THURSDAY, MAY 15, 1913.

A NEW TEXT-BOOK OF PHYSIOLOGY.

Principles of Human Physiology. By Prof. E. H. Starling, F.R.S. Pp. xii + 1423. (London: J. and A. Churchill, 1912.) Price 21*s.* net.

TO one familiar with modern text-books of human physiology, the title of this work suggests something out of the common run. Excellent "elements" of the subject, "manuals," and "text-books" exist in plenty. Indeed, English-speaking students are exceptionally fortunate in possessing as they do such a selection of trustworthy and often attractive presentations of the established facts of the science. At the same time many teachers have undoubtedly felt that the existing students' text-book, admirable as it is, is not in all things in tune with the times, and that a new presentation in which more attention should be paid to recently revealed or recently applied "principles" would be a welcome acquisition. Prof. Starling's work is a response to this commonly-felt *desiderium*.

To attempt to combine an up-to-date exposition of the traditional subject-matter of a manual of human physiology with a sufficiently well-informed *résumé* of new and unfamiliar but appropriate branches of chemistry and physics, showing wherever available the connection between the one and the other, and in addition indicating the general trend of modern physiological investigation, implies qualifications rarely met with in one individual. It will be generally conceded that no one, whether from versatility of personal experience or from environment, was more competent than Prof. Starling to undertake the task. It will be equally conceded that his reputation has not suffered in the achievement. In more respects than one the book represents an advance on previous works of a similar kind.

A word as to its history. Some fifteen or twenty years ago there existed an unpretentious little volume by the author entitled "Elements of Human Physiology." Admirably concise, clear in thought and style, no better epitome of physiology could be put in the hands of a student. The author subsequently enlarged this book, leaving the title unchanged. Although the enlargement went through a number of editions, it was never such an unqualified success as the original, at least from the reader's point of view. Like the new dress of the little girl who had made up her mind to cry, it was "either too long or too short." The present volume represents a further transformation, in which the whole work has been recast and greatly expanded, and the title changed. At the same time it carries within it unmistakable and almost ineffaceable traces of its predecessors.

An important feature of the book is the insertion of an introductory section on general physiology. This consists for the most part of two substantial chapters, one on the chemistry of cells and food materials, the other on elementary physical chemistry so far as it bears on physiology. The latter is a welcome innovation, for it provides essential information that can otherwise be obtained only with difficulty. The bulk of the volume is devoted to the stock subject-matter of a text-book of physiology, the material being grouped under two main headings, "The Mechanisms of Movement and Sensation" and "The Mechanisms of Nutrition." The author's first-hand experimental knowledge is especially brought out in the latter of these, while the former is mainly notable for the incorporation of Sherrington's work on the central nervous system. The book ends with a short section on reproduction. Apparently the author has not considered the time ripe for the introduction of a special section on growth. The book is illustrated with a wealth of pictorial matter, chiefly in the form of diagrams.

While the work as a whole bears evidence of strenuous effort to bring it up to date (it contains a large amount of material comprised in no other general text-book of physiology), the process of modernisation is unequal. Thus, the value of the chapters on muscle and nerve has been enhanced by the inclusion of much recent investigation, especially of workers in the Cambridge school, but the partial selection of this material and the omission of other recent Continental work indicate that the author has failed to grasp some of the most suggestive teachings of nerve and muscle experiment. Again, the chapter on coagulation of the blood contains an admirable history of the coagulation question almost up to the date of publication, but the account of blood-platelets, with which coagulation is so intimately associated, is not only inadequate, but in regard to many statements quite misleading.

The omission of any single section on the liver is difficult to explain. While a considerable amount of information (not always correctly indexed) on the physiology of the organ is scattered throughout the book, the structure and vascular relations of the liver are not described.

One greatly regrets that the author has not seen his way to provide occasional references to original papers. A good scientific text-book has two classes of readers, students and research workers. To the latter a handy reference is most acceptable. For students the systematic mention of names and *dates* (the latter word might be

written in capital letters) is an indispensable part of the apparatus of scientific education. On glancing over those names that are incorporated in the body of the text or attached to important illustrations, one cannot but remark how very English the experimental side of physiology has become.

Breadth of outlook, to which the author lays some claim in his preface, has been secured not in every case by new and suggestive presentation of the materials to hand. Often enough, the author has depended rather on weight of added fact to illumine the intelligence of his readers. The consequence is that while he possesses a clear style that states scientific fact and argument without prolixity or ambiguity, his book makes at the best hard reading, its perusal being calculated to inspire respect rather than enthusiasm for the subject. Its obvious merits, however, outweigh all its defects.

Textual errors and other discrepancies are present in not too great abundance. While no serious blunder of this kind has caught the eye of the reviewer, he *would* venture to protest against the retention of the Egyptian-like perspective of fig. 60.

BRITISH BOTANISTS.

Makers of British Botany: a Collection of Biographies by Living Botanists. Edited by F. W. Oliver. Pp. iv + 332 + xxvi plates. (Cambridge University Press, 1913.) Price 9*s.* net.

THE decision to publish the course of lectures on British botanists given at London University in 1911 was a very wise one, and Prof. F. W. Oliver deserves our sincere thanks for the trouble he has taken to produce so excellent a result. The volume is full of interest, and contains much concerning the lives and activities of some of the lesser-known British botanists that might otherwise have passed into oblivion.

Modern botanists, after the perusal of the several biographies, may well reflect not only when they consider the remarkable energy of their distinguished predecessors, but also when they realise, as they now can, how great were the advances made in botanical science, despite innumerable difficulties, by the pioneers of the subject.

The ten lectures of the course deal with the work of the following botanists: (1) Morrison (1620–83) and Ray (1627–1705); (2) Grew (1641–1712); (3) Hales (1677–1761); (4) Brown (1773–1858); (5) Sir W. Hooker (1785–1865); (6) Henslow (1796–1861); (7) W. Griffith (1810–45); (8) Henfrey (1819–59); (9) Harvey (1811–66); and (10) Williamson (1816–95).

Since these biographies did not, of course, include all the distinguished botanists to whose labours we owe the foundation of botanical science in this country, it was wisely decided to supplement the lectures by the inclusion of chapters dealing with certain other botanists equally deserving of recognition as founders of the science. Even with the inclusion of these worthies, namely, Hill (1716–75), Lindley (1799–1865), Berkeley (1803–89), Gilbert (1817–1901), Marshall Ward (1854–1905), the Edinburgh professors (1670–1887), and especially J. H. Balfour and Sir Joseph Hooker (1817–1911), the list is incomplete. Bentham, for instance, is an unfortunate omission, and it is to be hoped that it may not be long before a second edition is called for and that Prof. Oliver may carry out his intention of adding accounts of several other British botanists who should never be excluded from a historical account of botany in Britain.

Where the general level is so high, it is perhaps invidious to single out individual essays for special commendation, but of the lectures, Hales by Sir Francis Darwin and the account of Robert Brown by Prof. Farmer are of particular interest. The value of the volume is also very much enhanced by Sir W. T. Thiselton-Dyer's masterly account of Marshall Ward and by Prof. Bower's life of Sir Joseph Hooker, a task from its magnitude perhaps harder than that which fell to any other contributor to the volume.

One of the chief reasons why we are grateful for this book is not so much that it tells us once more about men whose names are as household words, but rather because the value of the work done by those whose contributions to the science have been known only to the few can now be seen in its true light by all. Until the appearance of the book, how few of the younger botanists could have given a coherent account of the work of William Griffith, Henfrey, or Harvey?

Griffith, as Prof. Lang points out, was a great botanist:

"It is true that he failed to break through the limitations of his time and period, that he left no new and more correct general views to modify the science. But this is true of all his contemporaries; indeed, it is true of most botanists. To recreate the department of a science in which a man labours requires a combination of ability and fortunate chances that is given to few."

