipin (an organic iodine combination), cacodylate of iron (an arsenic preparation), and cinnimate of sodium. The authors claim that this treatment markedly relieves the pain and other symptoms of cancer, and occasionally seems to cure.

R. T. H.

OUR BOOK SHELF.

Mosses and Liverworts: an Introduction to their Study, with Hints as to their Collection and Preservation. By H. T. Russell. Pp. xiii+200. (London: Sampson Low, Marston and Co., Ltd., 1908.) Price 4*s.* 6*d.* net.

NOTWITHSTANDING the frequent use of the term "life-history," the book under consideration only deals with the morphological side of the subject, and will be of greater service to systematists than to biologists. In the majority of systematic works, only just those structural features are countenanced that enable a student to determine the name of a given plant, the result being that a person may become fairly safe on the matter of names, whilst remaining quite innocent as to the general morphological and physiological features of the group he is studying. The second type of book, dealing with morphology proper, cytology, physiology, &c., that is, the biological aspect of the plant, is usually carefully avoided by the systematist. The present book follows a mean of the two extremes, and contains much useful information that would enable the systematist better to appreciate the part played by mosses and liverworts in the scheme of nature, and the ways and means by which such part is played.

Commencing with habitats, a very interesting account is given of the broad effects produced in nature by these minute plants, and also of their likes and dislikes in connection with climate, geological formations, and the surrounding vegetation. Commencing with the germination of the spore, the general morphological features of the succeeding structures of the asexual and sexual stages of a moss are treated somewhat in detail. The various vegetative modes of reproduction are also explained with accuracy. In dealing with the biological aspect of the subject, the author is not so much at home. Touching on the subject of fertilisation, it is stated:—"As a matter of fact we know no more of this process of fertilisation, what it is and how it is effected, than we know what life itself is and how it originated." Notwithstanding the occurrence of a few such blemishes, the book, as already stated, should prove of value to those students of mosses and liverworts whose sole knowledge of the structure of these plants is obtained from systematic works.

Eleven plates of very good figures illustrate the majority of the structural features dealt with in the text.

Methods of Surveying. A Manual for Students, Estate Agents, and Planters. By N. F. Mackenzie. Pp. ix+143; illustrated. (London: Bradbury, Agnew and Co., Ltd., 1908.)

WRITTEN by a practical surveyor and teacher, this manual is just what is required by the beginner, be he student or practitioner, in surveying. It contains just what is necessary and little that is superfluous; each step is so clearly indicated, and the little practical hints given are so apt, that a novice could go straight on with his work with only the manual to guide him; but a knowledge of plane geometry, trigonometry, and drawing is assumed. The book is only intended for teaching the methods employed in making large scale plans of comparatively small areas, therefore the methods of the trigonometrical survey and geodetic work are not given. The author deals in turn with chain surveying, prismatic compass surveys, theodolite traverses, levelling, plane table operations, and the determination and plotting of contours. Interspersed are chapters describing the various instruments, each of which is carefully explained in detail with the help of numerous photographs and diagrams. Problems are set and solved, and practical methods of overcoming incidental difficulties in the field are dealt with. As an example of the thoroughness with which each essential point is treated, one might take p. 21, where all the conventional signs employed to denote various objects shown on the finished plan are not only explained, but are also reproduced, and this is but one example among the many that this excellent manual contains. For teachers who have the desire, and are in a position, to teach real, practical geography, the book is the best we have yet seen. W. E. R.

A Guide to the Domesticated Animals (other than Horses) exhibited in the Central and North Halls of the British Museum (Natural History). Pp. vi+54; illustrated by 24 figures. (London: Printed by Order of the Trustees of the British Museum, 1908.) Price 6*d*.

DR. R. BOWDLER SHARPE states in a preface that this very attractive guide has been written by Mr. R. Lydekker, F.R.S., which is guarantee enough of its accuracy and completeness. The interest of the collection here dealt with to breeders, fanciers, and the public generally is self-apparent. Accompanied by such a guide as this little book provides, any intelligent person will be able to understand the principles exemplified by the specimens described. The excellent plates will make the book useful also to students unable to visit the museum.

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 Isothermal Layer of the Atmosphere.

IN NATURE of March 12, p. 437, I made some remarks under the above heading on temperature observations in the upper atmosphere, and suggested that it was desirable to have simultaneous records from thermographs of the different types in use in this country and abroad. From "Heft 2, Jahrgang 1907, of the Beob . . . . mit . . . . Ballons . . . ." recently published under the editorship of Prof. H. Hergesell, I find that the desirability of such comparisons had already been recognised on the Continent. There are only two or three examples of such comparisons in the volume, but they illustrate in a remarkable fashion the uncertainties which I was led to anticipate from general considerations. The thermographs compared were of two types—A (that of Monsieur Teisserenc de Bort), B (that of Prof. Hergesell).

Taking first Strassburg, we have data for the ascents only, on February 7 and 8, 1907. On February 8 the differences between A and B varied from 0·0 C. to 2°·1 C. in a total range of 52° C. In this case A gave, with one exception, the higher temperature, so the difference may have been partly due to "zero error" in one or both of the instruments. On February 7, as the balloon rose, the temperature recorded by A fell from −3°·4 C. at 140 metres to −60°·2 at 9280 metres. B, originally in agreement with A, gradually began to read lower, the difference amounting to 1°·8 when A recorded −34°·2. The difference then diminished, being only 1° C. when A recorded −60°·2. There then followed a thin isothermal layer, followed, as usual, by an inversion of temperature (a phenomenon not uncommon at comparatively low levels), but while A's temperature rose from −60°·2 to −58°·3 (or 1°·9 C.), B's only rose from −61°·2 to −60°·7 (or 0°·5 C.). The instruments then differed by 2°·4 C., and shortly after, when the ascent stopped—the temperature then being −53°·1 C.—by 2°·5 C.

When A, with falling temperature at 9140 metres, showed −58°·8, B read only 1°·2 lower, but when, after the inversion of temperature, A showed −58°·3 at 0690 metres, B read 2°·4 lower. There is thus in this case something quite different from mere zero or scale error. The cause must have been in the type or construction, or in the exposure of the instruments.

A still more instructive case is presented by the results obtained at Uccle on February 7, 1907, with the same two types of instruments; in this instance the observations are recorded during both ascent and descent. During the ascent the differences between A and B varied only from −0°·6 to +1°·1 C. As temperature fell to −42°, B usually read lower by a few tenths of a degree; at greater heights B read higher by from 0°·2 to 1°·1. During the descent, however, a marked difference of a systematic kind appeared, B reading higher than A. The maximum difference 2°·9 C. appeared when A recorded −46°·5, in spite of the fact that when A recorded −46°·3 during the *ascent*, B differed by only 0°·2. As the descent continued, the difference between A and B diminished and changed sign, until when A showed −8°·9, B read 1°·6 lower. Between the heights of 6000 and 1150 metres, when the extreme differences between A and B occurred, we have a range of 37°·6 from A as against 33°·1 from B, a difference of 4°·5 C., or about 12 per cent. On this occasion there was a marked inversion of temperature near the highest level attained, but the conclusions one would draw as to the nature or even as to the existence of an isothermal layer of finite thickness would depend a good deal on whether one took the ascending or descending readings, and in the latter event on whether A or B was accepted as correct. Thus, while A during the descent gave the same reading (−62°·5) at 9000 as at 10,090 metres, B read higher by 2°·2 at the lower level. Both at Strassburg and Uccle the differences between A and B became accentuated when temperature inversion occurred. So decided was the instrumental influence that in the short abstract accompanying the Uccle figures the writer speaks of "isothermie au T. de B."

In making these and previous comments, my object is not to criticise directly or indirectly any particular type of instrument, or any one observer or class of observers, but solely to secure the adequate and timely recognition of an idea, that idea being that no reasonable precaution should be omitted to ascertain how different types of meteorographs stand to one another, and how their records may best be interpreted. C. CHREE.

July 18, 1908.

The Nature of the γ and X-Rays.

THE arguments contained in Dr. Barkla's letter to NATURE of May 7 do not directly affect the position which I have taken in respect to the nature of the γ and X-rays. I have shown that all the striking phenomena of the secondary kathode radiations are simply and completely explained on a neutral pair theory, but not on the older theory of ether pulses. Dr. Barkla refuses to consider this large body of evidence on the ground that it is well to

deal with the simple and then proceed to the complex, and he would consider only the secondary X-rays. I grant this principle, of course, but I object entirely to the application which he makes of it. It is the γ rays which give the simpler effects, and the hardest γ rays which give the simplest, for the obvious reason that such rays ignore atomic structure altogether even in the case of the heaviest atoms. The X-rays are soft, and therefore atomic structure influences and complicates the effects to a remarkable degree, as Dr. Barkla's own work shows. A true application of the principle would lead us to work out the laws of the hard γ rays first, and then to consider the X-rays in the light of the knowledge we have obtained. This is what I have tried to do. The γ rays suggest a corpuscular hypothesis, and on turning to the X-rays it is at once clear that a large proportion of the effects which they show may also be simply explained on the same hypothesis.

Yet I am willing to meet Dr. Barkla even on the narrow ground on which alone he has chosen to risk encounter. He states certain pieces of evidence, numbered 1 to 9 in his letter, which should show convincingly that a theory of ether pulses is to be preferred to one of neutral pairs. Let us consider these.

No. 2 refers to the equal penetrating powers of primary and secondary rays in certain cases. This is a natural consequence of almost any theory, certainly of a corpuscular one, and the argument may be set aside at once.

No. 3 refers to the equality in the proportion of rays of different penetrating power which are scattered. The theory was given by Prof. Thomson in his "Conduction of Electricity through Gases," and experiments have been made by Dr. Barkla (*Phil. Mag.*, May, 1904) and Mr. Crowther (*Phil. Mag.*, November, 1907). The latter found notable exceptions to the rule, of which no theoretical explanation has yet been offered. The experiments are not easy, and there is enough chance of error to cover a considerable departure from the law, especially considering that no great variation of quality is possible with X-rays alone. In any case, there seems to be no reason for supposing the effect, if a true one, to be a special consequence of the pulse theory. It might well hold for a corpuscular theory, at least over the same limited range.

I have discussed No. 5 in a previous letter. The actual distribution of the secondary scattered rays agrees with the rule deduced by Dr. Barkla in special cases only. In others it does not, and the pulse theory does not say why. One might reasonably expect the rule to be of very partial application, for the secondary kathode radiation has such an extremely asymmetrical distribution that it is hard to believe in a complete symmetry of the remaining secondary radiation. Again, there seems to be nothing irreconcilable with a corpuscular theory.

As regards No. 6, it was asserted by Dr. Barkla as the result of his experiments that the ratio of the quantity of the secondary radiation to the quantity of the primary depended only on the density of the gas producing it. Prof. Thomson (*Phil. Mag.*, June, 1906) used the quantitative result as the base of one of three proofs that the number of electrons in an atom was nearly equal to the atomic weight. So far as I can judge, the proofs are not conclusive, and are not generally held to be so. In repeating Dr. Barkla's experiments, Mr. Crowther found the rule to be true only over a very limited range. C, N, and O did, indeed, give the same ratio, but all other atoms gave different ratios. In the case of H it was 70 per cent. larger, of He 10 per cent., of S 40 per cent., of Br about 8000 per cent., and so on. Any theory would show a constant effect over so narrow a range. Dr. Barkla considers his result to be evidence of value because it fits in with the result which Prof. Thomson derived from the ratio determined for air (N and O); but the strength of the other two proofs of Prof. Thomson's theory is hardly enough to permit this one to be removed and used to support Dr. Barkla's.

Nos. 1 and 4 refer to the well-known polarisation effects found by Dr. Barkla. The latter has been confirmed by Dr. Haga, who, however, rejects the former. I have already shown that it is not impossible to explain such effects on a neutral pair theory.

Lastly, there are the three statements Nos. 7, 8, and 9. They refer to certain remarkable effects observed by several workers, particularly M. Sagnac, Dr. Walter, Mr. Adams, and Dr. Barkla himself. Dr. Barkla says that they can be explained on the pulse theory. If any such explanation has been given I have not seen it, and I have not been able to devise any such explanation myself. The secondary X-rays from a substance like copper are homogeneous, and specially able to penetrate screens of the same substance. The homogeneity cannot result from sifting either primary or secondary rays, since it is complete when the radiation leaves the radiator, to say nothing of the difficulty of understanding how outer layers of a substance could sift rays emitted by inner layers of the same substance in the same condition. The effect cannot be due to anything like selective reflection, for then the secondary would be strongly turned back by screens of the same substance. For a similar reason it cannot be a true secondary. It must therefore be a transformed primary, transformed not by the conversion of primary energy into energy of secondary vibrations, but by a true change in its own properties. What can be suggested on the pulse theory as to the nature of this process? Again, in the case of the primary rays, a screen of any one substance has in nearly all cases the power of rendering the rays more penetrating to all other substances, but especially to that substance. It is true that this can be explained by sifting alone, *e.g.* a substance A might absorb soft rays, a substance B medium rays, and neither hard rays. But it can also be explained by true transformation of the primary as M. Sagnac and Dr. Walter have suggested, yet the transformation must not be accompanied by much scattering of the new radiation. I am aware that Mr. Adams (*Amer. Journ. Sci.*, xxiii., p. 376), unlike M. Sagnac, did not find any effect due to reversing two screens, but I am inclined to think that there is really some transformation of this sort. If that is so the effect will be very hard, if not impossible, to explain on the pulse theory. It is conceivable on a neutral pair theory, since the pair has properties which can be altered without disturbing the velocity and line of flight, so that the primary can be transformed without much scattering. Whether these surmises are correct or not, it seems to me that these particular phenomena give no support to the pulse theory.

Finally, it may be pointed out that the pulse theory will need radical alteration if it is to explain the asymmetrical effects which Dr. Madsen and I have lately investigated, and it is not clear that the revised theory will fit Dr. Barkla's experimental facts even as well as it does now.

W. H. BRAGG.

The University of Adelaide, South Australia, June 25.

The Discovery of the Weight of the Air.

THE discovery, in the first half of the seventeenth century, that the air has weight is associated with things of immense importance, for instance, the invention of the barometer and the refutation of the dogma—dear to the false science and the false philosophy of the day—that "Nature abhors a vacuum." In a new edition of the "Essais de Jean Rey," reviewed in NATURE of July 9, an attempt is made to assign this discovery to Rey, and, so far to regard Torricelli, Galileo, Pascal, and Descartes as his disciples. Without claiming to be an authority upon Rey or upon Galileo, I would direct attention to the statement, made in "Galileo—his Life and Work," by J. J. Fahie, that Galileo's way of determining the specific gravity of the air was first described in his letter to Baliani dated March 12, 1613. Rey's "Essais" was published in the year 1630.

Erroneous suppositions regarding Rey being frequently made, I may be allowed to quote Humphry Davy's description of the "Essais" as "a mere logical exercise in physical science." The fact that metals on calcination increase in weight was known to Cardan, Scaliger, Fachsius, Cæsalpinus, Hamerus Poppius, and Libavius, who are mentioned by Rey. For confirmation of the fact he relied upon the statements of his friend "le sieur Brun," and altogether the evidence that Rey made experiments of any value in support of his doctrines is slight.

A. N. MELDRUM.

Tannachie, Whitburn, Linlithgowshire, July 11.

ASTRONOMICAL ARCHÆOLOGY IN WALES.

A SOCIETY for the astronomical study of ancient monuments in Wales is being formed in imitation of a society for the same purpose which has been for some time at work in Cornwall. The movement was inaugurated in August of last year at Swansea, where Sir Norman Lockyer delivered a lecture to the members of the Royal Institution of South Wales, the oldest scientific society in Wales, on the antiquity of the Gorsedd. At the close of the lecture a resolution was passed in favour of forming "a society for the astronomical study of stone monuments in Wales." Since then other local scientific societies have given formal pledges of support to the work, such as the Cardiff and Rhondda Naturalists' Societies, and the Astronomical Society of Wales. The Swansea Scientific Society, under the leadership of the experienced archæologist, Colonel W. Ll. Morgan, have surveyed several monuments with an accuracy sufficient to meet the requirements of the astronomical inquiry. A small society at Bridgend has started work in the same direction.