It is especially fitting to remember Griffith at the present day since he was a pioneer in the line of botanical work now known as ecology. Not only did he collect plants, but he frequently adopted the "plan of roughly mapping each day's route and indicating the plants and associations of plants along the line of march." Ecological methods, it should be remembered, were also prominent in the teaching of John Hutton Balfour.

Many passages of particular interest might be quoted from all of the chapters, but as the book to be appreciated must be read as a whole, we would rather commend it warmly to students of natural history and to those who would know of Britain's worthies. Thanks to the diaries kept by our earliest botanists and from the free use of contemporary information, the biographies are full of living personal interest. We can picture Robert Brown—facile botanicorum princeps, Britanniæ gloria et ornamentum—all the more easily and truly from the human touches in the following extracts from his diary for two consecutive days:

"Feb. 7.—Before breakfast began the German auxiliary verbs. . . . At dinner about 3 pints of port . . . slept in my chair till nearly 3 in the morning.

"Feb. 8.—Before breakfast finished the auxiliary verb *Seyn*; to be. . . ." A. W. H.

PRACTICAL AND THEORETICAL PHYSICS.

(1) *The Essentials of Physics.* By Prof. G. A. Hill. Pp. viii+346. (New York and London: Ginn and Co., n.d.) Price 5*s*.

(2) *Practical Measurements in Radio-activity.* By Dr. W. Makower and Dr. H. Geiger. Pp ix+151. (London: Longmans, Green and Co., 1912.) Price 5*s*. net.

(3) *A Systematic Course of Practical Science for Secondary and other Schools.* By A. W. Mason. Book I., Introductory Physical Measurements. Pp. vii+126. (London: Rivingtons, 1912.) Price 1*s*. 6*d*. net.

(4) *Practical Physics: a Text-book for Technical Schools and Colleges.* By Angus McLean. Pp. xi+402. (London: Adam and Charles Black, 1912.) Price 7*s*. 6*d*. net.

(5) *A Course of Elementary Practical Physics.* By H. V. S. Shorter. Part i., Mensuration, Mechanics, Hydrostatics. Pp. 111. Price 2*s*. Part ii., Heat and Light. Pp. 216. Price 3*s*. (Oxford: Clarendon Press, 1912.)

(6) *Lehrbuch der Physik für Mediziner und Biologen.* By Dr. Ernst Lecher. Pp. vii+451. (Leipzig and Berlin: B. G. Teubner, 1912.) Price 8 marks.

(7) *An Introduction to Mathematical Physics.* By Dr. R. A. Houstoun. Pp. ix+199. (London: Longmans, Green and Co., 1912.) Price 6*s*. net.

(8) *Die Elektrizität.* By Prof. F. Adami. (Bücher der Naturwissenschaft, herausgegeben von Prof. S. Günther.) 9 und 14 Band. Pp. 126+4 plates+180+12 plates. (Leipzig: Philipp Reclam, jun., n.d.) Price 1.50 marks.

(1) OPINIONS differ as to the best mode of commencing instruction in every branch of knowledge. The correct solution of the problem is of much importance, particularly in physics, in which subject, for some reason, students seem to find more than average difficulty. The author of this book has been convinced by his teaching experience that the most efficient method of presenting the elementary principles is by means of question and answer. His book therefore consists entirely of a long series of questions. To the more difficult of these questions answers are appended; to the easier the student is expected to supply his own answers. The subjects treated are just those usual in an elementary text-book, the greatest stress, however, being laid on mechanics, to which about half the book is devoted.

While not questioning the undoubted value of question and answer in ascertaining the progress of students, it cannot be admitted that these form the function of a text-book. Question and answer should preferably be oral; they should also be mutual as between teacher and student. As a text-book the present volume is comparatively useless, principally on account of the lack of continuity and logical order which the method of presentation involves, but as a book of examples it may prove of considerable value.

(2) The appearance of a book on radio-active measurements is very welcome. That it should come from the laboratory of Prof. Rutherford, and have for its authors two such distinguished workers on radio-activity, practically ensures its general adoption in advanced physical laboratories. It can scarcely be doubted that the authors' assurance that so many and varied exercises in radio-activity can be performed with comparatively small quantities of active material will lead to the introduction of such measurements into the laboratory courses of many honours schools in physics. Most of the experiments described are already so included in Manchester, particularly with the view of the students ultimately taking up original research in this subject.

The earlier part of the book is devoted to the theory and practical use of the electrometer and various electroscopes, and the treatment is both detailed and lucid. Much useful advice in the construction of home-made instruments is given, and the student is also told how to surmount the various difficulties which arise. Chapters iii. to vi. are devoted to the practical exercises previously referred to, the number which can be performed by means of simple apparatus being surprisingly large.

The remainder of the book is intended for original investigators rather than ordinary students. Here the methods of making accurately standard radio-active measurements and the separation of radio-active substances are treated

in considerable detail. These, together with the appendices concerning radio-active constants, ranges of particles, rates of decay, &c., cannot fail to be of the utmost use to those interested in the extension of knowledge in this sphere. Lack of space forbids as detailed a description as the work deserves, but it can be confidently stated that it will prove its own recommendation.

(3) This is the first of a series of four little books on practical physics which the author proposes to publish. It is intended to form in schools a first year's course, and deals with measurements in mechanics of solids and fluids. The instructions are given in a very clear manner, and the student is told in every case exactly how to record the results. The arrangement of the book and the diagrams are excellent, rendering it quite one of the best of its kind.

(4) This is another book on practical physics, but one of a much more extensive and advanced character. The experiments described are those on general physics and properties of matter which are suitable for the advanced classes in colleges and technical schools. A knowledge of the calculus is assumed, being used for the theoretical treatment of many of the exercises. Students are instructed in the methods of eliminating errors, and advised as to the precautions necessary to secure accurate results. The author has been very thorough in this respect, and his work compares favourably with the various standard text-books of practical physics.

(5) Here is yet another book on elementary practical physics for use in schools. The two volumes deal respectively with mechanics, and heat and light. The method adopted is to ask a series of questions, the answers to some of them depending merely on theoretical knowledge and the others involving practical observations. In all cases space is provided in the book itself for the student to record the answers and results beneath the exercise itself. This certainly seems to be carrying this method of teaching a little too far, for in the case of the slovenly student the result will be that the book will be spoilt, while to the tidy student such spoon-feeding is quite unnecessary. The instructions given are rather meagre, and no diagrams are used for purposes of illustration.

(6) Dr. Lecher's book is a simple treatise on physics specially intended for students of medicine and biology. The author has endeavoured to make the subject appeal to them by the frequent introduction of illustrations drawn from their own subjects. Naturally the book is quite elementary in character, but the scope is fairly comprehensive from a descriptive point of view. Some of the diagrams are rather old-fashioned, depicting, as they do, persons performing experiments, but they are well and clearly printed, as is also the text.

(7) A book such as this of Dr. Houstoun's has long been needed. Many students of physics have experienced considerable difficulty both in selecting and in understanding the various treatises on mathematical physics which they ought to read. The present work will serve as an introduction to a variety of subjects, and the treatment is such that a student with a fair knowledge of the calculus and physics should be able to read it with comparative ease. The six chapters of the book deal respectively with attraction, hydrodynamics, Fourier series and the conduction of heat, wave motion, electromagnetic theory, and thermodynamics. There is also a series of examples at the end of each chapter. One is inclined to think that the section on thermodynamics is scarcely so extensive as the subject deserves, at any rate in comparison with the space devoted to the other sections. Standard works on thermodynamics are, however, more readily available to the average student; consequently this defect is less serious than it might otherwise have been.

(8) In this little popular treatise on electricity Prof. Adami manages to describe in non-mathematical language various principles in electricity and their applications to important practical developments. The book is nicely got up, and the diagrams are exceedingly well produced.

OUR BOOKSHELF.

The Electron Theory. By Prof. Toshinojo Mizuno. Pp. 336. (Tokyo: Z. P. Maruya and Co., Ltd., 1912.)

IN this book, which is intended for Japanese readers, Prof. Mizuno, of Kyoto Imperial University, gives the substance of a course of lectures which he delivered in 1911 at the Kyoto summer school. Beginning with the vacuum tube discharge, the author leads his readers through the various phenomena associated with the Zeeman effect, Brownian movements, Lenard and Röntgen rays, up to the modern conceptions of the structure of the atom. In this connection the hypothetical forms of stable configurations are discussed at considerable length. There then follow fairly detailed sections on the constitution of the spectrum lines, on radio-activity, on the energy quantum theory, on the longitudinal and transverse mass of electrons, and the like. Towards the end the principle of relativity is introduced in connection with Michelson and Morley's classical experiments.

The author makes no claim to any originality of treatment; but he has made himself master of the growing literature of the subject and has endeavoured to give a connected view of the many phenomena described. He is not satisfied with

the present state of speculation and hypothesis, and hopes for the coming of a great mind which will unify the whole.

Luftelektrizität. By Dr. Karl Kähler. Pp. 151. (Berlin and Leipzig: G. J. Göschen'sche Verlagshandlung G.m.b.H., 1913.) Price 90 pfennigs.

THIS is one of a long series of cheap, instructive books published by the firm of G. J. Göschen. The principal contents are the earth's potential gradient, forty-four pages; the electric conductivity of the atmosphere, thirty-five pages; electric currents in the air (including the ordinary fair-weather vertical current, electricity brought down by rain and snow, and lightning), twenty-nine pages; and the radio-active phenomena of the atmosphere, twenty-eight pages. Two other shorter sections deal respectively with the electric effects of sunshine and theories as to the source of atmospheric electricity. There are eighteen figures in the text, including some interesting Potsdam records of potential gradient during calm and disturbed weather. The author is a member of the staff of the Royal Meteorological-Magnetic Observatory at Potsdam, and is a recognised expert on the subject of which he treats. Considering its size, the book gives an excellent account, clear as well as concise, of the whole subject. German results loom somewhat more largely than they probably would in a text-book written in France or England, but there are a good many references to non-German writers, including Chauveau, Simpson, and C. T. R. Wilson.

Leçons sur les Hypothèses Cosmogoniques professées à la Sorbonne. By H. Poincaré. Edited by H. Vergne. Pp. lxx+294. Second edition, with a Portrait and a Memoir on H. Poincaré by E. Lebon. (Paris: A. Hermann et Fils, 1913.) Price 12 francs.

THE first edition of this work was given an extended notice in the issue of NATURE for May 2, 1912 (vol. lxxxix., p. vi). The present issue has been enriched by a portrait of Prof. Poincaré, and by the inclusion of a biographical notice and critical estimate of the eminent savant's work by M. E. Lebon, who has in addition made a few necessary corrections in the text.

A Manual of Agricultural Chemistry. By H. Ingle. Third edition. Pp. vii+397. (London: Scott, Greenwood and Son, 1913.) Price 7*s.* 6*d.* net.

THE first edition of Mr. Ingle's book—reviewed in the issue of NATURE for July 10, 1902 (vol. lxvi., p. 245)—dealt with the chemistry and physics of subjects relating exclusively to English agriculture. In the present edition, however, reference has been made to the chemistry of crops of tropical and sub-tropical countries, as well as to questions of stock-feeding in other lands. In addition, the book has been revised, and to bring it up to date some portions have been re-written.

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.*]

Some Phenomena Connected with Reflected X-Rays.

THE diagrams shown in Figs. 1 and 2 represent photographs obtained when X-rays were reflected on rock-salt and quartz. The spots lying on the left of the vertical line are due to the rays which have passed directly through the crystal, while those on the right are produced by reflected rays. It is easy to see from Fig. 2 that there are five spots due to the impact of the reflected rays. The middle spot and the two on the outside are more intense than the two others. The optical axis of the quartz specimen lies in this case in the plane of incidence forming an angle of 1′ with the surface of the crystal.

An explanation of the different spots of reflection shown in Fig. 2 can be given with the help of Fig. 3,

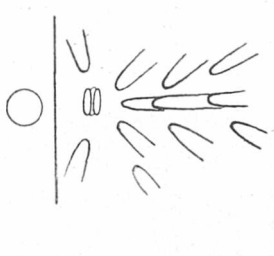


FIG. 1

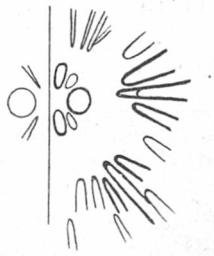


FIG. 2.

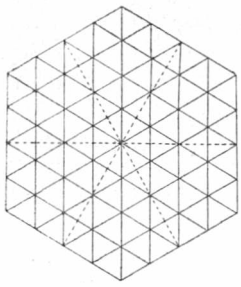


FIG 3.

which is meant to show a cross-section of a hexagonal crystal cut at right angle to the optical axis. The points of intersection of the lines drawn in full may represent the positions of the molecules in the crystal. Considering this figure we can assume that the more intense rays are reflected by the layers which are parallel to the lines drawn in full, and the weaker ones by layers which are parallel to the dotted lines. It is obvious that in the first case the molecules lie closer together than in the second.

In addition, in Figs. 1 and 2 there are seen a series of lines which seem to converge towards the points of impact of the reflected rays, and are distributed in a way which is very similar to a spectrum obtained with visible light by means of two crossed gratings. Provided that in our case the phenomenon is due to an effect similar to that of crossed gratings, the directly reflected rays must be regarded as spectra of the order zero. On account of the diffusion of the lines, however, it is not possible at present to deduce from this the wave-length of the X-rays.

E. HUPKA.

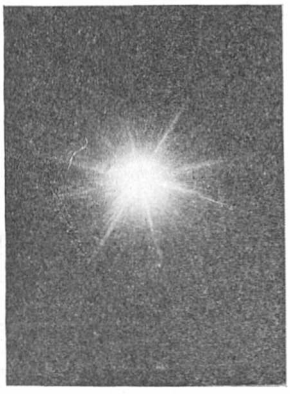
Physikalisch-technische Reichsanstalt,
Charlottenburg, April 12.

Diffraction Patterns from Crystals.

THE attention given, in this laboratory and elsewhere, to the effects produced by passing a beam of Röntgen radiation through crystals suggested to me that it might be of interest to examine the image produced when a narrow pencil of ordinary light falls on a photographic plate after passing through a crystal. The lens was removed from a camera, and in place of it there was attached a tube about 30 cm. in length and 3 cm. in diameter. The tube was lined with black velvet, and provided with three diaphragms pierced with pinholes from one-half to three-quarters of a millimetre in diameter. In this way I endeavoured to secure that a cylindrical pencil of light of small cross-section should enter the camera. In consequence of diffraction at the last aperture the impression on the photographic plate, when no crystal was interposed, sometimes extended over a considerable area, resembling the diffraction images recently discussed by Mr. J. W. Gordon (Proc. Phys. Soc., vol. xxiv., p. 428, 1912).

The crystal to be investigated was placed at a distance of about 5 cm. from the last aperture, and about 20 cm. from the photographic plate. The resulting image often showed lines or streaks radiating from the centre at angles depending on the crystal and its orientation. These effects are obtained only

Selenite.



Phlogopite.

by giving a prolonged exposure or using an intense source of light. With a mercury-vapour lamp, five or six hours' exposure was given; with diffused daylight, several days' exposure was required; but by employing the direct light of an arc lamp an exposure of five or ten minutes was found sufficient.