The Swansea men first showed their appreciation of the work by printing Sir Norman Lockyer's lecture, to which diagrams were added to make the pamphlet a handy field-book for workers.

In the spring Sir Norman visited Anglesey and Carnarvonshire, and the present writer joined him. Anglesey is regarded as the last home of Druidism in Wales, and we were very pleased to find the measures of the monuments there, so to speak, so uniformly orthodox. Both before and since the visit Lord Boston and Mr. Neil Baynes have also been working on the monuments.

The results of the measurements made are as follows. They have already been communicated to the fellows of the new society:—

Theoretical Solar Azimuths, computed for sun's radius (2′ showing), taking refraction into account.

Alignment and conditions	Elevation of horizon		
	0°	1°	2°
Summer Solstice ...	N. 46° 40′ E.	N. 48° 45′ E.	N. 50° 36′ E.
Winter Solstice ...	S. 49 40 E.	S. 47 34 E.	S. 45 32 E.
May Sun ...	N. 60 48 E.	N. 62 32 E.	N. 64 12 E.
November Sun ...	S. 63 9 E.	S. 61 24 E.	S. 59 40 E.

Latitude taken generally as 53° N., magnetic variation as 18° W.; in calculating the solar declinations it is assumed that 2′ of the sun's radius was showing, and refraction has been taken into account.

Measures made by Sir Norman Lockyer and Rev. J. Griffith.

Summer Solstice, Rising (present declination, N. 23° 27′).

Bryn Celli Ddu.
Magnetic, 69°; true, 51°; (value along creepway); hill estimated 2°.
Az., N. 51° E.; dec., 23° 31′ N.

Summer Solstice, Setting.

Presaddfed.
Magnetic, 152°; true, 134°; through cromlech to back stone. Amp. = E. 44° S. reversed; take 1° hill.
Az., N. 46° W., dec., 25° 2′ N.

Winter Solstice, Rising.

Pen y Cwc.
Magnetic, 328°; reversed, 148°; true, 130°. Amp. E. 40° S.; sea horizon.
Az., S. 50° E., dec., 23° 28′ S.

Glyn.
Mag., 330°; reversed, 150°; true, 132°. Amp. E. 42° S.; take 1° hill.
Az., S. 48° E., dec., 23° 25′ S.

Ty Newydd, line of two supporters.
Mag., 155°; true, 137°. Amp., E. 47° S.; take 1° hill.
Az., S. 43° E., dec., 25° 47′ S.

Cefn Isaf, at right angles to big back stone (approximate).
Mag., 147°; true, 129°. Amp., E. 39° S.; hill, 0°.
Az., S. 51° E., dec., 22° 58′ S.

Llanfechell.
Line from cromlech to Meini Hirion (25-inch map); true, S. 50° E.; hill (from 1-inch map) about 26′; dec., 22° 35′ S.

May Year (declination 16° 20′ N. or S.).

May.

Pant-y-Saer.
Mag., 77°; true, 59°; sea horizon (visible).
Az., N. 59° E., dec., 17° 22′ N. May 10, August 4.

November.

Plas Newydd.
Mag., 137°; true, 119°. Amp., E. 29° S.; outlook toward Snowdon; hill, 3°.
Az. = S. 61° E., dec. = 14° 53′ S. November 2, February 9.

Pleiades.

Plas Newydd Mound.
Mag., 269°; reversed, 89°; true, 71°; hill, 0°.
Az. = N. 71° E., dec., 10° 50′ N. Pleiades, 1000 B.C.

Ystum Cegid (Criccieth).
Mag., 279°; reversed, 99°; true, 81°; hill, 4°.
Az. = N. 81° E., dec., 8° 30′ N. Pleiades, 1400 B.C.

Clock Star.

Lligwy, outstanding stone.
Mag., 208°; reversed, 28°; true, 10°; hill, ½°.
Az., N. 10° E., dec., 36° 15′. Capella, 1000 B.C.; Arcturus, 1200 B.C.

Measures by Lord Boston and E. N. Baynes, Esq.

Summer Solstice, Rising.

Bryn Celli Ddu.
Mag., 70°; true, 52°; hill (as above) estimated 2°.
Az., N. 52° E.; dec., 23° 0′ N.

Ty Newydd.
Mag., 71° 30′; true, 53° 30′; hill (as above), take 1°.
Az., N. 53° 30′ E.; dec., 21° 18′ N.

November.

Bodowyr (mean value of N. and S.E. stones).
Mag., 315°; reversed, 135°; true, 117°; hill (say), 2°.
Az., S. 63° E.; dec., 14° 50′ S. November 3, February 9.

Equinoctial.

Lligwy, angle of left opening stone; value from chamber under capstone.
Mag., 110°; true, 92°. Amp., E. 2° S.; sea horizon.
Az., S. 88° E.; dec., 1° 50′ S.

Henblas, direct outlook between supporters (approximate).
Mag., 108°; true, 90° = E.; hill (say), ½°; dec., 0°.

It is the aim of the society to bring together the workers on the astronomical inquiry. The annual subscription is three shillings. It is proposed to issue brief reports of progress. Besides the planning and orienting of the monuments, workers in Wales can help greatly by sending in all available information about them.

Now that the Prime Minister has promised to appoint a Royal Commission to inquire into the condition of the ancient monuments of Wales, it is to be hoped that advantage will be taken of such a golden opportunity to carry out an adequate astronomical survey of the stone monuments of the Principality.

JOHN GRIFFITH,
Hon. Sec., S.A.S.A.M. (Wales),
Llangynwyd, Glam.

WILD-LIFE PHOTOGRAPHY IN AMERICA.

THE greater part of the June issue of the *National Geographic Magazine* is occupied by a lavishly illustrated article by the Hon. E. Shiras (who claims, we believe, to be the pioneer in flashlight photography) entitled "One Season's Game-bag with the Camera." The author is convinced that photographing big game in their native wilds is in a fair way to supersede shooting them, although we are fain to confess that so far as this country is concerned we fail to see marked, if any, signs of the supposed impending change. The suggestion of Mr. Shiras that "one can buy at half the cost [of shooting the animals] the skins or horns that later may adorn the home as a result of the hunting-trip" is most assuredly one that will not appeal to the present-day British sportsman.

Apart from all this, the author is to be heartily congratulated on the pictorial results of the three trips upon which the article before us is based. These three trips comprised one in April to an isolated coral-reef in the Bahama group tenanted by large breeding colonies of "man-of-war birds" and "boobies"; a second to New Brunswick in search of moose and deer, and later on to Newfoundland for caribou; and a third to Florida for brown pelicans and other local birds. The majority of the photographs were obtained on Kay Verde, as the aforesaid coral-reef is called, and comprise some excellent pictures of the booby colony, together with individual boobies incubating (herewith reproduced), and of man-of-war birds on the wing as well as of their callow young. It appears that the former birds are compelled to protect their young from the fierce rays of the sun by brooding them with their wings. The photographs of flocks of pelicans on the wing come almost as a revelation, although in some instances the birds in the foreground are unavoidably more or less blurred. The picture of something like a thousand young pelicans disporting themselves at the water's edge is another calculated to make the bird-lover long for a glimpse of such a wondrous scene. Mr. Shiras was equally successful in "snap-shotting," either by flash-light or in daylight, moose in the forest and caribou swimming in the lakes, one of the pictures of the latter (Fig. 2) showing most admirably the white collar distinctive of full-grown stags.

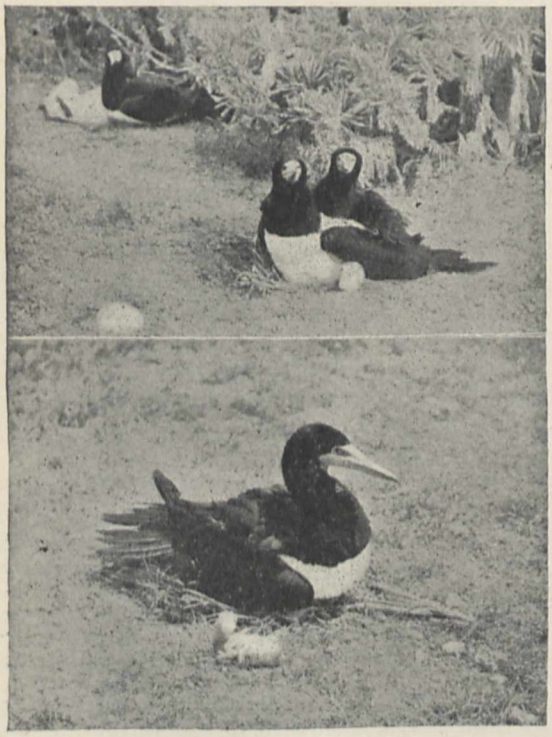

FIG. 1.—"Boobies" protecting their young from the sun, and a single bird incubating. From the *National Geographic Magazine*.

FIG. 2.—Caribou Stag with Symmetrical Horns. Photographed at a distance of 8 feet. From the *National Geographic Magazine*.

A CONTRIBUTION TO THE INDIGO QUESTION.[1]

A DECADE has elapsed since the chemical factories of Germany began to enter seriously into competition with plant indigo, and the gradual displacement of the latter by the synthetical product has from time to time been recorded in these columns. The writer of this notice was invited in 1900 to make known in this country the chemical history of this new development of applied science, and in a paper read before the Society of Arts the following year, after describing the various synthetical processes then available, attention was directed to the extraordinary want of skilled scientific supervision which had, down to that period, marked the cultivation of the plant and the processes of extraction carried on in India. In the year 1902 Mr. Bloxam was appointed to the research station of Dalsingh Serai, having associated with him Mr. H. M. Leake as biologist and Mr. R. S. Finlow as assistant chemist. Work was carried on in India by this staff until the spring of 1904, when Messrs. Bloxam and Leake returned to England.

[1] Report to the Government of India, containing an Account of the Research Work on Indigo performed in the University of Leeds, 1905–7. By W. Popplewell Bloxam, with the assistance of S. H. Wood, I. Q. Orchardson, R. Gaunt, and F. Thomas; and under the general supervision of Mr. A. G. Perkin, F.R.S., of the University of Leeds. (Published by Order of His Majesty's Secretary of State for India in Council.)

The results achieved down to that period were duly reported upon, and the report published by the Government of Bengal in 1905. Mr. Bloxam also gave an account of his work to the Chemical Society in 1904, and this was published by the Society in the 1905 volume of its Transactions. In the summer of 1905 the Government of India, through the India Office, authorised the continuation of the researches on indigo by Mr. Bloxam. The Clothworkers' Research Laboratory of the University of Leeds was appropriately chosen for the work, and the latter was placed under the general superintendence of Mr. A. G. Perkin, whose special familiarity with the chemistry of natural colouring matters is sufficiently well known to command full confidence in any results to which his name is attached.

So much by way of historical introduction. The report now before us is the outcome of the work carried on at Leeds by Mr. Bloxam and his colleagues from the summer of 1905 down to the end of last year. A careful consideration of the contents of this little official volume of about 117 pages will satisfy any impartial reader who is interested in the subject that the Indian Government has been well advised in the interests of a languishing native industry in authorising the continuation of the researches. The only point that arises, in fact, from the results so far obtained is whether the official authorisation of the work has not been prematurely brought to a close. The problems that have had to be worked out at Leeds are by no means simple—they were surrounded by experimental difficulties, and in spite of the very large amount of work carried out by the author and his colleagues, there still remain many questions of vital importance to the prospects of survival of natural indigo to which answers are urgently needed. To mention one only—why has it not hitherto been found possible to obtain from pure indican, the glucoside of indoxyl, a theoretical yield of indigotin by enzyme action or by chemical methods? It is probable that, under the conditions of manufacture, the indoxyl at the time of liberation, instead of condensing wholly to indigotin, gives rise to some secondary products (? indirubin and indigo brown) which, from a tinctorial point of view, represent so much loss of valuable material. If this secondary reaction could be converted into the indigotin condensation it might make an enormous difference in the struggle between natural and synthetic indigo. It is satisfactory to learn from the report that this point will be further investigated at Leeds.

The various papers published by Mr. Bloxam and his colleagues in the scientific and technical journals during the two years specified are re-printed in the present report, so that the case may be regarded as now presented in the order of its development. Section iii. is devoted to a consideration of the results of analysis of the indigo obtained from the "Mahai" of the plant grown on the experimental plots at the Dalsingh Serai Research Station during the season 1903. It is of interest to read, in connection with these results, the following passage:—"So to the author's extreme regret these expensive and laborious experiments result in inability to draw any exact conclusions as to the influence of the various manures —the results being completely obscured by the faulty and irregular nature of the 'Mahai'" (p. 98).

At the outset of his investigations the author decided, and we think wisely, that "before being certain of the efficiency of the manufacturing process, or of being able to suggest any valid improvement of it—two factors were necessary. (*a*) An accurate process for the estimation of the finished product (air-dried cake). (*b*) An accurate knowledge of the amount of colour which could be obtained theoretically from the manufacture, *i.e.* an accurate knowledge of the indigotin content of the green leaf." This extract furnishes the key to the whole of the subsequent work. It is now generally well known that a dependable analytical method for estimating indigotin has been worked out, and a very satisfactory process devised for estimating the indican in indigo-yielding plants. It is not necessary in these columns to enter into controversial points or into the minutiæ of analytical procedure. The merits of the "tetrasulphonate" method are sufficiently known to those who have used it or have seen it applied. Its accuracy is vouched for in an appendix to the present report by many well-known chemists who have given independent opinions—notably Prof. Norman Collie, Mr. A. C. Chapman, Prof. W. H. Perkin, and Prof. A. G. Green. As regards the beautiful application of v. Baeyer's synthesis of indirubin from isatin and indoxyl, suggested in the first place by Beijerinck as a suitable method for estimating indican, there was possibly a loophole for criticism in view of the most important fact that this method gives a higher result than any other known process for determining the quantity of indican in the leaf. It might have been fairly urged that in the leaf extract there might be contained substances other than indoxyl which, under the conditions of the analytical process, combine with isatin to give an insoluble compound which comes down with the indirubin and so adds to the weight of the dry precipitate. The answer to this objection is virtually contained in the present report, from which it appears that the indirubin obtained in the estimations is, as shown by ultimate analysis, a pure compound. But in order to get further assurance on this vital point, further experiments have, at the writer's request, been carried out at Leeds with the extract of the dried leaf of *Tephrosia purpurea*, in which not a trace of indican was found by the isatin method, the precipitate obtained being completely soluble in alkali. Special interest attaches to the selection of this plant because it is reputed to be indigo-yielding in a living state.

If it be now asked how, after this later work, stands the case for the indigo-planter, it must be conceded that if the results obtained by Mr. Bloxam and his colleagues are correct—and the present writer sees no reason for doubting their accuracy—there is yet hope for a considerable amelioration of the manufacturing process. The introduction of exact analytical methods has enabled the authors of this report to show that the older methods have overestimated the indigotin content of the dried "cake," and have underestimated the amount of indican in the leaf. If there is considerably more indican in the leaf than is accounted for by the present manufacturing process, there is assuredly scope for the further investigation of this process in the field. It may be a losing game; the "isatin method" may indicate results which are unrealisable in the factory. But these results are surely worth trying for in view of the enormous importance of the indigo cultivation to our Indian Empire. Even if the whole amount of indican in the plant cannot be made to yield the theoretical quantity of indigotin, there is still margin for such an improvement in the manufacture of plant indigo as to enable the latter at least to survive in face of the competition from the chemical manufacturers. Nor must it be forgotten that the Indian industry has a biological as well as a chemical side. The question was raised by the writer in 1901 whether there might not be plants suitable for cultivation in India containing a larger quantity of indican than those now made use of (*I. sumatrana* and *I. arrecta*). The answer is

contained in the report before us :—" Attention is now called to the remarkable specimen of leaf (*I. sumatrana*) . . . yielding in the air-dried condition, on analysis by the isatin process, almost twice as much indigotin as the best specimen of Java leaf " (p. 109).

This particular specimen appears to have been grown in southern India.

It is, unfortunately, only too notorious that those whose interests have been most severely assailed by the synthetical product, viz. the planters themselves, have assumed an attitude of hostility towards these later attempts to place their industry on a scientific basis. They have been advised, as the result of independent investigations by their own experts, that their present method of manufacture leaves no room for improvement. If this be the real state of affairs, then it may safely be asserted that the days of the native industry are numbered. The case has been further complicated by a most regrettable antagonism of parties, and at one period assumed a polemical aspect most detrimental to the real cause at issue. That cause is, in brief, the survival or extinction of the Indian indigo planter. It has transpired in the course of the development of the case that the decision whether the planters have been doing themselves justice as manufacturers has been of necessity thrown back upon the accuracy of certain analytical methods. It is on this very point that there has, unhappily, been conflict of evidence, and the planters have chosen, perhaps not unnaturally, that verdict which appeared to mitigate their past neglect of the scientific side of their industry. But if they have been wrongly advised, their advisers have made themselves answerable to the Indian Government and to the Indian nation on the very serious charge of having deliberately brushed aside the one chance of re-establishing the native industry which might fairly be expected to follow from the practical development of the results now made known. There are many scientific chemists in this country who, with full knowledge of the facts of the case, are distinctly of opinion that even a partial realisation of these results would enable the natural colouring matter to compete successfully with its chemical rival. R. MELDOLA.

THE DUBLIN MEETING OF THE BRITISH ASSOCIATION.

ALL indications point to a successful meeting in Dublin this year for the British Association. The number of visitors already announced renders it very probable that the attendance will largely exceed that at the last Dublin meeting in 1878, and will compare favourably with many of the more recent meetings.

The list of papers to be read is practically complete, and the time allotted to scientific proceedings will be fully occupied, as will be seen from the provisional programmes of the sections given below. In Irish circles great interest is displayed in the discussion on the working of the Land Acts and the relation of railways to the State, problems on which the average Irishman is rather more of an expert than the ordinary citizen. That Sir Horace Plunkett will preside at the agricultural subsection, which deals with cooperation and allied matters, is a happy touch. Sir Horace founded, in 1896, the Recess Committee of Irish Parliamentarians, a non-political body convened for the purpose of gaining information with regard to the best methods of cooperative agriculture carried on abroad. That body subsequently led to the foundation of the Irish Board of Agriculture and Technical Instruction, which took over the whole of the work of the Science and Art Department in Ireland and a number of new duties, with the immediate result of regaining for the Irish producer much of his pre-eminence in the butter and egg market. Sir Horace Plunkett was the first vice-president of the new board, and although Ireland was considered to be " boarded over " already to suffocation, the new office had no difficulty in making itself beneficially felt from end to end of the country.

A considerable number of manufacturing establishments will be open to the inspection of members who visit Dublin. Foremost among these is Guinness's great brewery at St. James's Gate, one of the largest works of the kind in the world. These works will be open daily from 11 to 3, but the special British Association day will be Thursday, September 3.

The Dublin Corporation will show its electric light works daily from 10 to 4. These are situated on the site of the old Pigeon House Fort, on the south wall of Dublin Harbour. They lie right out in the sea, in the centre of Dublin Bay, surrounded by the unsurpassable scenery of the Dublin coast. The generating station of the Dublin United Tramway Company at Ringsend is also well worth a visit as the first representative of the three-phase system of traction in the United Kingdom. Dublin has every reason to be proud of its tramways.

Small parties of twelve will be admitted to Perry's planing and saw mills in Camden Row. I understand that ladies will not be encouraged to visit these, on account of the dangers threatened by the machinery.

No such restriction applies to Atkinson's poplin factory in Thomas Court, where visitors will be welcomed on the Tuesday, Wednesday, and Thursday. Poplin is a peculiar mixture of silk and linen, which combines most of the advantages of both materials. Its manufacture was introduced into Dublin by the Huguenot refugees in the eighteenth century, and has flourished ever since. Irish poplin is always among the materials worn at the Royal and Viceregal courts on Irish occasions.

Among the other establishments to be visited are Peterson's pipe factory, Jacob's biscuit works, Power's distillery, Winstanley's boot works, the Alliance gas works, and the great railway works of the Great Southern and Western Railway at Inchicore.

The social gatherings are numerous and attractive, as befits the gay city on the Liffey. On Wednesday, September 2 (the opening day), the Lord Mayor and Lady Mayoress will be at home at the pretty Mansion House in Dawson Street from 3 to 6 p.m.

On Thursday, September 3, the Provost and senior fellows will give a garden party at Trinity College from 3.30 to 6.30 p.m. This will be followed at 8 p.m. by a conversazione at Leinster House, the spacious and historic home of the Royal Dublin Society in Kildare Street. Smaller receptions will be given on Friday, September 4, by the Dean of St. Patrick's at his deanery, by the Irish Astronomer Royal at Dunsink Observatory, and by Miss White at Alexandra College. On the same day, at 2.30, a special *matinée* performance of Irish plays will be given at the Abbey Theatre (the Irish national theatre) of Yeats's *Hour Glass* and *Riders to the Sea*, and Lady Gregory's comedy *Spreading the News*. These should prove particularly enjoyable to those who look for a refreshing native atmosphere.

Saturday will be largely devoted to excursions, but a smaller conversazione will be given in the evening by the Classical Association of Ireland in the hall of the Royal College of Physicians.

For Sunday, September 6, special services will be arranged in various churches, and a special sacred concert, open to all members, will be given at the

Kingstown Pavilion, by special arrangement with Messrs. Adeler and Sutton.

The remaining days will be filled as follows:—Monday, September 7, 3.30 p.m., garden party at St. Anne's, Clontarf, given by Lord and Lady Ardilaun; Tuesday, 3.30, garden party at the Zoological Gardens, given by the local committee. At 8.30 p.m., reception by Viscount and Viscountess Iveagh at 80 St. Stephen's Green. Both Lord Iveagh and Lord Ardilaun belong to the Guinness family.

Wednesday, September 9 (closing day), garden party by their Excellencies the Lord Lieutenant and the Countess of Aberdeen at the Viceregal Lodge, Phœnix Park.

The excursion programme for Saturday, September 5, provides for six different routes. Perhaps the best of these is the excursion to Mellifont Abbey and the prehistoric tumuli of Dowth and Newgrange on the Boyne, passing on the way through Monasterboice and Drogheda. It leaves Amiens Street at 9.15 a.m., inclusive fare, 12*s*. Route B leads by Rathnew through the wild Devil's Glen to Glendalough, an old monastic retreat situated among the grandest scenery of County Wicklow. It leaves Harcourt Street 10 a.m., inclusive fare, 11*s*. 6*d*. Route C proceeds south-west to visit Killaloe, its cathedral, and (by steamer) Holy Island, on Lough Derg. It leaves Kingsbridge at 9 a.m., inclusive fare, 13*s*. 6*d*. Route D comprises Athlone, the "lordly Shannon," and the ancient and picturesque ecclesiastical ruins of Clonmacnois, where St. Kieran founded an abbey as early as A.D. 548. It leaves Broadstone station at 9 a.m., inclusive fare, 13*s*. 6*d*. Route E leads to Bray, the Dargle Glen, and to Powerscourt Waterfall, ending with a reception by the Earl and Countess of Meath at Kilruddery at 3.30 p.m. Route F leads south to the historic Rock of Cashel, Holycross Abbey, and Thurles. It leaves Kingsbridge at 9 a.m., inclusive fare, 13*s*.

Among the foreign invited guests of the British Association the following have accepted to date:—John Graham Brooks, Moritz J. Bonn (Munich), Prof. J. W. Brühl (Heidelberg), Prof. Ernst Francke (Berlin), Prof. Gustave Gilson (Louvain), Prof. A. A. Hubrecht (Utrecht), Prof. E. J. James (Illinois), C. W. Rubensen (Christiania), Prof. A. L. Rotch (of the Blue Hill Meteorological Observatory), Prof. Lotsy (Leyden), Haakon Schetelig (Bergen Museum), Prof. Achille Russo (Catania), M. Teisserenc de Bort (Paris), Prof. A. Kossel (Heidelberg), and W. Vernadsky (St. Petersburg).

A novel feature will be the intersectional telephone service, whereby a list of papers being read at each section will be on view at every section. This will be organised by means of a special telephone service worked by a staff of more than thirty operators. Communication between the various sections will be facilitated by a special tram service connecting all the sections, and also by a service of motor cars kindly placed at the disposal of the local committee.

The funds locally required have been subscribed without any very special effort, and a large amount of hospitality is being offered. E. E. FOURNIER.

PROVISIONAL PROGRAMMES OF SECTIONS.

SECTION B (CHEMISTRY).—A leading feature in this year's programme are discussions arranged with the object of focussing as clearly as possible the present state of knowledge and opinion. The subjects selected are:—Fermentation; the nature of chemical change; peat; and colloids. In the first, Dr. Harden, Prof. A. J. Brown, Dr. Slator, Dr. E. F. Armstrong, and others are taking part. The subject of chemical change will be introduced by Prof. H. E. Armstrong, and his views should provoke a lively opposition on the part of the upholders of the ionic theory. Peat has been selected as likely to arouse local interest; those contributing include Dr. Wohltereck, Capt. Sankey, Prof. Ryan, Prof. Johnson, Prof. Lyon, Dr. Adeney, Mr. K. B. Eller, and others. Prof. Procter will present a report on the present position of the chemistry of the colloids, and Dr. Findlay promises a paper in this subject. Sir Wm. Ramsay, K.C.B., is contributing a popular account of his recent researches entitled "The Inactive Gases," in which these and the emanations will be dealt with in respect to the periodic table. Prof. W. H. Perkin will describe synthetical experiments in the terpene series, and other papers from his laboratory are promised by Messrs. C. Weizmann and R. Robinson. Further papers in organic chemistry will be contributed by Prof. F. S. Kipping—optically active silicon compounds—Dr. F. D. Chattaway, and Mr. M. Nierenstein. Prof. Pope and Mr. Barlow will deal with valency, a subject which provoked so much discussion last year. Other papers include:—The properties of oxygen; and the curriculum in chemistry, Prof. H. E. Armstrong; the selective permeability of the coverings of certain seeds, Prof. A. J. Brown; rapid electrolysis, Dr. Sand; mercerisation, Dr. Hübner.

SECTION C (GEOLOGY).—Great interest centres in the address of the president, Prof. J. Joly, F.R.S., who will deal with the question of radium and geology. At the Leicester meeting Prof. Joly gave a foretaste of the widespread effects which radium may exercise on geological problems, and in the hands of one who is at once a high authority on physics as well as geology we may look for important and stimulating results. After the president's address, Prof. Cole will give a popular lecture on the general geology of the Dublin district, and a series of excursions arranged by Mr. H. J. Seymour will enable members to gain a practical knowledge of the district. Other papers dealing with local geology will be given by Prof. Cole (1) on probable Cretaceous outliers off the coast of co. Kerry, (2) on the laterite and bauxite zone of north-east Ireland. Mr. H. Bolton will describe a section of the emerald pit at Dungannon, and an important contribution by Messrs. R. J. Ussher, H. J. Seymour, E. T. Newton, and Dr. R. F. Scharff will throw new light on the question of the age of some caves in Castle Park, near Doneraile. Petrology will be represented by papers by Dr. F. W. Hume on the petrography of Egypt, Prof. Joly will record the occurrence of native iron in the Deccan basalts, Mr. W. G. Fearnsides will describe the tourmaline rocks of Cwm Dwthwc, near Llanberis, and Mr. H. Brodrick will give an account of the formation of cave pearls. Palæontology does not promise to occupy an undue amount of time, but the announcement by Mr. H. Brodrick of the occurrence of reptilian footprints in the inferior oolite of Whitby, and the report on the fauna and flora of the Trias, will no doubt arouse some interest. In general geology, Prof. W. M. Davis, of Harvard, will give a new rendering of the glacial erosion which has taken place in the Snowdonian district. Dr. Tempest Anderson will describe the changes which have taken place in St. Vincent since the great eruption, and Dr. Woolacott will give an account of a case of thrust and crush brecciation in the magnesian limestone of co. Durham. A discussion on mountain building has been arranged, and it is expected that some of our foremost geologists will take part. *Habitués* of Section C always look forward to an address by Prof. J. Milne, and his contribution on the duration and direction of large earthquakes will be as suggestive and inspiring as any in the past. Besides the papers mentioned above, the results of the various research committees will be presented to the meeting.

SECTION D (ZOOLOGY).—Dr. S. F. Harmer, F.R.S., in his presidential address, will deal with polyzoa. *Discussions*:—(i) On the abuses resulting from the strict application of the rule of priority in zoological nomenclature, and on the means of protecting well-established names, opened by Mr. G. A. Boulenger, F.R.S.; probable speakers: the president, Dr. Smith Woodward, F.R.S., Dr. Hoyle (Manchester), and others. (ii) Determination of sex, opened by Mr. Doncaster; probable speakers: Prof. Bateson, F.R.S., Mr. Punnett, Mr. Walter Heape, F.R.S., Prof. Russo (University of Catania), jointly with Section K; afternoon lecture (lantern): Some points in the evolution of

fishes, Dr. Smith Woodward, F.R.S. *Papers:* Wild ancestors of the domestic horse, Prof. Cossar Ewart, F.R.S.; gastrulation of Amphioxus, Prof. MacBride, F.R.S. (Montreal); Arctic and Antarctic Collembola, Prof. Carpenter; reciprocal mimicry or diaposematism, Dr. F. A. Dixey; migrations of wading birds, Prof. C. J. Patten; lantern demonstration of the segmentation of marsupial ova, Prof. J. P. Hill; an inquiry into the feeding habits of birds, Mr. Gordon Hewitt; some points connected with the vertebrate alimentary canal, Prof. Alex. Fraser; nerve cells and giant nerve fibres in worms, Dr. Ashworth; vascular system in Stylodrilus, Mr. R. Southern; (α) maxilla and palatine in mammalia, (β) epiphyses in reptilia, Prof. R. J. Anderson; distribution of Irish fresh-water mites, Mr. Halbert. Monday, September 7, will be devoted to a joint session with Section I.

SECTION E (GEOGRAPHY).—The president (Major E. H. Hills, C.M.G.), will give an address on the survey of the British Empire; Prof. W. M. Davis, of Harvard, will read a paper on the physiographic subdivisions of the Appalachian mountain system, and their effects upon settlement and history; the Rev. W. Spottswood Green will discuss certain effects of geographical conditions in Ireland; Prof. R. A. Gregory will discuss school geography as a mental discipline, and Prof. J. L. Myres will give a paper on the geographical study of Mediterranean man in connection with classical education; Mr. W. L. Grant, of Oxford University, will lecture on geographical conditions affecting the northward development of Canada, in especial view of the visit of the Association next year to Winnipeg; Capt. F. V. Thompson and Mr. E. A. Reeves will exhibit and demonstrate surveying instruments designed by them; Capt. Thompson's work has been directed towards the development of stereophotographic surveying; Mr. H. G. Fordham will discuss and illustrate early county maps of England and Wales; Capt. H. G. Lyons will lecture on the longitudinal section of the river Nile; Mr. L. G. Bernacchi will give some results of a visit to Peru, and the Rev. S. Furlong will describe and illustrate volcanic phenomena in Samoa; Mr. Harold Brodrick will give results of his explorations, with illustrations, in the Marble Arch caves in the county Fermanagh, and Dr. Charles A. Hill will similarly describe the Mitchelstown caves in the county Tipperary.