I have only found such radial streaks in cases where the crystal showed a more or less streaky appearance when examined by the naked eye. It seems clear that the striations in the crystal act just like a diffraction grating. In the case of selenite the *complete* pattern resembles an eight-rayed star; the angles between the radial streaks seem to agree with the angles between the axes *a* and *c* and (possibly) the first and second median lines.

I desire to thank Dr. Sibly and Dr. Tutton, to whom some of the photographs were submitted, for crystallographic information. Dr. Tutton writes:—

"I should think the phenomenon of the streaks in the photograph is due to the well-known 'asterism.' Asterism is particularly well shown by mica, especially the variety known as phlogopite. It is due to fine enclosures arranged along the glide-planes, and parallel to the cleavage plane. It shows itself as a six-rayed star (or occasionally twelve-rayed) when the mica is held between the eye and a bright source of light. Calcite also shows asterism, certain crystals held in front of a candle flame showing a radiating star of light. In this case, however, it is due to tubular cavities parallel to the glide-planes (the rhombohedron known as $e\{110\}$). Some sapphires also show asterism, and here again it is due to tubular cavities in planes parallel to the prism $\{10\bar{1}\}$. I am not aware that selenite has been studied for asterism. I should think it is very likely that certain specimens will show it, those rich in cavities or enclosures. The cavities would probably be parallel to the perfect cleavage plane (the symmetry plane $b\{010\}$ along which selenite crystals are tabular), and possibly along the two minor cleavage directions $a\{100\}$ and $n\{\bar{1}11\}$, the former of which would be parallel to the vertical axis *c*. They might also lie parallel to the inclined axis *a*. In this case your phenomenon would be at once explained."

Although the results obtained do not reveal any new physical phenomenon, I shall be glad if the experiments prove of interest to the crystallographer as affording him a convenient method of studying certain features of crystal structure. H. S. ALLEN.

Wheatstone Laboratory, King's College, London.

Bird Protection and the Collector.

THE protection and preservation of wild birds in Great Britain is in these days beset with difficulties of many kinds; but as regards especially the preservation of the rarer birds of our country, the one great and ominous danger is the individual whom Sir Herbert Maxwell has described as "the cursed collector." At this time of the year the professional collector of eggs infests the country wherever rare species are known or discovered to breed, and wherever clutches are to be had which have their value in the market. At all seasons of the year the professional collector of birds is despoiling the land of the noble, the beautiful, the unfamiliar forms of bird-life that hide in diminished numbers among little-frequented commons and heaths, mountains and lakes, woodlands and forests, or visit the country in small numbers and nest at their peril, with a price upon their heads and upon every egg they lay.

It may indeed be said that while a percentage of naturalists are working to protect birds, to keep up the number of our native species, and to bring about some comprehension of the living creature, others are eager only to secure for themselves, by hook or by crook, the skins and feathers, and the empty shells, to fill their cabinets or to sell or barter. As one of their number has written, with unconscious irony, the preservation of a bird should begin as soon as it is killed.

A correspondent of *The Times* wrote the other day of the egg-collector:—"These pests know no boundaries and observe no laws which stand between them and the objects of their rapacity." Could the experiences of some of the workers in this society be divulged the truth of that statement might be thoroughly demonstrated. Neither the "rarity" collector who values the "British-taken" bird or egg solely because it seldom occurs or is on the verge of extinction in Britain, nor the "rarity" collector to whom the speckles on an eggshell are things of absorbing interest, will stop at any artifice or any dodge in pursuit of his quest.

The problem lies in this, that the offenders are largely men of wealth and position, officers in the Army, clergymen, "ornithologists," popularly known for their interest in bird-life, and even for their pronouncements in print on bird protection; and that these collectors not only snap their fingers at the law and take pride in evading and transgressing its pro-

visions, but employ trade agents and dealers to work for them, and give heavy bribes to poorer men—men in the responsible position of keepers and coastguards, and also fishermen, shepherds, and others whose ignorance and poverty render them ready cat's-paws. The gamekeeper receives an intimation that a certain firm of "naturalists" will be happy to hear from him with regard to certain birds or eggs which may come to his notice, and will give him handsome terms; possibly the owner of the estate inquires later on whether a notable species which he was a little proud to have on his land is still there, and is told that it unfortunately attacked the chicks and had to be shot, or, more simply, that it has "disappeared." The crofter or the fisherman is told that the rich visitor at the hotel gives a wonderful sum for such-and-such eggs, which he hears are found on a neighbouring islet or moor, or that he wishes to be taken to see a nest, and will pay his guide well; and in a few years the bird has ceased to breed in that neighbourhood.

The creation of reserves has been advocated; various areas have been described in county council orders as "protected," in which birds or eggs may not be taken. But the creation of reserves or the definition of areas will not in themselves check unscrupulous collecting. For some years this society has, with the best results, employed watchers to guard certain breeding-places of rare birds. Some score of these are scattered over Great Britain, from the Shetlands and Orkneys to Sussex and Cornwall, and more will be employed as the much-needed funds permit; but the utmost care has to be exercised in their appointment; they must have fair pay to protect them to some extent from the temptation of bribes; and members of our watchers' committee visit their stations from time to time to inspect and judge actual results. Brean Down, of which the society rents the shooting rights, we hope to make a complete reserve for birds. It is exceptionally well suited for the purpose, and cannot well be visited without the knowledge of the watcher. Dungeness is a "protected area" guarded by the society's watchers during the breeding season. Yet at Dungeness a collector took advantage of a permit obtained by an unsuspicious friend to pocket all the eggs he could seize upon; followed by a watcher he was compelled to disgorge and restore every one. At Brean Down last spring the solitary young bird was taken from the peregrine's eyrie; an honorary watcher, discovering what had happened, pursued the culprit by motor-car, obtained the bird, brought it back to the down, and with considerable difficulty restored it to the nest.

On a protected island, a few seasons ago, permission to view was again gained by stratagem, and the visitor, closely followed, was at last impelled to say that "it was a pity to leave such nice eggs," and he would stand the consequences of taking them; the consequences happily worked out at 1*l.* per egg, and the eggs were forfeited. In Scotland the society has had to employ detective-inspectors, whose work called for vigilant circumspection. In Wales the kites' nests have to be guarded day and night. In many cases the eggs of harriers, ravens, peregrines, and other species are taken year after year, so that no young bird is ever reared, and only the presence of keen and determined watchers can stop this, or prevent the destruction finally of the parent birds. To the collector the idea of extermination of a species can suggest no regret; it would but add to the value and interest of his specimen.

Reserves and county council orders are admirable in intention; the latter are useful as affording possibility of conviction and fine where offenders are caught in the act. But as deterrents they avail nothing for persons of this class, and unless carefully worded may indeed serve to advertise the presence of a rare species. A law to deal with possession and the possessor is now absolutely necessary, as well as a strong public opinion which shall cause these collectors to be held in the contempt they deserve and shut them out from the society of decent naturalists. One proposal as to the kind of law needed has been made by Mr. W. H. Hudson ("Birds and Man," chap. xii.):—

"There is really only one way out of the difficulty—one remedy for an evil which grows in spite of penalties and public opinion—namely, a law to forbid the making of collections of British birds by private persons. . . . Without such a law it has now become impossible to save the best of our wild bird-life."

The words are even more true now than when they were written, and the time is more ripe for translating them into action. The old idea that not only must the ornithologist make collections, but that collections make the ornithologist, is giving way before the nature-reserve and the nature-student. But if the nature-reserve and the prohibition to take rare birds and rare eggs are to be more than a comfortable delusion, the open advertisement and the secret circular, the open incentive and the secret bribe for "procuring" specimens and for harrying nests, must be put a stop to. The source and motive, the *fons et origo*, of all these things is the private collection.