SUBSECTION F (AGRICULTURE).—*September* 3: Presidential address, Sir Horace Plunkett; agricultural education, Prof. J. R. Campbell; some Irish experiments on warble flies, Prof. G. H. Carpenter; Barley growing and selection in Ireland, Herbert Hunter; electricity in agriculture, Sir Oliver Lodge, F.R.S. *September* 4: Discussion on breeding and the relation of modern theories of heredity to the problems of the stock-raiser, opened by Prof. W. Bateson, F.R.S., followed by Prof. T. B. Wood, Mr. W. Heape, Mr. R. C. Punnett, Dr. J. F. A. Marshall, and Prof. James Wilson. *September* 7: Discussion on small holdings—some considerations on their successful establishment," opener, Mrs. Wilkins. *September* 8: Joint meeting with the economics section: psychological aspects of agrarian reform, Dr. Moritz J. Bonn; the increase in the productivity of English agriculturists during the last two centuries, Prof. James Wilson; statistical and economic investigation in agriculture, W. G. S. Adams.

SECTION G (ENGINEERING).—*September* 3: Address by the president of the section, Mr. Dugald Clerk, F.R.S. *September* 4: Report of the committee on gas explosions, to be followed by a discussion jointly with members of the physical and chemical sections. *September* 7: Recent advances in steam turbines, Mr. Gerald Stoney; producer gas, J. Emerson Dowson; suction gas producers, P. W. Robson; the utilisation of peat for making gas or charcoal, Capt. H. Riall Sankey, R.E. *September* 8: The laws of flight, F. W. Lanchester; on the causes of wear in motor vehicle machinery, F. H. Royce; on a fundamental error in the theory of power transmission by belts, W. Worby Beaumont; railless traction, F. Douglas Fox.

SECTION H (ANTHROPOLOGY).—The proceedings will include a number of communications of first importance. Prof. G. Elliot Smith will read a paper on the history of mummification in Egypt, and in a second communication —anthropological work in Egypt—will deal with the physical type of the Egyptians from the earliest discovered human remains to the present day. A paper by Mr. C. T. Currelly, on the sequence of Egyptian flint implements, is of special importance in reference to the question of the relation of the Stone age of Egypt to that of Asia and Europe. Mr. J. P. Droop will describe a Neolithic site in the valley of the Spercheos; Mr. Thompson, the important excavations in Sparta during the past season; while a communication by Prof. R. C. Bosanquet will deal with the Minoan settlements in eastern Crete. Local archæology finds a place in a discussion on the Iron age in Ireland, of which the nucleus will be formed by papers by Messrs. G. Coffey, Armstrong, and Prof. Scharff, the last-named dealing with the early history of the horse in Ireland. Among other archæological papers may be mentioned one by Dr. H. Schetelig, of the Bergen Museum, on sculptured stones in Norway and their relation to some British monuments; prehistoric archæology in Japan, by Mr. Gordon Munro; and reports on the excavations made at Avebury by the Stone Circles Committee, at Caerwent by Dr. T. Ashby, and on the work of the Liverpool Committee for Excavation and Research in Wales and the Marches. Papers on general ethnography and the history of religion include a communication by Dr. C. G. Seligmann embodying the results of his recent expedition among the Veddahs of Ceylon; on a collection of Dinka laws and customs, by Mr. E. S. Hartland; the wandering of a cult in India—the god of the flood, by Sir Richard Temple; and a paper dealing with the origin and customs of the Mahrattas and Rajputs, by Mr. W. Crooke. Papers in physical anthropology include, in addition to that by Prof. Elliot Smith already mentioned, an important communication by Prof. D. J. Cunningham on the supraorbital region of the Neanderthal race; a paper by Mr. J. Gray, in which an attempt is made to identify the builders of the British Megalithic monuments with the hyperbrachycephalic race, of which remains have been discovered in the north-east of Scotland; and a paper by Prof. A. Fraser on certain points connected with the human brain.

SECTION I (PHYSIOLOGY).—*September* 3: Address of president, Dr. J. S. Haldane, F.R.S.; report of committee on the metabolic balance sheet of the individual tissues; report of committee on the effect of climate upon health and disease; report of committee on the ductless glands. *September* 4: Discussion on mental and muscular fatigue, opened by Dr. W. MacDougall, followed by Prof. J. S. MacDonald, Prof. T. H. Milroy (colour fatigue), Mr. H. Sackville Lawson (some aspects of mental fatigue, measurements by æsthesiometer); report of committee on body metabolism in cancer; report of committee on the electrical phenomena and metabolism of arum spadices. *September* 7: Joint meeting with Section D. Papers promised for joint meeting: Bionomics of tsetse-flies, R. Newstead; cultures of amœba, Dr. J. W. Stephens; on the action of atoxyl and allied compounds *in vivo* and *in vitro*, Dr. M. Nierenstein; on the life-history of piroplasma canis, Dr. A. Breinl and Mr. Hindle; pharmacological treatment of trypanosomiasis, Prof. B. Moore; the action of acids and alkalies on the growth and division of animal and vegetable cells, Prof. B. Moore and Dr. H. E. Roaf; digestive enzymes of invertebrates, Dr. H. E. Roaf. *September* 8: Discussion on instruction of school teachers in physiology and hygiene, opened by Prof. C. S. Sherrington, F.R.S., followed by Prof. W. H. Thompson and Prof. F. Gotch, F.R.S. Other papers (dates not yet arranged): Localisation of the brain in lemurs, Prof. W. H. Wilson and Prof. G. Elliot Smith, F.R.S.; localisation of the human cerebral cortex and the nature of sulci, Prof. G. Elliot Smith, F.R.S.; the functions of salts in metabolism—a request for information, Prof. H. E. Armstrong, F.R.S.; the relationship of the fundic to the pyloric part of the stomach, Dr. E. P. Cathcart. Arrangements will be made for demonstrations in the physiological laboratory of Trinity College.

SECTION K (BOTANY).—The presidential address will deal with the manifestations of the fundamental quantitative laws of physical chemistry in the living organism. Physiological communications are expected from Prof. Dixon, of Dublin, on the ascent of water in wood; from Prof. Bose, of Calcutta, on the mechanical and electrical responses of plants (with demonstrations); and from several workers in

the Cambridge botany school on researches connected with photosynthesis in green plants; an account will be given by Miss Harriette Chick, of the Lister Institute, of the important laws governing the rate of killing of bacteria, brought out by the scientific study of disinfection; and some consideration will be given to the application of these laws to higher types of plants; Mr. Balls, of Cairo, will contribute a novel theory of the mechanism of mitosis; Mr. A. G. Tansley will read a paper on the woodlands of southern England, giving an account of the work done under the auspices of the central committee for the survey of British vegetation, by which a natural classification of these woods has been arrived at. There will be a discussion on the origin of dicotyledons, and the section will also join in a discussion organised by Section D on the determination of sex in animals and plants. It is expected that various distinguished foreign biologists, Prof. Bateson, and other zoologists will take part. Prof. Keeble, of Reading, will deliver the semi-popular lecture, giving an account of his interesting researches on the symbiosis between unicellular algæ and the marine worm Convoluta.

SECTION L (EDUCATIONAL SCIENCE).—Meetings for discussions and the reading of papers will be held in the mornings only. Visits have been arranged to selected schools on four afternoons. *September* 3: Presidential address, Prof. L. C. Miall, F.R.S.; the outlook: a grand experiment in education, Prof. H. E. Armstrong, F.R.S.; education under local authorities, Mr. R. Blair; schools for defective children, Mrs. Burgwin. *September* 4: Discussion on education in relation to rural life; openers, Prof. L. C. Miall, F.R.S., Prof. D. Houston, Miss Lilian J. Clarke, the Most Rev. Dr. Foley, Dr. W. J. M. Starkie, Mr. George Fletcher, and Mr. C. H. Bothamley. Practical studies in elementary schools: report of subcommittee on experimental science studies, Mr. W. M. Heller. *September* 7: Discussion on tests of educational efficiency (examination and inspection), openers, Mr. T. P. Gill and Dr. C. W. Kimmins; discussion on training in teaching, openers, Miss C. P. Tremain and Mr. C. Macgregor; open discussion on (1) note-taking and reports on work, (2) clear speaking and reading aloud, (3) motive and purpose in experimental work. *September* 8: Discussion on types of education and their relative values, openers, Dr. G. Archdall Reid and Prof. E. P. Culverwell; discussion on experimental inquiry in education, openers, Prof. J. J. Findlay (with Mr. P. Sandiford) and Prof. J. A. Green; curricula of secondary schools: report of subcommittee on the sequence of science subjects, Mr. G. F. Daniell.

LORD BLYTHSWOOD, F.R.S.

THE number of great territorial magnates who take a practical interest in science is no doubt larger than appears at first sight, but it is nevertheless regrettably small. Many of our landed gentry are unfitted by inclination and temperament to play any part in the game of politics, and their education, though it has not been without a certain valuable influence on character, has not, as a rule, been such as to encourage and develop that healthy and keen interest in natural things which is shown by almost all boys at an early age. Thus too many men, who have been placed by fortune above the necessity of earning their living in business or in the professions, are driven to spend their days in sport of one kind or another from year's end to year's end. At the best they lead a life, healthy it may be in a physical sense, but productive of no particular good to the community or the world at large, and detrimental to the strong plea which can be put forward for the existence of a leisured and broadly cultured class.

Happily there are and have been notable exceptions, and among these the late Sir Archibald Campbell, Lord Blythswood, must be accorded a high place. Born in 1835, the son of Archibald Campbell of Blythswood, he was of direct descent from the old Douglases who played such a prominent part in the English and Scottish wars of the thirteenth and fourteenth centuries, and was a member of the semi-regal family of the Campbells, who, whatever faults and foibles may have been rightly or wrongly attributed to them, have been conspicuous in the Scottish struggle for civil and religious freedom. In early life he was, as befitted such an ancestry, both soldier and politician. He saw active service with the Scots Guards in the Crimea, where he was severely wounded, and continued in the army until the death of his father in 1868. He then retired with the rank of lieutenant-colonel, to devote himself during the remainder of his life to work for the auxiliary forces, to politics (he was a keen Conservative), and to science.

He was married in 1864 to the elder sister of the present Lord Carrington, and held the offices of Lord Lieutenant of the County of Renfrew and of *aide-de-camp* to the late Queen Victoria. He sat in Parliament for West Renfrewshire from 1883 until 1892, when he was raised to the peerage as Baron Blythswood. He was elected to the Fellowship of the Royal Society in 1907. For some time Lord Blythswood had been in failing health, and the early part of the present summer was spent by him and Lady Blythswood in the south of France. On July 8 he died of heart failure at his seat of Blythswood, near Renfrew.

For a long time Lord and Lady Blythswood acted as hosts to members of the Royal family when they visited the west of Scotland for public functions; he entertained the King and Queen when—as Prince and Princess of Wales—they visited Glasgow to lay the foundation stone of the new university buildings at Gilmorehill in 1870, Queen Victoria when she opened the Glasgow Exhibition in 1888, and the Prince and Princess of Wales when they opened the new Natural Philosophy Institute and the new medical buildings of the university in April of last year.

But though Lord Blythswood had many interests, and devoted much time and attention to them all, his ruling passion was for physical science. He established at Blythswood a laboratory and workshop, which he equipped with the best instruments which could be procured for investigation, and with tools of the most refined description for the construction of apparatus and for the realisation of his own ideas regarding astronomical and physical machinery.

He employed skilled experimenters and mechanics to aid him in the work of construction and observation, and he obtained some notable results. He was a strenuous worker with his own hands at the bench; indeed, one of the most striking exhibits of the Glasgow Exhibition of 1888 was some fine wheelwork (for a magnificent astronomical driving clock), which had been cut by him in an almost incredible number of hours of continuous work.

Lord Blythswood's earlier work was mainly constructional, and valuable service was rendered to science by the improvement of tools and processes which resulted. A very important instrument, his great dividing engine, is perhaps the most striking outcome of this part of his scientific activity. As it now stands, this instrument is capable of ruling diffraction gratings with very great accuracy to as many as 14,400 lines to the inch, and many gratings of excellent optical quality have been made with it; but it has taken twenty-five years of modification and improvement to bring it to its present state. By a carefully designed and ingenious motion the diamond point is brought very gradually into contact with the surface to be ruled, so that disaster from its breaking is entirely avoided. Surely the skill and patience required for such work is as well deserving of recog-

nition as a service to science as many more showy performances.

Several very large Wimshurst electrical machines (including one of 160 plates!), in which the oppositely rotating plates are specially mounted so as to run truly and smoothly, were made in the workshop, and greatly increased the experimental resources available for X-ray work and the investigation of the phenomena of electrical discharge.

Lord Blythswood himself came very near to the discovery of the X-rays, for he had obtained photographic action through various opaque substances before Röntgen made his memorable announcement. Since that time much work has been done in the Blythswood laboratory on this subject. With the skilful help of Mr. H. S. Allen, and more lately of Mr. Walter Scoble, Lord Blythswood carried out many interesting researches on spectrum photography and the Zeeman effect, in radiography, and in radio-activity generally.

During the last year or so Lord Blythswood and Mr. Scoble had been engaged in experiments in flight. In the course of these they designed an air-engine for a model aëroplane, which gave more than one-half of a horse-power and weighed only two pounds! The air for driving this engine was stored in the liquid form, so as to keep down the weight of the containing vessel.

At the end of a long and active life, Lord Blythswood has passed away, leaving a fine record behind him of good work done and notable results obtained. If his example should lead other men of means and leisure to follow in the same path, then in a more than usual but very real and true sense his work will follow him. A. GRAY.

THE NATURAL HISTORY MUSEUM.

TEN years ago, upon the retirement of Sir William Flower from the post of director of the Natural History Museum, a memorial signed by many distinguished men of science (see NATURE, July 14, 1898) was presented to the trustees of the British Museum urging that it is "of great importance to the welfare of natural history that the principal official in charge of the national collections relating to this subject should not be subordinate in authority to any other officer of the Museum." The recent retirement of Sir Ray Lankester has again provided an opportunity for pressing the adoption of this principle, and a strong deputation waited upon the Prime Minister on Tuesday to ask for an inquiry into the administration of the Museum. From the *Times* report we extract the following account of the interview:—

Prof. Adam Sedgwick, F.R.S., said the objections to the present administration of the Natural History Museum had reference to a system, and not to individuals. For many years the condition of the Natural History Museum and its mode of government had been a standing grievance to naturalists, and many endeavours had been made to obtain a separate government for it. The reasons of the deputation for asking for an inquiry could not be better expressed than by summarising the history of the principal attempts which have been made to bring about a change in the methods of administration of the museum. Forty-two years ago the most distinguished men of science of the day, in a memorial to the Government, expressed the opinion that "it is of fundamental importance to the progress of the natural sciences in this country that the administration of the national natural history collections should be separated from that of the library and art collections." Thirty-five years ago a Royal Commission, in pressing the same points, directed attention to the statements of witnesses that it was "unsatisfactory that the national collection should be managed by a body of gentlemen whose time is in most cases fully occupied by other important duties, and the majority of whom are not selected with reference to any special qualifications for such a post." Twenty-nine years ago the council of the British Association for the Advancement of Science endorsed these recommendations both of the Royal Commission and of the leading naturalists of the day, and strongly urged upon the Government the importance of giving effect to them. Ten years ago a representative body of scientific men presented a memorial to the trustees, in which it was urged that the principal official in charge of the national collections relating to natural history should not be subordinate in authority to any other officer of the museum. The present deputation also felt that the method of administration of this great national institution, which had not only been an important means of scientific research and an example to other nations, but had given the highest instruction and purest delight to hundreds of thousands of persons was in matters of vital importance seriously defective. They were there to ask for a full official inquiry into the organisation and administration of the Natural History Museum, with the view of a reasonable treatment of the matter in the immediate future by the Government.

Speeches in support of the views above expressed were made also by Mr. Francis Darwin, F.R.S., Prof. G. C. Bourne, and others.

In reply, Mr. Asquith pointed out that, as regards the administration of the museum, the trustees are a superior body with whom the Government are powerless to interfere. The arguments advanced by the deputation as to the management by the trustees apply equally to the Bloomsbury Museum. The trustees, men of wide experience and great discretion, are equally cognisant of natural history and archæology. The trustees are about to appoint a keeper of zoology, and it is not intended to abolish the directorship, but only to wait to ascertain who is the best man for the responsible position. He sympathised with the view that the director should have a free hand in the management of his department, and promised to convey to his fellow-trustees of the British Museum all that the deputation suggested.

NOTES.

WE regret to see the announcement of the death, on July 27, of Sir Thomas Stevenson at seventy years of age. Sir Thomas was appointed senior scientific analyst to the Home Office in 1881, and was knighted in 1904. He was past-president of the Society of Medical Officers of Health, the Society of Public Analysts, and the Institute of Chemistry. He was also the author and editor of various memoirs on forensic medicine.

THE death is announced, at sixty-seven years of age, of the engineer René Panhard, whose name is well known in connection with the development of the motor-car. We also notice the announcement of the death of Prof. Daguillon, assistant professor of botany at the Sorbonne, Paris, and author of a number of books upon botanical science.

THE German Kepler Society has founded a prize of 50*l.* to encourage research on the early traces of life (pre-Silurian) and their relation to the theory of evolution.

AT the congress of historical sciences to be held in Berlin on August 6–12, there will be a section concerned with the history of science. Among communications to be dealt with in this section are, we learn from the *Revue scientifique*, the work of Avogadro from the point of view of chemical theory, by Prof. Guareschi, of the University of Turin; the history of the development of physical chemistry, by Prof. Gerland, of Clausthal School of Mines; Arab contributions to the progress of science, by Prof. Wiederman; and on Boyle's law, by M. F. Mentré.

AMONG other prizes offered for scientific researches in Italy, we note a gold medal, of value 40*l.*, offered for the

best essay on "galvanism" (*i.e.* animal electricity) by the Bologna Academy, the last date of entry being May 26, 1909; and one of 20*l.* for the best work on the mineralogy of Vesuvius, offered by the Naples Academy, for which essays have to be sent in not later than June 30, 1909. In either case the essays may be in Latin, French, or Italian, and must be sent in under a *nom de plume*, the author's name being enclosed in a sealed envelope.

THE Italian Geographical Society (Rome, 102 Via del Plebiscito) offers a prize of 200*l.* for the best original work by an Italian author on economic geography, *i.e.* geography studied in its relations with commerce, emigration, and colonisation, with special reference to Italian economic requirements.

MR. W. T. LYNN has kindly sent us the following answer to the inquiry of a correspondent as to why June 24 is called Midsummer Day:—"Our ancestors decided that the quarter-days should be the sacred or holy days nearest to the four astronomical quarters, that is, the two solstices and the two equinoxes. So the four quarter-days are March 25 (Lady Day), June 24 (St. John the Baptist's Day), September 29 (St. Michael and All Angels' Day), and December 25 (Christmas Day). As the June quarter (St. John the Baptist's Day) was so near Midsummer, it acquired the name of Midsummer Day. If it be further asked why June 24 was St. John the Baptist's Day, it is that it means the day of his birth, and it would appear from Luke i. 26 that this was a little more than six months before that of Christ, so it is taken as six months and one day before Christmas day."

MR. C. KENRICK GIBBONS has presented to the Zoological Gardens a large number of the small fresh-water fish from Barbados known as "millions" (*Girardinus poecilloides*). These little fish, which have been placed in a tank in the tortoise house, are of special interest because of their supposed action in preventing malaria. Malaria is very much less common in Barbados than in other West Indian Islands, and it has been suggested that this freedom is due to the presence of enormous quantities of the "millions" in the fresh-water pools. The little fish are very voracious, and destroy large numbers of the larvæ of mosquitoes that spread malaria. The males are about half an inch long, with brilliant iridescent colours, and large black spots on the sides. The females are considerably larger and less highly coloured. It is understood that experiments are going to be made with the introduction of these fish into tropical countries where malaria is prevalent.

AT a meeting of the British Academy, held on July 22, Prof. R. S. Conway reported the results of his tour in Austria and the north of Italy, undertaken with the aid of the academy in order to collect inscriptional and other material for the study of the ethnological questions which he indicated at a meeting of the academy in May, 1907. From the report in the *Times*, we learn that Prof. Conway said he has revised and made many corrections in the text of nearly all the inscriptions previously known (about eighty-eight in number), leaving only six or seven which proved inaccessible within the limits of time at his disposal. Of the eighty-eight, three are Etruscan, and ten belong to a problematic group which it is convenient to call Rhætic, found mostly in the region of the Brenner Pass, both north and south of it. To this group are added eight hitherto unpublished; but nothing definite can at present be said as to their language or languages. On the ethnological questions, Prof. Conway reported that none of the Venetic inscriptions is older than 500 B.C., and that they were certainly written by a community which shared the Villanova culture, which first appeared in Este, as in Bologna, according to the accepted dating, in the eleventh or tenth century B.C. It remains, therefore, still to be determined whether, as Strabo thought, they were identical with the Veneti of Gaul, and so brought the language with them into Italy, or whether they merely learned the language from the people on the soil when they arrived.

ACCORDING to the report for 1907, the Rhodesian Museum at Bulawayo continues to make satisfactory progress, although its expansion is somewhat hindered by lack of sufficient funds. The curator contributes a list of the local mammals in the collection.

THE ticks (Ixodoidea) of the United States are reviewed and re-arranged by N. Banks in Bulletin No. 15 of the technical series published by the Entomological Bureau of the U.S. Department of Agriculture, a work which, according to the author, was urgently needed. Africa is the true home of ticks, all the genera being represented on that continent, where species are likewise most numerous.

SOME time ago the Field Columbian Museum received an application from the President of Guatemala for advice concerning the possibility of introducing food-fishes from the United States into lakes Amatitlan and Atitlan. Mr. S. E. Meek was accordingly dispatched to Guatemala, and his report is now published by the museum as No. 6 of vol. vii. of the zoological series. It deals with the general zoology of the lakes, although devoting special attention to the fishes, and as our information with regard to the natural history of tropical lakes is very meagre, its interest is considerable.

ACCORDING to the report for 1907, the working of the Field Columbian Museum at Chicago has been rendered simpler and easier by the introduction of new regulations, which have now been in force for a twelvemonth. An important event of the year was the receipt of a sum of money to defray the expenses of an expedition about to be dispatched, where it is to remain for a period of three years. The report also includes an account of the results of a collecting expedition sent by the museum to British East Africa, the account being illustrated by photographs of a recently killed rhinoceros and giraffe. The latter evidently belongs to the race known as *Giraffa camelopardalis tippelskirchi*, athough this is not mentioned on the plate.

THE mode of origin of new colonies of the South American sauba-ant (*Atta sexdens*) forms the subject of an article by Dr. J. Huber in vol. v., No. 1, of the *Boletim do Museu Goeldi* at Pará. As the result of recent observations, the statements of the older naturalists to the effect that a single fertilised female is capable of founding a colony by herself are proved to be true. The first batch of workers in the new colony appears to be developed within a minimum period of forty days. When these workers (the mode of alimentation of which is referred to in the paper) are fully developed, they forthwith commence the cultivation of the Rozites mycelium on leaves, the larvæ of the later broods being nourished on the "kohlrabi," or growths produced in the leaves by the presence of the fungus.

TO the July number of the *Century Magazine* Mr. C. R. Stockyard contributes an interesting account of the fishery for spoon-beaked sturgeon (*Polyodon spatula*) in the lakes of the Mississippi region, together with notes on the habits of these huge fishes. The fishery is principally

carried on for the sake of the caviar yielded by these sturgeons, although the flesh, which is smoked and dried, also forms an important asset. These sturgeons attain a maximum weight of about 140 lb., with a length of nearly 6 feet, and in the case of a female yield some 16 lb. of roe. The average is, however, considerably below this, the yield of caviar being about 10 lb. Caviar is obtained from the roe by washing the eggs out of the membrane in which they are enveloped. The energy with which the fishery is carried on has greatly reduced the number of sturgeons in the lakes, where they do not breed, and plans for increasing the stock are under consideration. One of these fishes leaping out of the water in their characteristic fashion forms the subject of a full-page illustration.

IN the June number of the *Quarterly Journal of Microscopical Science*, Sir E. Ray Lankester states that a minute chlorophyllogenous organism, described by himself in 1885 as *Archerina boltoni*, is identical with the subsequently named *Golenkinia radiata*, and also with *Richteriella botryoides*, and he accordingly urges that the two last-mentioned names should give way to the one proposed by himself. Owing, apparently, to its frequent association with extraneous amœboid protoplasm, Archerina was referred by its describer to the Protozoa, whereas it now turns out to be a plant. Since names employed in zoology are not considered to preoccupy those used in botany (and *vice versâ*), it remains to be seen whether the proposed change in nomenclature will be accepted by the botanists. In the same issue Prof. E. A. Minchin continues his account of the ascon-sponges, dealing in this instance specially with the mode of spicule-formation in the genus Leucosolenia, while Mr. C. L. Boulenger describes a new genus of hydromedusans from Lake Qurun, in the Fayum province of Egypt.

A SHORT paper on the development of flowers as influenced by the partial removal of roots and leaves is communicated by Mr. M. Shiga to the Journal of the College of Science, Tokio (vol. xxiii., article 4). The result of the few experiments recorded tends to show that moderate root-pruning hastens flowering, but leaf-removal is deleterious.

MR. H. PITTIER supplies a note on the Lecythidaceæ of Costa Rica to the series of Contributions from the United States National Herbarium (vol. xii., No. 2), in which two new species of Eschweilera and one of Lecythis are described and illustrated. These genera belong to the group that bear the characteristic "pyxidium" fruit. The seeds of the Lecythis are stated to have a finer flavour than the Brazil nut. The number also contains the diagnosis of a new apocynaceous genus, Tonduzia, by Mr. Pittier, and the identifications of a collection of Venezuelan plants by Mr. J. R. Johnston.

A PICTURESQUE narrative of the expedition undertaken by New Zealand men of science to the southern islands attached to the dominion occupies the first place in the latest instalment (No. 6) of the *Kew Bulletin*. Captain Dorrien Smith furnishes the biological account of the Auckland Isles. The striking vegetative features consist of a Rata, *Metrosideros lucida*, formation at the lower level; higher up, *Danthonia bromoides* forms large tussocks growing out of its own peat, and *Suttonia divaricatum* develops into a close scrub about waist high which can be traversed above, or under which the traveller may crawl. The occurrence of a tree fern, *Hemitelia Smithii*, in this southerly latitude testifies to the remarkable climate. Dr. Cockayne's account of the Snares Islands is also reproduced.

FROM the article communicated to the *Kew Bulletin* (No. 6) by Dr. O. Stapf, there is reason to expect that a rubber-yielding tree of Indo-China, *Bleekrodea tonkinensis*, which has been made the subject of special investigation and report, may prove to be more valuable than the various other recent discoveries in this direction. The tree was found in the forests of Tonkin, where, on a dry soil, it forms gregarious areas. It produces a latex fairly rich in caoutchouc that is best separated by treatment with sulphuric acid. The rubber, known in the vernacular as "teo-non," has been compared with Para. In connection with the rubber industry, the Bulletin contains a copy of a despatch from Mexico announcing that the supply of the plant yielding "Guayule" rubber is coming to an end, as reproduction is for practical purposes impossible owing to its slow growth.

THE first number of vol. vii. of *Abhandlungen der k.k. Geographischen Gesellschaft in Wien* contains a paper by Dr. Th. A. Ippen on the mountains of north-west Albania. After giving a general description of the mountain ranges, Dr. Ippen discusses in detail the valleys on the south side of the North Albanian Alps, commenting on the population and the means of communication in the Drin or Dukadschin mountains. Geographical details are given of the Fandi valleys and the Mirdita district, and the relation between the physical features and the industries of the inhabitants noticed. In a section dealing with the valley of the Mat, Dr. Ippen describes the Matja, Birschkasch, Uraka, and Kurbin districts, and discusses the customs and history of the inhabitants from evidence collected in the ruins of ancient villages. Further observations are still needed in the valleys of the Valbrona, Zmya, and Uraka, and in the district between Prizren and Djakova.

THE recent claim that the geysers in the Yellowstone Park are exhibiting signs of diminishing energy is discussed by Dr. Roland Dwight Grant in the Bulletin of the American Geographical Society for May. Changes observed in the colouring of the Minerva and Angel Terraces indicate that apparent diminutions of energy are due in reality to the diversion of the hot-water current to a new direction. The Excelsior Geyser is mentioned as an illustration of the many apparently dead geysers which have ceased to play on account of less clearly defined throats. Dr. Grant describes the Fountain and Black Growler geysers, which ceased to play owing to breaks in their pipes. He emphasises the fact, however, that in both cases the energy had merely been diverted to form new geysers, and that the current tended to return when the disturbing force ceased to act. The "mud volcano" is described, and the regularity of its action noticed. As a result of his observations in the Yellowstone Park, therefore, Dr. Grant is of opinion that the supposition of diminishing energy is unfounded.

WE have received the results of the magnetical and meteorological observations made at the Royal Alfred Observatory, Mauritius, in the year 1906. Having already referred to the report of the observatory for that year, we need only add that the results obtained from the self-registering instruments, the records of which are tabulated for each hour, and from eye observations, are very carefully worked out on the pattern of the Greenwich observations; monthly and annual rainfall at sixty-five stations are also given. The mean rainfall for the year over the whole island was 73·44 inches, as compared with the average 80·34 inches. Particulars are given of sixty-four earth movements shown by the photographic records of a Milne's seismograph during 1906.

THE report of the meteorological observations made at the Perth Observatory and other places in Western Australia in 1906 contains much useful information. The tables for Perth, which are given in great detail, include monthly mean values of the principal elements from 1876; monthly and yearly results are also given for some fifty stations, and rainfall at a large number of places, with averages for previous years. Mr. Cooke, the Government astronomer, remarks that the readings from the various localities may be considered trustworthy; some very high shade temperatures are recorded, *e.g.* 116°·4 at Eyre (January 22), and maxima exceeding 100° were recorded at the majority of stations. In previous years readings of 117° were observed at several places. The weather forecasts are very accurate; figures 1–5 are added to each forecast to indicate its degree of probability. Eliminating those stated at the time to be very doubtful, the success was 96 per cent.

IN the *Bulletin de la Société d'Encouragement* (vol. cx., No. 6) there is an interesting paper on the combat against fire-damp and carbonic oxide in collieries by Prof. N. Gréhant, in which illustrations are given of the fire-damp detector designed by the author. In the same issue Mr. S. Wologdine has a note on the heat-conductivity of refractory materials.

THE recent engineering and manufacturing development of Sweden has been rapid. With the opening of the railway through the rich iron-ore fields north of the Arctic circle and the extension of hydroelectric installations are now allied many important ship-canal and other projects, which are fully described in a profusely illustrated article by Mr. J. G. Leigh in the *Engineering Magazine* (vol. xxxv., No. 4). Another interesting article in the same number deals with the new processes for metal cutting and autogenous welding.

AT the installation of Dr. W. F. M. Goss as dean of the college of engineering of the University of Illinois, several interesting addresses were delivered, which are now published in a Bulletin (No. 21) of the University. The subjects dealt with were:—significant events in the development of the college of engineering, by Prof. Ira O. Baker; on the standing of the technical graduate in the engineering profession, by Mr. W. L. Abbott; on the State College of Engineering, by Prof. W. F. M. Goss; on the value of engineering research, by Mr. R. W. Hunt; and on the need of graduate courses in engineering, by Mr. Willard A. Smith.

A PAPER on rail corrugation, read by Prof. C. A. Carus-Wilson before the Tramway Congress on July 10, is reprinted in *Engineering*. The investigations outlined appear to show that the following conditions are necessary for the formation of corrugations on grooved rails:—(1) in the track (*a*) irregularities in gauge or level, (*b*) curvature, or (*c*) a packed groove; (2) a rail surface rough with sand or gritty dust; (3) wheels with check-cutting flanges; and (4) a critical speed. Corrugations cannot be formed unless conditions (1), (2), (3), and (4) are all present at the same time. These considerations suggest the lines on which it may be possible to avoid the formation of corrugations.