L. GARDINER,
Secretary, Royal Society for the Protection of Birds.
23 Queen Anne's Gate, London, S.W.

Mechanically-formed Grikes in Sandstone.

IN the Lower Old Red Sandstone of the west of Caithness I have noticed an appearance which recalls the grikes due to erosion of which Mr. Carus-Wilson writes in NATURE of May 1. It is seen in the platform of marine denudation in a minor inlet on the north coast at the village of Reay, eleven miles west of Thurso. The dip of the rocks varies from 10° to 30°, averaging 17°, 10° west of north, and the low scarps, lying transverse to the axis of the bay, run down to the sea, giving rise to the tiny inlets locally known as "ports," or "porties."

At the harbour begins a thick sandstone, stretching in a southerly direction to a thickness of about 120 ft., which appears to pass laterally into the grey and blue flags so prevalent in the area. Separated from the main body of the sandstone by a flaggy sandstone and blue flag is the thin sandstone in which the "grikes" are seen.

There does not seem to be any lithological difference between the rock of the main body and that of the layer with the "grikes." Both are grey sandstone, which weathers to a light reddish-brown colour, and there is an appreciable amount of hæmatite present surrounding the quartz grains which make up the bulk of the rock. Felspars are fairly numerous and fresh, and there are wisps both of muscovite and biotite. The cement is largely micaceous, but calcite is present, and there has been some deposition of quartz from solution. The quartz grains are not well rounded.

The grooves are smaller than those Mr. Carus-Wilson mentions; the largest are about a foot deep and four inches wide, but the length of the longest is well over 16 ft. They run in two directions at right angles, parallel to the dip and strike, and the network is at places so fine that miniature stacks stand out, about 4 in. square in section.

As the place is about 40 yards below the beach of

very coarse shingle one turns from the erosion hypothesis, and the slightly pitted nature of the rock surface suggests solution. ALEX. STEVENS.

Geological Department, University of Glasgow, May 6.

The Mountains and their Roots.

MAJOR COWIE'S letter in NATURE of May 8 gives the impression that I had the facts of the observations on the deflection of the plumb-line in India before me, and that I made my assumptions as to relative densities, and the mode of compensation by extension of depressed crust beneath the plains, "suitably adjusted," so as if possible to bring out the desired results. This was not the case. I made the assumptions about relative densities which seemed to be *a priori* probable; and it will be seen from the diagram at p. 184 of my "Physics of the Earth's Crust" that fifteen years before I wrote the paper in the *Phil Mag.* I had suggested that compressed mountains would be partly supported by an extension of the depressed crust beyond them.

Should anyone be inclined to undertake the labour of calculating from my formulæ, introducing fresh constants, or other distances, I would warn him that in the *Phil. Mag.* there is a misprint. In the formula for the plateau, after the first bracket, insert x.

I am much pleased that after so long a time my theories are under discussion, and I hope to come well out of it. I am sending to the *Geological Magazine* a reply to some remarks by Sir T. H. Holland in that journal, and to this I would refer your readers as more fully giving my views on some of the points under discussion. O. FISHER.

Graveley, Huntingdon, May 9.

An Application of Mathematics to Law.

I HAVE read Mr. Potts's letter in NATURE of April 24, but am at a loss to understand the use to which he would put his equations.

If it be his object to find some equation giving the validity of a patent or foretelling in any way the probability of its being upheld in a court of law, he has clearly failed to do anything of the sort.

If his equation $I=M+i$ is to be of any value, the quantity i must have a fixed value greater than zero. In fact, however, for any given patent, i may have an infinite number of values, including zero, since each person will have his own idea of the amount of ingenuity that must be shown in the particular case by the inventor. Thus the inventor will certainly put a high positive value upon i, while his opponent will as certainly say that the value of i is zero. It is clear that the value of i can only be finally settled when the validity of the patent has been settled by the House of Lords, and at this stage of a patent's career it is scarcely necessary to have an equation to test its validity. So far as the rest of his letter goes, he seems to have chosen a rather complex method of setting out a few of the chief principles of patent law.

R. STAFFORD CRIPPS.

Fulmer, Slough.

I DID not imagine that my letter would be taken as an attempt to supersede the present methods of determining validity. I intended it as a contribution to the theory which underlies the enormous volume of our case-law on the subject. Surely, as in other cases of the progress from empiricism to science, the first step must be in the direction of mathematical or symbolic expression of the facts. The value of such a symbolism is twofold: first, as an aid to precision of thought; and second, as a preliminary to generalisation. It is a vital principle of English law that all decisions shall harmonise with precedents as much as possible, and on this account alone anything should be of value which assists in formulating generalisations. We admit the value of theory in the physical sciences, apart from immediate practical results: why should an attempt to develop a theory of law be condemned because it does not at once do away with the functions of the judge?

Mr. Cripps's difficulty as to the value of i will not be so great if the actual cases given in my letter are studied. I may add here, however, that it is immaterial what this value is, provided that it is measurably greater than zero. It is settled law that a scintilla of ingenuity is sufficient to support a patent for something new and useful (*cf.* Thompson *v.* Amer. Braided Wire Co., in the House of Lords, and other cases). I therefore employed this symbol merely to indicate that there had to be some positive difference.

HAROLD E. POTTS.

University Club, Liverpool.

SYNTHETIC BIOLOGY AND THE MECHANISM OF LIFE.

THE presidential address delivered by Prof. Schäfer to the British Association in 1912, and the subsequent independent discussion at a joint sitting of two of the sections, served, as was pointed out by Prof. Armstrong in a paper in *Science Progress* in October last, "as a useful corrective to the wave of vitalism that has passed over society of late years owing to the pervasive eloquence of Bergson and other writers." Probably the majority of those who have studied the phenomena of life from the chemical side will agree with Prof. Schäfer in his dictum that "at the best vitalism explains nothing," and accept his opinion "that we may fairly conclude that all changes in living substance are brought about by ordinary chemical and physical forces." The difficulty, however, lies in obtaining any satisfactory information as to what are the actual chemical or physical changes which occur in the real living cells or tissues. Since this discussion was held Prof. S. Leduc, of the School of Medicine at Nantes, has published a monograph[1] in which he approaches the problem from the novel point of view which now for several years past has guided his experiments and with which readers of his "Mechanism of Life" will be familiar.

It is impossible to do justice to the author's arguments or make clear the proper value of his demonstrations in a short article such as the present, but this will at least serve to direct attention to a few of the very remarkable results that he claims to have achieved, which, if verified, are certainly of the highest significance to the student of the phenomena of life.

The basis of Prof. Leduc's work may be summarised in his own words as follows: "It is in the physico-chemistry of liquids that an explanation of the phenomena of life is to be sought"; and he develops his views largely by studying the nature of diffusion in liquids and the phenomena

1 "La Biologie Synthétique." By Prof. Stéphane Leduc. Pp. ii+217 (Paris: A. Poinat, 1912.)