THE use of concrete and reinforced concrete pipe for culverts in railway embankments has suggested to Prof. A. N. Talbot an elaborate series of experiments, described in Bulletin No. 22 of the University of Illinois. The results throw light upon the resistance of pipe to embankment pressures, and also upon the action of sewers under similar conditions. Cast-iron pipes, concrete pipes, and reinforced concrete pipes were tested. The specially prepared testing apparatus used included a box of strong and stiff construction, and the pipes were embedded in sand, and the load applied through a saddle which rested on a sand cushion. Auxiliary tests were made to connect the results of the investigation with the strength of the materials.

IN a paper on space and mathematical reasoning (*Mind*, xvii., 67, July), Mr. Leonard J. Russell discusses the theories of Poincaré and Russell, and puts forward a view of space on the analogy of number, empty space being found to have just such a significance as pure number has.

IN a note contributed to the *Rendiconti del R. Istituto Lombardo* (2), xli., 11, on problems and methods of metallography, Dr. Gaetano Maderna urges the importance of metallographic researches, and directs attention to the fact that this branch of study has been neglected in Italy, both by the Government and private firms.

PROF. FAUSTO MORINI contributes to the *Rendiconto* of the Bologna Academy a short note on a monstrosity in the fern *Aspedium lobatum*, var. *angulare*, Metten, found in the Apennines of the Bologna region. One of the lateral segments of the leaf is replaced by a very tiny leaflet devoid of sori, but possessing all the characteristics of an entire leaf, and the author considers that this monstrosity is due to the development of an adventitious gemma, the subsequent development of which has been limited to the formation of the leaflet in question.

IN the *Atti* of the Naples Academy of Physical and Mathematical Sciences, xiii. (1908), Prof. G. de Lorenzo discusses the origin of the volcanic craters of the Capo Miseno and the island of Nisida. The papers are illustrated by photographs, and the observations point to somewhat similar conclusions in both cases, namely, that the craters were caused by eruptions at first submarine in character, but ultimately rising into the air, and that the erosive action of air and water, and in particular of the sea, is accountable for the present configuration of the harbours in question.

TWO papers dealing with considerations relating to statistics and probability have reached us. In the *Statistical Journal*, Prof. F. Y. Edgeworth (June 30) discusses the probable errors of frequency constants. The author alludes to the objections that have been raised to the use of the term "probable error," and examines the evidence for the existence of an index of credibility of this character from the consideration of a number of different problems. A recently issued number (Studies in National Deterioration, part iii.) of the Drapers' Company Research Memoirs contains a paper by the late Ernest G. Pope on marital infection in tuberculosis. While Prof. Karl Pearson in his editorial criticisms deviates in several points from the opinions expressed by Mr. Pope, it may be safe to infer from the statistics that the effect of infection on the coefficient of correlation is less than the effect which may be attributable to "assortative mating."

MR. J. W. GILTAY, of Delft, writes to say that the optical illusion, mentioned by Dr. Terada in NATURE of July 16 (p. 255), and also in the following issue (p. 277), reminds him of a similar effect noticed some weeks ago when witnessing a bicycle race at the velodrome at Scheveningen. "After having looked for some time at the racers, I casually looked at the spectators: the whole range of benches with the spectators appeared slowly to slide around, in a direction contrary to that moved in by the racers."

MESSRS. GEORGE BELL AND SONS have published a third edition of Mr. W. M. Baker's "Elementary Dynamics." Except that a number of minor corrections have been made, this edition appears not to differ from the second.

WE have received the forty-first volume, that for 1907, of the Journal and Proceedings of the Royal Society of New South Wales. The meetings of the society are reported from time to time in these columns under "Societies and Academies," and it is sufficient to direct attention to the publication of the annual volume.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN AUGUST:—

Aug. 1. 11h. 28m. Minimum of Algol (β Persei).
4. 8h. 17m. ,, ,, ,,
8. 6h. 41m. to 7h. 54m. Moon occults 4 Sagittarii (mag. 4·6).
9. 8h. 31m. Moon in conjunction with Uranus (Uranus 0° 24′ N.).
10–12. Maximum of the Perseid meteors (Radiant 45°+57°).
11. 12h. Venus at greatest brilliancy.
14. 23h. 53m. Moon in conjunction with Saturn (Saturn 2° 46′ N.).
16. Saturn. Outer minor axis of outer ring = 5″·84. Polar diameter of ball = 17″·6.
18. Venus. Illuminated portion of disc = 0·327.
24. 10h. 0m. Minimum of Algol (β Persei).
27. 0h. Vesta in conjunction with Moon (Vesta 0° 21′ S.).
31. 3h. Ceres in conjunction with Moon (Ceres 0° 31′ N.).

EARLY PERSEIDS.—Mr. Denning, at Bristol, observed the first traces of the great August meteor shower on July 21, but no signs of it were apparent during watches maintained over a part of the nights of July 18 and 19. On July 25 meteors were very rare in a beautifully clear sky, but on July 22 and 26 they were numerous, and supplied evidence of several active minor showers at 298°−15°, 280°+57°, and 303°+24°. On July 26 the Perseid display had assumed very decided prominence, for it furnished during the two hours preceding midnight about four meteors per hour within the sphere of vision commanded by a single observer. The radiant point appeared diffused over an area with centre at 25°+53°, which agrees very nearly with the computed place of the shower centre on July 26.

A bright flashing Perseid, nearly equal to Jupiter, was recorded at 10h. 23m. on the night mentioned crossing the Milky Way in the south-west region of Aquila, the path being from 287°+3° to 278°−11°, where it left a bright streak for a few seconds. A bright star meteor from a southern radiant was seen at 11h. 33m. moving from 350°+6° to 17°+20½°, and at 11h. 49m. an Aquarid shot upwards close to γ Pegasi. A radiant at 45°+85°, near Polaris, became well defined on the same night.

LARGE METEORS FROM SCORPIO.—In a letter to the July *Observatory* (p. 287, No. 398) Mr. Denning directs attention to the recent apparition of several large meteors coming from a radiant apparently situated in the constellation Scorpio. So far back as June 7, 1878, Mr. Denning's attention was directed to this radiant by the appearance of a large meteor, and since then he has regularly observed it, and has seen several very attractive meteors from it.

This year two fireballs from this radiant were observed, on May 19d. 10h. 20m. and May 22d. 8h. 50m. respectively, and duplicate observations show that the former passed over Ireland, from Ballyteigne Bay to co. Mayo, at a height of about sixty-nine to forty-five miles, along a path 142 miles in length; the radiant was in the region of 252°, −22°. Mr. Denning suggests that observations of this radiant in future years will amply repay the observers by providing them with brilliant meteoric phenomena at a season of the year when such phenomena are neither plentiful nor conspicuous. On the day of the partial solar eclipse, June 28, Mr. Denning saw a magnificent meteor, directed from Scorpio, which occupied seven seconds in passing from 276°, +23°, to 1°, +48½°, and cast off a bright trail of yellow sparks.

THE RECENT NIGHT-GLOWS.—Several accounts of observations of the night-glows which were seen, about the beginning of the present month, by observers throughout mid-Europe appear in No. 4262 of the *Astronomische Nachrichten* (p. 239, July 16).

Prof. Weber, of Kiel University, reports that no marked, irregular oscillations of the magnets were registered, but from June 27–30 small regular oscillations of 2′ amplitude and 3m. period were observed at intervals, and were not ascribable to any recognised cause.

Herr Köhl, of the Carina Observatory, Denmark, suggests that the solar illumination of cometary dust in the higher atmosphere might account for the phenomenon, and in this connection directs attention to the fact that several very large meteors were recently observed in Denmark.

Herr N. Donitsch states that on June 30 a fine aurora borealis was seen at Starya Doubossary, Bessarabia, and was visible from 11h. 10m. p.m. (local time) until dawn. The maximum illumination was a few degrees east of north, and suffered several variations; filaments, changing rapidly in form, were also seen.

DOUBLE-STAR MEASURES.—No. 4261 of the *Astronomische Nachrichten* contains further micrometer measures of double stars made by Prof. Burnham since the publication of his General Catalogue. The main idea of these observations is to establish beyond doubt the existence, or absence, of relative change of any kind in the lesser known and often neglected pairs. With this idea, the present list, as did the former, contains a note on each system indicating the nature and amount of any change which has been discovered.

THE HISTORY OF LUNAR RELIEF.—Charged with the task of bringing to completion the Lœwy-Puiseux "Atlas photographique de la Lune," M. Puiseux is preparing the text which is to accompany the work. Whilst studying the photographs for this purpose, he has been struck by the peculiar formations surrounding the northern pole of our satellite, and finds in them and their structure a possible key to the history of lunar formations in general. These rectangular formations, prominent in the region of Anaxagorus, M. Puiseux concludes to be typical of the earlier types of lunar structure, since modified, in other latitudes, by subsequent action, and he shows in a note published in No. 2 of the *Comptes rendus* (p. 113, July 13) how they were probably formed by the contortions of the thin superficial crust. M. Puiseux does not, in the present note, discuss the reason why the period of structure-formation should be a function of latitude, but points out that in this respect the earth affords a parallel case.

MINERALS, INCLUDING GEM-STONES, AT THE FRANCO-BRITISH EXHIBITION.

SCIENCE and commerce regard minerals from two very different points of view, and many of the specimens to which much prominence is given at the Franco-British Exhibition—such as, for instance, the ubiquitous masses of silver-bearing galena—would find no place in a purely mineralogical collection. Commerce is concerned only with the ore value of the specimens, and attaches no importance to the presence of crystals or to their form and symmetry. On the other hand, in a museum specimens are arranged by the most interesting or the best developed species displayed on them, and it is impossible to realise at a glance what precisely are the minerals found in some particular quarter of the globe. Thus collections that are representative of the mineral products of various countries cannot fail to be of interest, from whatever point of view they may be considered; moreover, here and there the mineralogist will note with appreciative eye a well-crystallised specimen.

Most of the minerals will be found at the far end of the extensive grounds in the spacious halls of the Dominion of Canada and the Commonwealth of Australia. In the former, a singularly tasteful hall, the collection of minerals is the property of the Government, and is permanently

kept together for sending to great exhibitions in order to testify to the mineral resources of the country; specimens are added from time to time to replace breakages and to represent newly opened mines. The small specimens are arranged in flat table-cases; of the large specimens, the more valuable are placed in large upright cases, and the remainder are piled near by in the open court. Information as to the nature of the ore, and in some instances the minerals present and the locality, is given on the labels accompanying the specimens. We may pass over the gold specimens from British Columbia and the Yukon district, and direct attention to the extensive series of silver associated with smaltite, niccolite, erythrite, &c., from the rich mines of Temiskaming, Ontario, first discovered five years ago. Some large crystals of phlogopite and apatite, and a small polished piece of beautiful blue sodalite, may be noticed.

In the Australia Hall the several component States have worked in their own courts independently, and not always on similar lines. In the Western Australia court the organisation and arrangement of the minerals have been managed entirely by the Government, and the result, as regards both the type of show-case and the selection and labelling of the specimens, is admirable. The gold industry naturally takes a prominent position. Some rich specimens of tellurides are shown, but they reveal no signs of crystal form. At the somewhat analogous district of Cripple Creek the telluride of gold, calaverite, occurs in many-faced crystals, the symmetry of which has been such a baffling problem. The tantalite from Greenbushes is interesting as the source of the filament of the new electric lamp; generally it is found in curiously marked massive pieces, but one or two specimens show unmistakable indications of crystal form. A huge lump, said to be only a portion of the original mass, testifies to the size attainable by tin-stone. At the principal entrance to the Queensland court are placed cases containing both rough and cut examples of the gem-stones found in the southern and central districts, viz. opal, colourless topaz, green and yellow sapphire, pink and green tourmaline, and pale green beryl. Conspicuous among them is the novel "black opal," which is of various shades to the deepest blue, and flames with vivid opalescence. Among the ore specimens at the further end of the court may be noted a bright wolframite and a fine bismuth. The gem-stones occurring in New South Wales are very similar to those just mentioned; perhaps the best black opal, of which some exceptional specimens are exhibited, comes from Lightning Ridge. Few good specimens from the famous Broken Hill mines are to be seen, and the arranging and labelling in at least two of the show-cases leave much to be desired.

Time, unfortunately, has not permitted of the organising of a collection of typical minerals in the India Hall. The Ruby Mines, Ltd., however, exhibit a magnificent series of rough and cut rubies and sapphires from Burma; no attempt is made to distinguish between the species corundum and spinel. Those interested in minerals will find much to attract them in the finely-crystallised specimens from the new lead and zinc mines at Broken Hill, North-Western Rhodesia, exhibited by Mr. Percy C. Tarbutt in the British Science Hall. They will see the zinc phosphates, hopeite, previously to the discovery of these mines known only by a few rare crystals, and tarbuttite, a new species, which was named after the exhibitor by Mr. L. J. Spencer, who recently described this remarkable mineral occurrence. In the same case Mr. Arthur Russell shows some minerals from the British Isles, mostly from abandoned mines or unrecorded localities, and Mr. F. N. A. Fleischmann exhibits a series of zeolites from the basaltic lava near Belfast.

Probably never before has such a superb collection of fashioned gem-stones been brought together for public view as are exhibited in the French and British Applied Art Halls. Space, however, permits us to direct attention only to the remarkable series of coloured diamonds exhibited by M. Eknayan in the former hall.

G. F. H. S.

PROTECTIVE DEVICES FOR HIGH-TENSION TRANSMISSION CIRCUITS.

IN the Journal of the Institution of Electrical Engineers issued in June (vol. xl., No. 189), Mr. J. S. Peck describes some methods in use for protecting high-tension transmission circuits from lightning and other high-voltage discharges. The development of apparatus for this purpose has received little attention in Great Britain owing to the fact that there are comparatively few overhead systems working at pressures greater than 11,000 volts, and severe thunderstorms are of very rare occurrence. On the Continent and in America, however, where very high voltages are used in overhead systems, and where thunderstorms are more frequent and severe, it has been essential for the success of transmission to develop considerably such protective devices.

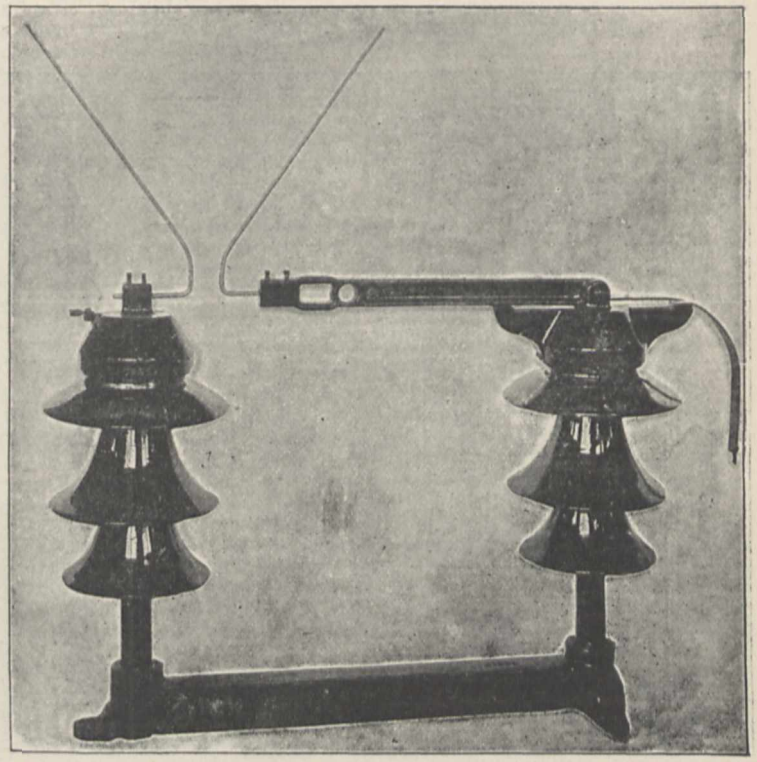

FIG. 1.—Horn-type gap.

Generally speaking, the effect of a lightning discharge on the circuit will be to cause a large increase of potential at certain points. Should the line insulation be insufficient, the charge may jump to earth, shattering poles, but probably protecting the apparatus at the end of the line from damage. If there is no escape in this direction, then there is the possibility of the insulation of the end apparatus breaking down, which is very serious.