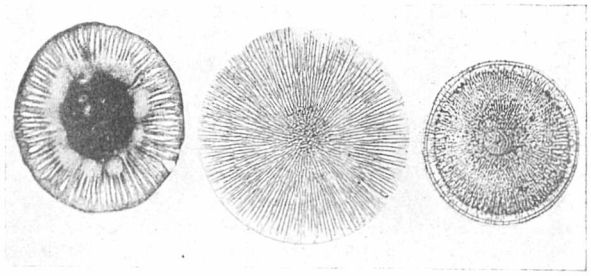
that are thereby produced. He regards diffusion as brought about by currents which radiate to and from the centres of greatest concentration; when a drop of solution of higher concentration is placed in a solution of lower concentration, the drop becomes the centre of symmetrically radiating currents, the one set, consisting of the solution of higher concentration, radiating outwards (centrifugal), the other set (centripetal) radiating inwards and consisting of the solution of lower concentration. "The force producing the currents is the osmotic pressure. Their centres of emission, true dynamic centres or poles, are of two kinds: centres of osmotic pressure greater than that of the medium or positive poles of diffusion, and centres of lower osmotic pressure or negative poles of diffusion. Around these poles of diffusion the dynamic and kinetic phenomena are the same as those which exist in the æther around electric or magnetic poles; the same mechanical laws control them, and a molecule is displaced in the liquid exactly like an ion in an electric field." Photographs are given by Prof. Leduc which show that, for example, a drop of tinted water diffuses into a saline solution along lines which exactly correspond with the discharge from an electric point or with the lines of force from the pole of a magnet. "It is the graphical representation of a centre of force such as was demonstrated by Faraday." Concentric circles of concentration are produced by diffusion which correspond with Faraday's equipotential surfaces.[2]

By utilising differences of concentration and the accompanying osmotic and chemical phenomena under different conditions and with different substances and media, Prof. Leduc states that he has been able to reproduce many phenomena which have hitherto been regarded as characteristic exclusively of living matter. Of a few of these a brief description is appended.

Cell Synthesis.—Of the many different types of cell which Prof. Leduc states that he has "synthesised," the photograph, Fig. 1, shows three varieties: A is an artificial cell produced by a drop of solution of triammonium phosphate in a solution of sodium carbonate and trisodium phosphate; the "nucleus" is large and the analogues of the protoplasmic processes and the enveloping membrane thick. The middle figure B is an artificial aster produced by a drop of water tinged with Indian ink in a solution of potassium nitrate. C shows an artificial cell with interior granulations. When such cells are prepared with a precipitated membrane composed, for example, of calcium carbonate or phosphate, they grow in size owing to the fact that the centripetal diffusion (of water) is greater than the centrifugal, the surrounding membrane becoming correspondingly extended.

[2] Reference may here be made to a paper by Dr. Horace T. Brown and F. Escombe on static diffusion of gases and liquids, &c. (Phil. Trans., 1900, 193 B, 223), which is not referred to by Prof. Leduc, but substantially corroborates his views on these points. In this paper it is shown that the lines of flow of gas or solute diffusing through a perforated diaphragm are the analogues of the lines or tubes of force, and the shells of equal density or concentration obtained the analogues of electrical surfaces of equipotential.

Karyokinesis.—The reproduction artificially, by very simple means, of all the phenomena characteristic of karyokinesis is one of the most striking achievements to which Prof. Leduc lays claim. The photograph (Fig. 2) shows four successive periods of cell-division reproduced by diffusion. "If in a saline solution there is introduced between two tinted drops, of less or greater concentration than the solution and representing the centrosomes, a drop of solution very slightly more or less concentrated than the solution and representing a nucleus, all the transformations, all the movements,

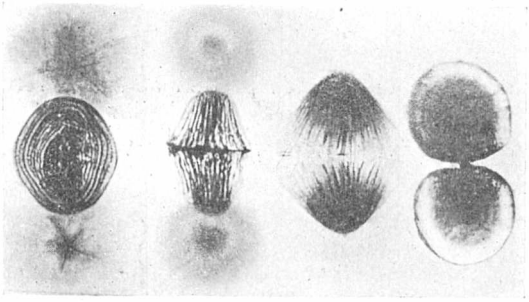


A B C

FIG. 1.

and all the figures characteristic of nuclear division are seen to unfold themselves in their proper sequence and regular order." In the figure A shows the spirem stage, B the orientation of the chromatic substance in the equatorial plane, C the chromosomes on their way to the centrosomes, and D the two final cells produced as a result of the action.

Multiplication.—If an artificial cell is kept for a sufficient time in the liquid from which it has been formed, after a time a furrow appears in the interior of the cell and later other furrows



A B C D

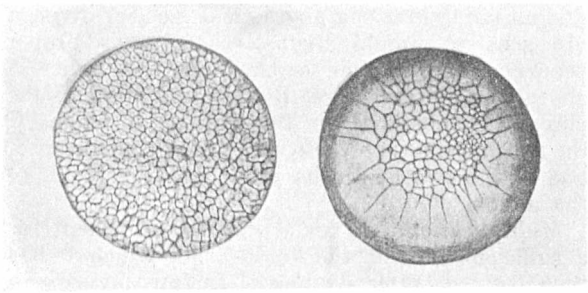
FIG. 2.

appear which split up the cell into secondary cells, the number of which rapidly increases until the artificial cell becomes nothing but a group of secondary cells—that is, an "artificial morula." Fig. 3 shows a comparison of the germinative disc of a hen's egg (A) with the segmentation of an osmotic cell produced artificially.

Nutrition and Development.—In a chapter on the physiology of nutrition, illustrated by a number of striking photographs which we cannot reproduce here, Prof. Leduc contends that the "facul-

ties of nutrition, absorption, elaboration or chemical metamorphosis, assimilation, elimination, growth, development, functional differentiation, organisation, inanition and disease are shown by osmotic growths exactly as by living organisms." Striking examples of a comparatively high degree of organisation are given in the chapter on "morphogeny," such, for instance, as the capsular terminations of the filament-like growths obtained with manganese salts, or the "osmotic fungi" which very closely resemble natural fungi in their appearance and structure. One of the most interesting features of these growths is the selective distribution of colour in the different parts, one portion of which may be, for instance, greenish-white, another light green, another part dark green and other parts golden yellow.

Phototropism, galvanotropism, &c.—Prof. Leduc contends that the majority of such phenomena as phototropism, chemotropism and galvanotropism, which have been regarded as essentially vital phenomena, can be artificially reproduced with purely mineral or unorganised material. If, for example, a bath of a salt solution is placed so that one half is illuminated and the other half



A B

FIG. 3.

is in darkness, and a drop of water tinted with Indian ink is added, "the particles of carbon abandon the illuminated portion and take refuge in the dark part." These and similar results are utilised by Prof. Leduc in a discussion of the nature of the changes occurring in the production of sense impressions. One of the most striking phenomena in this domain, the deformation of the ovule, with the production of a protuberance on the side of the spermatozoid, which Sachs called "the most surprising phenomenon in fecundation," Prof. Leduc claims to have reproduced artificially in a very simple way: If near an artificial cell (hypotonic), produced in a non-saturated solution of potassium nitrate, a small crystal of potassium nitrate be placed, not only is the artificial cell deformed with a protuberance on the side of the crystal, but the lines of circulation within the cell are evidently also influenced.

In this small treatise 118 photographs are reproduced, each of which is said "to be expressive of a fact and to represent the result of a series of experiments." It has here been possible only to outline in the most general manner the character and scope of the work. W. A. D.

SEMI-CENTENNIAL CELEBRATION OF THE NATIONAL ACADEMY OF SCIENCES IN WASHINGTON.

THE National Academy of Sciences of the United States celebrated the fiftieth anniversary of its foundation on April 22–24 at Washington. A special programme was arranged, and many distinguished guests were invited to participate in the celebration. In recognition of the function of the academy as the scientific adviser of the Government, President Wilson, Vice-President Marshall, and Chief Justice White took part in the exercises.

The celebration was held at the Smithsonian Institution, and began on the morning of April 22 with an address by the retiring president of the Academy, Dr. Ira Remsen, who reviewed the history of the organisation and gave an account of the scientific labours of the incorporators, and of the various trust funds of the academy.

Dr. Remsen was followed by President Hadley, of Yale University, whose theme was the relation of science to higher education in America. An address was then delivered by Dr. Arthur Schuster, F.R.S., on international cooperation in research. After a luncheon the academy and guests listened to a brilliant lecture by Dr. G. E. Hale, director of the Mount Wilson Solar Observatory, on the earth and sun as magnets. The lecture was illustrated by lantern-slides and experiments. In the evening a reception was given by the regents and secretary of the Smithsonian Institution, the hosts being Vice-President Marshall and Chief Justice White, Chancellor of the institution.

On the morning of April 23 an address was delivered by Dr. J. C. Kapteyn, director of the astronomical laboratory of the University of Groningen, on the structure of the universe. In the afternoon the academy and guests assembled at the White House, where certain medals and prizes of the academy were presented by President Wilson. Dr. R. S. Woodward, director of the Carnegie Institution of Washington, read the reports of the committee on the awards, after which the President handed the medals and prizes to those who were to receive them, or to their representatives, prefacing his action by brief remarks in which he gracefully referred to the academy as a great society, and as one long associated in an advisory capacity with the Government of the United States. The awards were as follows:—

The Watson medal to Dr. J. C. Kapteyn in recognition of his bold, penetrating researches on the problem of the structure of the stellar universe. Dr. Kapteyn received the medal in person.

The Henry Draper medal to M. Henri Deslandres, of Meudon, France, for his noteworthy researches in astrophysics. M. Deslandres not being present, the medal was delivered to the French Ambassador, M. Jusserand.

The Agassiz medal to Dr. Johan Hjort, of Bergen, Norway, for his meritorious contributions

to the science of oceanography. In the absence of Dr. Hjort, the medal was received by the Norwegian Minister, Mr. Bryn.

The Comstock prize of 1500 dollars to Prof. Robert A. Millikan, of Chicago, for his demonstrations of the existence of electric atoms in elements and of the equality of the electrical charge of positive and negative ions in ionised gases, and his additions to the knowledge of the molecular constitution and kinetic phenomena of gases.

A business meeting was held on the morning of April 24, when the following officers and new members and foreign associates were elected: *President*, William H. Welch; *Vice-President*, Charles D. Walcott; *Foreign Secretary*, George E. Hale; *Home Secretary*, Arthur L. Day; *Treasurer*, Whitman Cross. *New Members:* Henry A. Bumstead, Gilbert N. Lewis, Louis V. Pirsson, Erwin F. Smith, Leonard E. Dickson, Lafayette B. Mendel, Edward B. Rosa, Ross G. Harrison, George H. Parker, Armin O. Leuschner. *New Foreign Associates:* Arthur Schuster, Theodor Boveri, William Crookes, Gaston Darboux, Henri Deslandres, Albert Heim, Albrecht Kossel, Karl Friedrich Küstner, Johannes D. van der Waals, August Weismann, Max F. J. C. Wolf.

On the afternoon of April 24 an excursion was made to Mount Vernon on the U.S.S. *Mayflower*, which had been placed at the disposal of the academy and its guests by the Secretary of the Navy. In the evening a banquet was held in the New Willard Hotel, at which speeches were made by Vice-President Marshall, the Right Hon. James Bryce, President Remsen, Dr. S. Weir Mitchell, Senator T. E. Burton, of Ohio, and Dr. W. W. Keen, President of the American Philosophical Society.

To mark the anniversary, the academy published a history of its first half-century in a handsome volume of some 400 pages. It includes an account of the founding of the academy, its annals, biographical sketches of the incorporators, and a chapter on the work of the academy as the scientific adviser of the Government, together with appendices, among which is a list of publications.

SCALES OF FISH AS TESTS OF AGE.

THE general principle that the age of a fish may be determined by a study of the markings on the scale has now been generally accepted for many fishes, especially for the Gadoids, Clupeoids, and Salmonidæ. It has been maintained, especially by Norwegian naturalists, that the principle may be carried still further, and that from a measurement of the portions of the scale representing the growth of successive years the length of the fish at the end of each year of its life may be calculated. If this proved to be true, the average annual growth rate of fishes could be determined by the examination of comparatively small samples of fish, since each of the older fishes would give values for a number of years.

That the use of the method in this way must be undertaken only with great caution is clearly shown in a paper by Miss Rosa M. Lee, published by the International Council for the Study of the Sea (*Publications de Circonstance*, No. 63), entitled "An Investigation into the Methods of Growth Determination in Fishes." By an acute and penetrating analysis of the measurements of scales from herring, haddock, and trout, Miss Lee shows that if the lengths of the fish at the end of each year are calculated from the lengths of the annual rings on the scale, measured from the centre of the scale along its major axis, the figures obtained appear to indicate a change in the growth rate of such a nature that the younger fishes attained a greater size at any given age than was attained by older fishes at the same given age. Thus whereas in a sample of herrings the four-year-old class gave an average calculated length of 25·8 cm. at the end of the third year, the ten-year-old class gave an average calculated length of only 21·3 cm. at the end of their third year.

Various hypotheses are put forward to account for this phenomenon, of which the most probable seems to be either that it is due to an actual shrinkage during the later life of the fish of the portion of the scale already laid down, or that in the samples of fish examined there has been a segregation according to size of such a character that only the larger sizes of the earlier age groups are present. The subject is clearly one which must be further investigated before certain conclusions as to age can be arrived at from the study of fish scales.

THE ROYAL SOCIETY CONVERSAZIONE.

THE annual May conversazione of the Royal Society was held in the rooms of the society at Burlington House on Wednesday, May 7. During the evening lantern demonstrations were given by Mr. Leonard Bairstow illustrating cases of eddying fluid motion of interest in aëronautical research, and by Dr. A. Smith Woodward on the discovery of a palæolithic human skull and mandible at Piltdown, Fletching, Sussex. Many objects and instruments illustrating recent scientific methods and results were exhibited, and most of them are described in the subjoined summaries from the official catalogue. Exhibits referring to related branches of science have, so far as possible, been grouped together.

Prof. J. T. Morris: The electrical measurement of wind velocity, as applied to the distribution round a circular rod in an air current. In the air current is fixed a Wheatstone bridge made with alternate arms of platinum and manganin. At normal temperature this bridge is out of balance. It is supplied with either (*a*) a constant voltage, when a millivoltmeter in place of the usual galvanometer gives indications depending on the wind velocity; or (*b*) a current which can be varied so as to bring the bridge into balance for any velocity; the square of the watts used in the bridge wires is then proportional to the wind velocity subject to a small correction. It is unnecessary to know the direction of the wind before a measurement can be made. *Mr. M.*

O'Gorman: Instruments for aëronautical work, and research on aëroplane stability. (1) Ripograph: to record velocity, roll, pitch, yaw, and the corresponding movements of the flyers controls on a continuous photo-strip. (2) Velometer: to indicate speed through the air of aëroplanes and airships. (3) Trajectograph: to record the path through the air of aëroplanes. (4) Air distance recorder or log: to give miles passed through the air of aircraft. (5) Recording accelerometer. (6) An airship and aëroplane instrument board complete. (7) Tautness meter: to enable the pull on a wire to be measured without altering or cutting it, or putting fixtures on the wire. Suitable for using during flight. *Mr. J. D. Fry:* A micromanometer capable of detecting differences of pressure of the order of one-millionth of a millimetre of mercury. The difference of pressure to be measured is applied to the two sides of a stretched membrane; the centre of the membrane by its displacement twists a mirror which is suspended in a special manner, the pressure differences being indicated by the deflection of a spot of light. *National Physical Laboratory:* Apparatus for the rapid determination of the lifting power of samples of hydrogen. (*Mr. Guy Barr.*) The method employed depends on the principle of balancing columns commonly used for comparing the densities of liquids. From the reading of a gauge, when the pressure difference is balanced, the lifting power of the hydrogen is determined with an accuracy of about 0·02 per cent. From the lifting power the purity of the hydrogen may be deduced by making corrections to N.T.P. after observation of the volume of a known mass of air.