Similar dangers may arise from sudden shorts in the system itself, and in dry climates the wind blowing over the transmission wires has been found to build up a high static potential. It is essential, then, to devise apparatus (1) to prevent concentration of potential at the end wind-

ings, and consequent shorts between adjacent turns; (2) to prevent excessive voltage between the wires and ground, causing breakdown to ground over insulators. To avoid (1), recourse may be had to high insulation, but this is not always practicable, and generally well-insulated choking coils are placed between the line and the terminal apparatus. If these break down they may be easily taken out and repaired. For (2), "lightning arresters" must be used. The essentials of such an arrester are that it must form an easier path to earth than the insulation resistance of the transmission line or other parts of the apparatus, and yet it must hold back the line voltage. There must, in addition, be some device for suppressing the arc which accompanies the discharge.

One of the earliest forms of arrester was the horn type (Fig. 1). This consists of two wires, one connected to line and the other to earth. Each is bent at an acute angle, so that they diverge from one another vertically upwards. Their distance apart at the lowest point must be adjusted so that no arc will occur for small increments of normal line voltage, but if the potential of the line connected wire rises considerably, an arc is formed. This arc rises, increasing in length, and is finally ruptured.

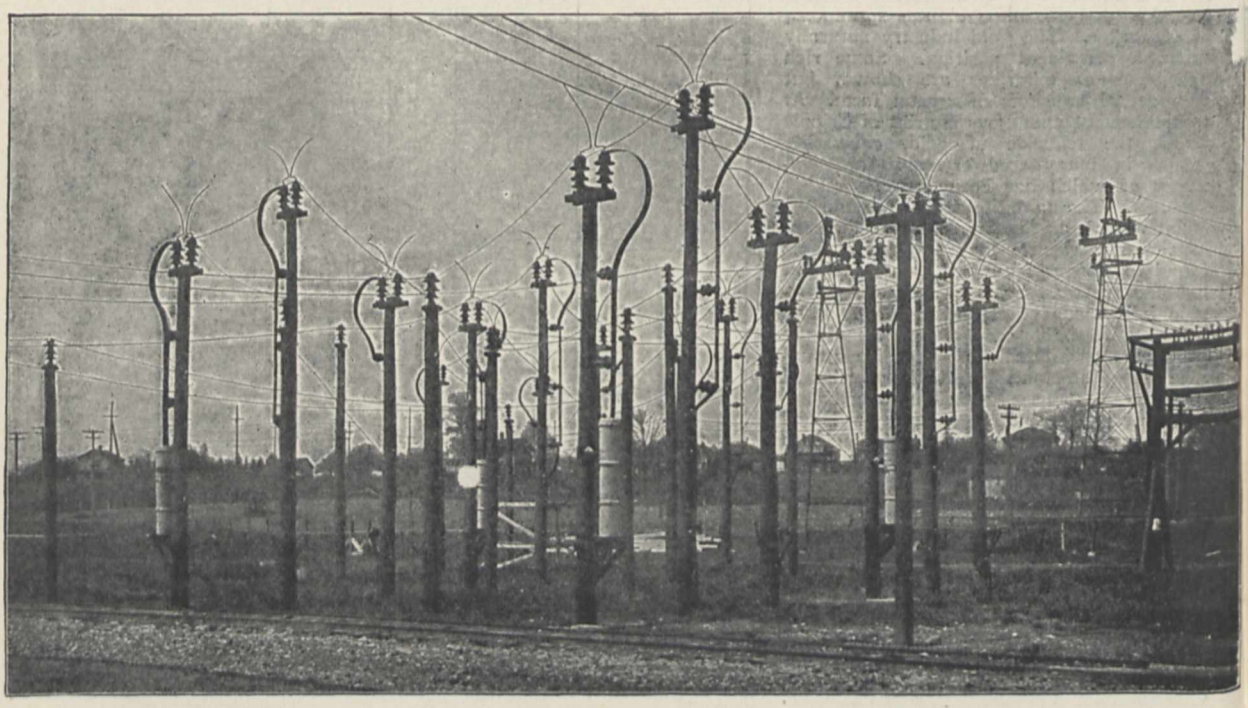

FIG. 2.—General view, 60,000-volt lightning arresters.

An objection to this form of arrester is the length of time elapsing between formation of arc and its rupture, for during this time the system is earthed. It is usual to place a high resistance in series with this arrester so that the current to earth from the line is diminished, but this will retard the static discharge. Owing to fusion of the metal at the lowest point where arcing occurs, it needs constant re-adjustment. An improved form is in use with an auxiliary gap and adjustable platinum point.

The "non-arcing multi-gap arrester" depends on the power certain metals have of suppressing an alternating arc. A number of cylinders of suitable metal are placed between line and earth. The cylinders are separated by gaps of 1/32-inch. They allow escape of the static charge, but no arcing occurs. These have proved most successful on low-voltage systems (2000 volts).

On the Continent, an arrester consisting of jets of water playing upon the line has been used. The chief objection to this is that it allows leakage of current from line to earth. The latest type of protecting device is the "electrolytic arrester." If aluminium electrodes are placed in certain electrolytes a non-conducting film is formed on the surface of the metal. This film can withstand a pressure of about 400 volts. At higher potentials it is punctured with a series of small holes, and the cell becomes conducting. When the excess voltage is removed the non-conducting film re-forms. By building up a number of such cells in series they may be made to withstand any desired voltage. Such a series is contained in a cylindrical earthenware vessel, the number depending on the normal line voltage, and is connected between line and earth (Fig. 2). It is usual to have a gap between line and electrolytic unit. For voltages not exceeding 13,500 volts, a non-arcing metal-cylinder gap may be used; for larger voltages one of the horn type is usual. Such arresters have been adapted successfully to lines with voltages varying from 4000 to 60,000 volts.

THE ROYAL INSTITUTE OF PUBLIC HEALTH.

THE annual congress of the Royal Institute of Public Health was held at Buxton from July 18–24. Among the many and varied subjects which were discussed, the following papers aroused considerable interest and discussion:—

Sir James Crichton-Browne took for his presidential address to the preventive medicine section "Parsimony in Nutrition." He did not concern himself with any particular dietetic system, but considered the general dietetic tendency towards abstemiousness which exists at the present day. Detailed reference was made to the dietary standards of Profs. Voit, of Munich, and Atwater, of the United States. These standards have been since found to be too high. An American, Mr. Horace Fletcher, showed that by careful and thorough mastication and insalivation the bodily needs are not only satisfied by a smaller amount of food, but the tone of the body is improved. Prof. Chittenden's careful researches on the subject led him to conclude that half the amount of proteids formerly considered necessary are quite sufficient. It was pointed out that before our dietetic system was revised on any such lines, it was essential to consider other facts. Concomitant with the proteid-consuming habits of the western races there had been a development of increased precision in

mental operations, as seen in the rise and progress of the exact sciences. A liberal proteid input is serviceable in such morbid conditions as tuberculosis, hysteria, neurasthenia, &c. The evil influence of parsimony in nutrition has been shown by the researches into the condition of elementary-school children in large towns.

Mr. C. Gordon Hewitt read a paper on the biology of house-flies in relation to public health before a joint meeting of the preventive medicine and bacteriology sections. After a short description of the more important characters and the breeding habits of the species of flies that inhabit houses, the chief of which is *Musca domestica*, the public health aspect of the question was discussed. It had been proved that house-flies are able, if the necessary conditions were present, to carry the pathogenic bacilli of such infectious diseases as tubercle, cholera, anthrax, and those of an enteric nature. He contended that house-flies were not only able to be largely responsible for the dissemination of these diseases, but that summer diarrhœa, which was the greatest cause of infantile mortality, was largely due to the combined action of house-flies and unsanitary conditions. It was a striking fact that in places where the water-system of sewage disposal was used, the death-rate from infectious disease of an enteric nature was less than that of places where the older conservancy methods were employed. The study of the breeding habits indicated the means of reducing the evil for which they were responsible. In the discussion which followed, a number of members referred to the connection between flies and infantile diarrhœa.

Dr. C. W. Saleeby contributed a paper on racial hygiene or negative eugenics. He advocated the forbidding of parentage to the drunkard, the chronic inebriate, or the dipsomaniac. Our studies might now be extended, he thought, from the hygiene of the individual to that of the race.

The spread of tuberculosis by means of milk and meat was made the subject of several interesting papers which provoked considerable discussion.

Dr. A. M. Fraser showed that of the 60,000 people who die annually from tuberculosis, 11,000 are children under five years of age, that is to say, among the section of the community most dependent upon milk for its nourishment, 11,000 deaths occur from the disease. It has been demonstrated that 10 per cent. of the milk sent in churns to the cities of Liverpool, Manchester, Leeds, Birmingham, and Sheffield is infected with tubercle bacilli. Meat affected with tubercle is systematically sold in the markets for human consumption. He suggested the systematic inspection of farms by qualified veterinary inspectors and the elimination of tubercular animals; also, the improvement of the conditions under which the cows lived.

Prof. Cameron stated, in the discussion, that he believed town milk was freer from tubercle bacilli than country milk, and that the latter was contaminated before it left the country.

Mr. Thomas Ryan read a paper before the engineering and architectural section on radio-activity in water from hot springs. As Strutt has found that the residue deposited in the Buxton and Bath hot spring waters, he was of the opinion that the Buxton water contained radium emanations, which view, he said, was supported by the fact that a large amount of nitrogen was present in the water. He urged further research on the subject.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Prof. W. J. Pope, F.R.S., professor of chemistry and head of the chemistry department in the Municipal School of Technology, Manchester, has been elected to succeed Prof. G. D. Liveing, F.R.S., in the chair of chemistry.

LONDON.—At the meeting of the Senate on July 22, Dr. H. A. Miers, F.R.S., was appointed principal of the University in succession to Sir Arthur Rücker, F.R.S., who retires on September 30. Dr. Miers is at present Waynflete professor of mineralogy at Oxford, and fellow of Magdalen College. He has had a good deal of administrative experience at Oxford, being a member of the Hebdomadal Council, a delegate of the University Press, a delegate for the inspection and examination of schools, and secretary to the delegates of the museum. He served on the council of the Royal Society, 1901–3, and is at present president of the Mineralogical Society and of the Public Schools Science Masters' Association. He was educated at Eton and Trinity College, Oxford, and after graduating served as assistant in the British Museum (1882–95), and as instructor in crystallography at the Central Technical College (1886–95). He was appointed professor of mineralogy at Oxford in 1895, and is now fifty years of age.

Important modifications have been made in the regulations in medicine for internal and external students. After January, 1909, there will be three examinations for medical degrees (M.B., B.S.)—the first, second, and third. The first examination (replacing the preliminary scientific examination, part i.) will still consist of chemistry, physics, and general biology, but new syllabuses, of a more professional character, have been approved. The second examination will be in two parts, part i., organic and applied chemistry, and part ii., anatomy, physiology, and pharmacology, including pharmacy and materia medica. The third examination for medical degrees is similar to the present final examination, which it replaces. The whole course, both for internal and for external students, will extend over at least five and a half years, of which at least three must be devoted to the final subjects. After July, 1909, the scholarships at present offered for anatomy, physiology, and pharmacology will be withdrawn.

The Imperial College of Science and Technology has been admitted as a school of the University in the faculties of science and engineering.

The Royal Army Medical College, Millbank, has been admitted as a school of the University in the faculty of medicine for officers of the Royal Army Medical Corps.

The following degrees have been granted:—D.Sc. in physiology to Miss Winifred Cullis, an internal student of the London School of Medicine for Women; D.Sc. in physics to Mr. S. W. J. Smith, an internal student of the Royal College of Science; D.Sc. in zoology to Mr. W. N. F. Woodland, an internal student of University and King's Colleges; D.Sc. in zoology to Mr. R. E. Lloyd, an external student of University College, Marine Survey, India, and Indian Museum; D.Sc. in geology to Mr. T. F. Sibly, an external student of Birmingham University; B.Sc. by research in chemistry to Mr. Jacob Fox, East London College.

DR. NANSEN has been elected professor of oceanography at the University of Christiania.

THE Society of Merchant Venturers has decided to petition His Majesty in Council in favour of the grant of a charter for the establishment of a University of Bristol on the lines of the draft charter prepared by the local university college, but suggesting certain modifications, which will define more precisely the position in the University to be occupied by the university classes of the Merchant Venturers' Technical College. Among the most important are those which provide that Bristol students whose means are small shall still be able to obtain a university education at fees as low as those charged by the Merchant Venturers' Technical College, and that the degrees of the University shall be open to evening students.

THE Royal Commissioners of the Exhibition of 1851 have appropriated the whole of the remaining site of their estate at South Kensington for the purposes of the Imperial College of Science and Technology. This announcement was made at a meeting of the governing body of the college on July 24. The question of the provision of additional buildings and laboratories on the sites granted by the Commissioners was under consideration, and it was decided, in the first instance, to proceed at once with the provision of new mining and metallurgical buildings for the Royal School of Mines, and to invite Sir Aston Webb, R.A., to serve as architect to these buildings and of such other buildings as the governing body may determine to erect. The Hon. R. J. Strutt, F.R.S., was appointed by

the governors additional professor of physics, and Mr. S. Herbert Cox as full-time professor of mining. An additional professor of zoology, a professor of metallurgy, and an assistant professor of botany are to be appointed shortly.

THE Manchester Microscopical Society is doing some excellent pioneer work through the agency of its extension section, the objects of which are to spread the knowledge of microscopy and natural history among outside associations by means of lectures and demonstrations. We have received a copy of the society's lecture list for 1908–9, and find that local associations in or near Manchester may select from forty-seven lectures on botanical, zoological, and nature-study subjects, which certain members of the society are willing to deliver gratuitously. The associations securing the services of lecturers are expected to pay for hire of lantern-slides, travelling and out-of-pocket expenses only. The Manchester Microscopical Society is to be congratulated upon its efforts to bring scientific knowledge, in a popular form, before associations of persons anxious to be instructed. Full particulars of this enterprising scheme may be obtained from Mr. R. Howarth, honorary secretary of the section, 90 George Street, Cheetham Hill, Manchester.

WE have received from Prof. L. Weber, of the University of Kiel, a copy of his report to the Magistrate of Kiel on the daylight illumination of the various primary and secondary schools of the town, thirty-four in number. At each of these schools measurements have been made of the illumination of a surface placed horizontally on desks selected as the best, medium, and worst illuminated, in about four of the most representative of the rooms of the school, on days when the illuminating power of the sky was known. In addition, the solid angle subtended by the portion of sky visible from each of the three desks, and that subtended by the sky visible from the middle window of each of the rooms tested, were observed. The report contains a description of the apparatus used, and details of some of the most interesting cases are given. Prof. Weber considers that an illumination equal to thirty candles at a metre distance throughout the darkest month should be taken as a minimum, and on this basis about 5 per cent. of the rooms tested are deficient, and should be improved by the provision of larger windows or by the trees in front of the windows being trimmed. In congratulating Kiel on the wisdom it has displayed in having an investigation of this kind carried out, one is tempted to ask whether any town of the size of Kiel in this country has ever thought it worth its while to have such measurements made, or is everyone too much absorbed in the educational controversy to think of the eyesight of the child?

EARL PERCY took part in the debate on the Indian Budget in the House of Commons on July 22, and in his speech gave a prominent place to the problems of Indian education. After instituting a comparison between the conditions of elementary education in this country and in India, he said that in England our system of education is directed towards preparation for an industrial career. In India almost the only industry is agriculture, but the system does nothing to qualify the people for their calling in life, and any special aptitude finds no outlet except in the law or in Government employment. Speaking of technical education, he remarked that it is seven years since a conference at Simla went into all the phases of Indian education, primary, secondary, and technical, and passed an enormous number of resolutions, upon which it was expected prompt action would have been taken. The resolutions dealt with the neglect of the study of the vernacular, recommending that it should be carried on throughout; that the results of examination should be taken as passports to the universities and Government employment; that in secondary schools a modern side should prepare pupils for a commercial career; that relations should be established between school authorities and chambers of commerce; and, lastly, the subject of technical education was dealt with in a valuable report. Industrial institutions were recommended for the different provinces connected with special local industries, with a system of apprenticeship in workshops under the supervision of Europeans, and the training of village schoolmasters in village. Are we really making substantial progress in any of these directions? he asked, and answered the question by saying the whole reforming energy of the Government seems to have been directed to the universities. The increase in educational expenditure has taken place on too low a basis; the total amount is almost insignificant. How can we ask the Indian to believe that his own Government, which in the last three or four years has sacrificed three or four millions of revenue from the salt duty and opium, and is contemplating large borrowing powers, cannot find money enough to spend on the development of technical education, which is of vital interest if the people of India are to be prepared to take their proper part in the development of industries? With regard to the general administration of education, Earl Percy thinks we shall never get any real enthusiasm or progress until the administration is reformed. There is now a director-general of education, but it is still the fact that, not only is there no member for education in the Viceroy's Council, but the director-general, if he wishes to bring any educational matter before the member who represents the home department, has to do so through the ordinary machinery of the office. Earl Percy expressed the opinion that, having a member on the Council directly representative of and responsible for education, the director-general ought to be given the same right and privilege of free access to the Viceroy which it is proposed to give to the new President of the Railway Board.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 7.—"Seleno-aluminium Bridges." By Prof. George M. **Minchin**, F.R.S.

A seleno-aluminium bridge consists of two plates, P, Q, of aluminium separated by a very thin flake of mica and having a thin layer of sensitive (or conducting) selenium spread across one edge of the mica and the two adjacent portions of the aluminium plates. We have thus the separator of mica bridged over by the selenium, which, of course, adheres to the two aluminium plates. If before the bridge of selenium connected these plates, P, Q, the plates were connected in series with a battery and a galvanometer, no current would flow, but when the selenium bridges over the mica separator, the current passes. Let C_0 denote the strength of this current when the bridge is completely screened from light. C_0 will, of course, depend on the voltage of the battery and the thickness of the mica separator, as well as on the length of the edge of mica covered by the selenium.

If now the selenium layer is exposed to light, the current will be increased—multiplied five times, or more, if daylight is allowed to fall on the selenium.

Owing to the extreme thinness of the mica, the intensity of the light along any line of a spectrum (say that of a star) can be measured if we know the way in which the current-strength, C, depends on the intensity, i, of the light. The main object of experiments carried out recently in the electrical laboratory at Oxford was to discover the relation between C and i. After many assumptions of the form $C=C_0+k\sqrt{i}$, and others, it was found that no such assumptions satisfy the observations, but that an equation of the form $\log \frac{C}{C_0}=ki^n$, where k and n are constants for the particular kind of light employed, agrees very well with experiment. Thus, suppose that we are using red light of a particular wave-length, let C_1 be the value of current when the intensity of this light is i_1, and let C be the current when the intensity is i; then our equation is

$$\log \frac{C}{C_0}=\left(\frac{i}{i_1}\right)^n \log \frac{C}{C_0} \quad . \quad . \quad . \quad . \quad . \quad (1)$$

The red light employed was that obtained by passing the light of a Nernst lamp through a thick column of water (to cut off heat), and then through a solution of fuchsine. This light was passed along a dark cylinder 6 metres long, the length of which could be varied by removing metre lengths successively, and, as the selenium bridge was at one end of this cylinder, i was varied. Blue light

was also used in this way, and it was found that n is not the same for blue as for red: for the first $n=0{\cdot}36$, and for the second $n=0{\cdot}25$, nearly. Thus it appears that the method of measuring light which consists of various colours by exposing a selenium resistance to the compound light is erroneous; the light must be broken into a spectrum, and the intensity measured in each part.

A selenium bridge possesses the peculiarity (which was noticed by Adams and Day in their experiments) that, once it has been exposed to light, while a current is passing through it, its resistance is not the same to currents passing in one direction as to currents passing in the opposite direction, and apparently the two resistances never again become equal.

Moreover, the resistance to a current of given direction *depends on the voltage*. It was found that if c is the conductivity of the bridge when the voltage of the battery is V,

$$c=kV+k', \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

where k, k' are constants. Thus the conductivity is a linear function of the voltage, but this will not be found unless the observer allows the current to run for several minutes. When light falls on the bridge, the current produced increases as the exposure is continued. With red light the current rises very rapidly, and after, perhaps, forty-five seconds moves slowly towards an asymptotic value. With blue light the rise of current at the instant of exposure is much slower. The curve the ordinates of which are the values of C and abscissæ the times, t, has an equation of the form

$$(H-C)^{-m}-(H-C_0)^{-m}=\lambda t, \quad . \quad . \quad . \quad (3)$$

where H (the final value of C), m, and λ are constants depending on the colour of the light.

The curve is hyperbolic in appearance.

Finally, a spectrum was formed by passing the light of the Nernst lamp through quartz lenses and prisms, and it was found that the effect is a maximum in the red near the yellow, and that effects are produced in and a little beyond the violet, while at the infra red end the effects extended to more than a whole spectrum length. The radiation of a very hot, but invisible, metal ball produces scarcely any effect, even at a small distance from the bridge.

Geological Society, June 17.—Prof. W. J. Sollas, F.R.S., president, in the chair.—The hornblendic rocks of Glendalough and Greystones (co. Wicklow): J. Allan **Thomson.** Both these rocks are intrusive into Ordovician strata in the east of county Wicklow, the former occurring as a small boss in the south side of Camaderry, a ridge which separates the Vale of Glendalough from the valley of Glendrosan, while the latter occur as three dykes traversing the sedimentary rocks on the shore at Greystones. The Glendalough rock is older than the Great Wicklow Granite, and exhibits much heterogeneity in composition. The Ordovician sediments are converted into hornfels at the contact with the igneous rock, and this type of rock has resisted the dynamic metamorphism which occurs elsewhere in the district. The Greystones rock shows a transformation from peridotite into amphibolite, but with a greater development of talc. Olivine and rarely mica are present in the original rock.—On the occurrence of footprints in the Lower Sandstones of the Exeter district: A. W. **Clayden.** Suitable exposures in the "Lower Sandstones" of the Geological Survey map are very rare. Dr. Shapter has recorded "claw-like footmarks," &c., from a locality about half a mile north-east of Broadclyst. Another quarry has been recently re-opened here for building-stone, and, on a search being made, slabs with footprints were found by the author and his students. Later, a slab with a track containing thirty pairs of footprints was found. In all, five specimens have been secured, and three of the sets of prints may have been made by the same individual, one with fore and hind feet about the same size and bearing about the same weight. The two other sets of prints were made by smaller and different individuals.—The basic intrusion of Bartestree, near Hereford: Prof. S. H. **Reynolds.** The Bartestree dyke, which has a thickness of about 35 feet, strikes in an east-north-easterly direction through the Old Red Marls and Sandstones, which for a distance of at least 10 feet from the contact are strongly metamorphosed, the marl being converted into a hard purplish-grey rock with yellow patches, while in the sandstone the felspars are re-crystallised and the quartz-grains corroded. The dyke itself is not a single uniform intrusion, but a multiple dyke composed of several allied though differing types of dolerite and basalt.

Challenger Society, June 24.—Prof. d'A. W. Thompson in the chair.—Oceanography in America: Prof. C. A. **Kofoid.** The recent traverses of the interesting stretch of ocean lying between the Galapagos and Easter Island, on the one hand, and the S. American coast on the other, made by Prof. Agassiz in the U.S. Fish Commission steamer *Albatross*, with which the speaker had been associated, were described in detail, and valuable conclusions drawn as to the influence of currents, up-welling, and eddies on the richness or poverty of both plankton and benthos. Some of the more important marine stations of the United States, and the character of their work, were also dealt with.

PARIS.

Academy of Sciences, July 20.—M. Bouchard in the chair.—The minerals from the fumaroles of the recent eruption of Etna, and on the existence of boric acid in the existing fumaroles of Vesuvius: A. **Lacroix.** One of the peculiarities of the recent eruption of Etna was the slight intensity of the fumaroles. The latter offered all the usual phenomena, with the exception that the warmest fumaroles contained no copper salts. Those containing ammonium chloride as the principal constituent also contained a notable quantity of fluorine. In the fumaroles of Vesuvius a small quantity of the mineral sassolite was found; this was identified by its hexagonal form, its optical properties, and its chemical properties, the last corresponding to normal boric acid.—The hydrates of strontia and baryta: M. **de Forcrand.** Strontium hydrate can be converted into the anhydrous SrO by heating for a long time in a current of hydrogen at a temperature of 850° C. BaO can be obtained in a similar manner in two or three hours at 780° C. Various intermediate hydrates are described and thermochemical data given.—Remarks on the note of M. Lebedew. The apparent dispersion of light in interstellar space: G. A. **Tikhoff.** Some new observations on the star RT Perseus, and a reply to the criticisms of M. Lebedew.—Ruled surfaces: M. **Tzitzéica.**—Algebraic functions of two variables: H. W. E. **Jung.**—The points of equilibrium of a fluid in movement: M. **Popovici.**—The periodic solutions of a functional linear equation: Ernest **Esclangon.**—The calculation of the tensions in articulated systems of three dimensions: B. **Mayor.**—A safety apparatus against continuous disturbing sparks in wireless telegraphy: Edouard **Branly.**—The flame spectra of calcium: G. A. **Hemsalech** and C. **de Watteville.** The finely divided substance, pulverised by the electrical method previously described by the authors, was introduced into various flames, air-coal gas, air-hydrogen, oxygen-coal gas, and oxygen-hydrogen, and the observed spectra compared with the arc spectrum (Kayser and Runge).—Variations in the fringes in the photochromes of the spectrum: E. **Rothé.** A study of the conditions necessary to free the photographs from the results of secondary phenomena. Photographs of spectra are submitted to the academy, in which the colours are pure, the exact reproduction of the colours of the spectrum, all the accessory reflections having been suppressed.—Electric and magnetic double refraction of nitrobenzene. Variation with the wave-length: A. **Cotton** and H. **Mouton.** In nitrobenzene, Kerr's phenomenon is exceptionally large, being ninety-seven times that of carbon bisulphide for the yellow mercury line. Within the experimental error of the experiments, the dispersion of the electric double refraction of nitrobenzene is the same as the dispersion of the magnetic double refraction.—A case of anomalous rotatory dispersion; application of the measurements of rotatory dispersion to the study of the composition of essence of turpentine: Eugène **Darmois.** Some mixtures of dextro- and lævo-rotatory turpentine show an anomalous dispersion: the rotation becomes zero for one colour of the spectrum, and passes through a minimum for another colour.—The reduction of alkaline chloroiridates by oxalates: Marcel **Delépine.** A reply to

a claim for priority by M. Vèzes.—Researches on the ketodiacids: E. E. **Blaise** and H. **Gault.** By saponifying oxalsuccinic ester with cold hydrochloric acid, the authors have succeeded in obtaining α-ketoglutaric acid,

$$CO_2H—CO—CH_2—CH_2—CO_2H.$$

Attempts to generalise this reaction to the alkyl derivatives have not been completely successful.—A new crystallised sugar, perseulose, with seven atoms of carbon: Gabriel **Bertrand.** This new sugar has been obtained by the biochemical oxidation of perseite with the sorbose bacterium, particulars being given of the details of the operation. The sugar has the constitution $C_7H_{14}O_7$; it is lævorotatory, and shows the phenomenon of multirotation. Particulars are given of its reducing power and of its osazone.—The formation of compounds in solutions of tartaric acid and sodium molybdate: P. **Quinet.** The densities of the solutions, rotations, electric resistance, and cryoscopic constants have been studied. The graphical analysis indicates definite compounds between one molecule of tartaric acid and one and two molecules of sodium molybdate.—The alkaline granites of eastern Corsica: Pierre **Termier** and Jacques **Deprat.**—Urohypertensine: J. E. **Abelous** and E. **Bardier.** This substance is extracted from normal human urine by ether, and separated by means of oxalic acid. It acts as an energetic vaso-constrictor, principally of peripheric origin. The hypertensive substance acts by exciting the peripheric ganglia of the great sympathetic, and also, to a minor degree, the muscular fibres of the vessels.—The relative magnitude of the eye and the appreciation of encephalic weight: Louis **Lapicque.**—Contribution to the study of the nucleo-proteids. Researches on the constituents of pepsin: L. **Hugounenq** and A. **Morel.** The authors have applied the method of hydrolysis with hydrofluoric acid, described by them in an earlier paper, to the study of the nitrogenous substances obtained by the hydrolysis of pepsin. Thirteen of these bodies were isolated and their proportions given.—The semi-logical signification of urinary indoxyl. The examination of pus for indol: Ch. **Porcher.** The method for detecting indol in pus is given in detail. Twenty-five observations on pus of different origins showed indol in nine cases only, so that indol is not an invariable constituent of pus. It is noted that when indol occurs in pus it is never in minute quantities.—Researches on the pharmacodynamic action of cyclohexane and some of its derivatives: A. **Brissemoret** and J. **Chevalier.**—Researches on the presence of the rare gases in the atmosphere at various heights: L. Teisserenc **de Bort.** The samples were collected from captive balloons provided with an automatic apparatus for collecting the samples at different known heights. In all the samples, whatever the height of collection, a notable proportion of argon was found; helium was only found in the lower layers up to a height of 10 kilometres, neon being found in all the samples.

CAPE TOWN.

Royal Society of South Africa, June 17.—Mr. S. S. Hough, F.R.S., president, in the chair.—A new Transvaal tick, a variety of *Ixodes pilosus* (Koch): Prof. J. G. **Neumann.**—The distribution and hosts of the New Transvaal tick *Ixodes pilosus howardi*, Neum.: C. W. **Howard.** Mr. Lounsbury, in one of his reports, stated that *I. pilosus* was only found in the Cape Colony in places which were very humid, such as kloofs containing a stream of running water, or in the vicinity of vleis. Apparently, *I. pilosus howardi* was not limited in its distribution to these conditions, since Mr. Howard had taken specimens from places which were more or less dry, unless they could consider Durban as humid, but such places as Leydsdorp and Zoutpansberg, from which some of the specimens were taken, were very arid. The principal host was the dog, but at the Ivy Mine, Moodies, Barberton, a few specimens were found on a cat, and a few on a hedgehog at Pienaars River.—The occurrence of the genus Sphæroplea in South Africa: W. T. **Saxton.** The previously noted localities where the green alga Sphæroplea occurs are the inundated plains of Central Europe, Asia, and America. Specimens were collected in South Africa by Mr. Saxton in a freshwater pool on Dassen Island nearly two years ago, and again recently in pools on Green Point Common by Mr. E. P. Phillips. The alga is interesting as representing a monotypic and rather isolated family, and is the only one of its species known. Diagrams were shown illustrating the structure and life-history.—Some investigations regarding brak (alkali) in Cape Colony soils: Dr. C. F. **Juritz.** Brak or alkali in soil consisted of accumulations of sodium salts. Rainy weather carried them to varying depths, but prolonged dry weather caused their return to the surface. Irrigation tended to accentuate these conditions, hence the adaptability of any tract of country for irrigation depended, other things apart, upon the proportion in the soil of salts which might render it unproductive. To test a soil as to its liability to become brak under irrigation, it was essential to take samples at regular intervals all the way down from the surface to the greatest depth which irrigation water might penetrate. Brak was caused by carbonate, chloride, and sulphate of sodium, the first doing the most and the last the least injury. Natural drainage usually carried these noxious salts seawards, but this was prevented by (1) an impermeable layer below the surface forming a basin; (2) compactness of the soil itself, and (3) a high water-line in the subsoil. Even these obstacles, where frequent rain resulted in an even distribution of salts throughout the soil, were not always sufficient to prevent successful cultivation. The difficulty arose with a scanty rainfall and a warm climate, or long drought after heavy rain; then it became important to ascertain how much salt the soil could contain and still be successfully cultivated. Investigations had been made in the divisions of Herbert, Colesberg, Britstown, Steynsburg, Robertson, and Carnarvon.

CONTENTS.