The Cambridge Scientific Instrument Company, Limited: (1) Apophorometer: an instrument designed by Prof. J. Joly, for easily obtaining sublimates from substances at high temperatures. (2) Rack barometer: a barometer of the marine type, in which a dial is substituted for the vernier in general use. The dial is divided to read directly in tenths of a millibar. (3) Stomatograph: an instrument which records the amount of opening of the stomata on a leaf. (4) Yaw indicator: this instrument is designed to indicate the direction of a current of gas in any plane. *M. C. V. Boys:* Rainbow cups—old and new patterns. The chief characteristic of the new pattern is the point support of the cup. The accurate work necessary with an axle is avoided and the friction is greatly reduced. The cup supported at a point is free to precess, and during this motion the coloured rings appear to expand and contract in time with the precession. The direction of precession is opposite to that of an ordinary top. *Sir John Thornycroft:* Model to illustrate the effect of a compound cross sea on vessels of various rolling periods. In the model a plane surface is supported on three points, two of which move vertically and the third is stationary. In the vertical motion of each of the two moving supports four simple harmonic motions are combined, and the phase of motion in the two differ by a quarter of their time period, and produce in the moving surface a symmetrical motion, resembling that of a small portion of a complicated sea in which similar waves are crossing at right angles. *Mr. R. E. Gillmor:* The Sperry gyro compass. To be efficient the gyro compass must be so suspended that there is almost an entire absence of friction about the vertical axis, while at the same time forces must be impressed upon the wheel itself about the horizontal and vertical axis to cause the wheel to rotate into the plane of the earth's rotation. In the Sperry compass both are accomplished by suspending the gyroscopic or sensitive element from a stranded wire, the top of which is held in a frame surrounding the sensitive element and made to follow it by a system of electrical contacts controlling a motor which drives the frame.

Underfeed Stoker Company, Ltd.: CO_2 thermoscope, a self-contained pocket instrument for the thermometric analysis of carbonic acid gas in furnace and other gases. The instrument operates by measuring the heat of reaction between CO_2 and dry pulverised caustic alkali. (See NATURE, April 17, p. 171.) *Mr. F. W. Jordan:* Convection radiometer and thermo-galvanometer. This instrument is primarily intended for the measurement of feeble steady rates of evolution or absorption of heat. *Mr. Dugald Clerk:* Determination of the volumetric heat of air, carbon dioxide, nitrogen, and flame in the cylinder of the internal-combustion engine. The volumetric heats of various gases and flames have been determined by the method of alternate compressions and expansions described in a paper read before the society in 1906. The present investigation deals with gases at low and high temperatures, and gives values between 100° C. and 1000° C. Laws of cooling have also been investigated, and the remarkable effect of turbulence on the rate of flame propagation in engines has been demonstrated. *Prof. Leonard Hill:* Kata-thermometers or comfort-meters. Two large-bulbed spirit thermometers are used. The bulb of one is surrounded with muslin. The stem of each is marked with heavy black lines at 110° F., 100° F., and 90° F. Readings can be taken with the bulbs of the instruments (1) clothed; (2) exposed or shielded from radiant heat, *e.g.* a fire. By this means the heating and ventilation of rooms and the effect of clothes can be investigated and arranged so as to give (1) comfortable loss of body heat; (2) prevent depressing effect of uniformly heated air on cutaneous nerves. *Prof. L. R. Wilberforce:* Experiments with ripples. Ripples produced on a water surface by a vibrating dipper are projected by intermittent light so as to appear stroboscopically in slow motion. A phonic wheel drives the slotted disc which produces the intermittence, the motion being transmitted by fluid friction whereby a very uniform rotation is obtained.

Mr. E. Leitz: Ultra-condenser for the observation of ultra-microscopic particles. The ultra-condenser has been devised for ultra-microscopic observations, especially in the examination of fluids and gases. The condenser renders any ordinary microscope suitable for the purpose. It consists of two glass bodies, each having a reflecting spherical surface, cemented into a metal box fitted with a bayonet-jointed and rubber-faced cover. The cover is fitted with a disc of quartz which serves as a cover glass. Underneath, the cover glass has a cavity for receiving the liquids and gases for examination. The condenser is not intended for high-power observations, and therefore objectives of shorter focal length than 8 mm. may not be used. *Prof. J. Norman Collie and Mr. H. S. Patterson:* The presence of neon and helium in hydrogen after the passage of the electric discharge through the latter at low pressures. Whatever the explanation may be of the presence of neon and helium in hydrogen after the latter has sparked it seems to be certain that:—(1) Neon and helium cannot be obtained from either glass or from the electrodes by heating alone; (2) glass, when heated to near its softening point and subjected to the action of kathode rays, is not permeable to neon or helium, so neither neon nor helium diffuses into the apparatus from the atmosphere. *Mr. A. Fowler:* New lines in the spectrum of hydrogen. Certain lines which occur in the spectra of stars and nebulæ have been attributed to hydrogen by Pickering and Rydberg in consequence of numerical

relationships with the well-known Balmer series. Some of these "cosmic hydrogen" lines have lately been produced by passing a strong condenser discharge through a mixture of hydrogen and helium. *Prof. H. H. Turner:* Diagram of sun-spot analysis. Wolf's sun-spot numbers 1750–1910 can be closely represented by the harmonics of a period of 156 years, the coefficients of which rise and fall in a regular manner. The familiar $11\frac{1}{9}$ year period is the fourteenth harmonic, and has the maximum amplitude; but periods near it, especially thirteen and fifteen, are also important. All the chief harmonics were determined approximately, and their sum is compared with the numbers showing that the residuals are small. *Capt. H. G. Lyons:* An ancient Egyptian astronomical instrument. The original of this instrument was found in Upper Egypt, and is now in the Royal Museum at Berlin. By means of the wooden "sight-vane," one observer aligned the plumb-line, which was held by a second observer, on the pole-star. The second observer then noted the passage of certain stars over the first observer's head, and thus determined the divisions of the night.

The National Physical Laboratory: Specimens illustrating the behaviour of metals at relatively high temperatures. (*Dr. Rosenhain and Mr. Ewen.*) In researches on the intercrystalline cohesion of metals their behaviour at temperatures near their respective melting points has been examined, both by heating *in vacuo* and by mechanical tests. The volatilisation which occurs in many metals at temperatures below their melting points results in the formation, on previously polished surfaces, of patterns corresponding to the structure of the metal. This constitutes a process of vacuum etching. *Prof. W. J. Pope:* A collection of artificial crystals. A number of large crystals of various salts prepared by slow crystallisation of aqueous solutions; most of the crystals are well-proportioned, and peculiarities of face development, &c., can be observed upon them.

Prof. E. B. Poulton: All-female families and mixed families of *Acraea encedon,* bred by Mr. W. A. Lamborn in the Lagos district. These researches indicate the existence of two castes of females, one of which produces mixed families and the other all-female families. Both require fertilisation. *Mr. L. Doncaster:* The moth *Abraxas grossulariata*: inheritance of tendency to produce unisexual broods. In six successive generations families consisting wholly of females have appeared. *Dr. S. F. Harmer:* Polyzoa of waterworks. (See NATURE, May 8, p. 260.) *Dr. W. S. Bruce, Scottish Oceanographical Laboratory:* Collection of deep-sea animals taken by the *Scotia,* Scottish National Antarctic Expedition, 1902, 1903, and 1904. While a few of the animals shown are representative of shallow-water antarctic fauna, the greater number are from depths down to 2645 fathoms, or about three miles. An important feature of the scientific results of the *Scotia* lies in the fact that the Scottish expedition was the only antarctic expedition which has been completely fitted for deep-sea research in high southern latitudes. *Marine Biological Association of the United Kingdom:* Living crabs and their allies arranged to show some of the various modifications of form and structure found in this group, and the relation between such modifications of structure and the mode of life of the animals. *Mr. Conrad Beck:* Marine Coscinodiscus showing filaments, shown under the microscope with high-power dark ground illuminator (mounted by H. J. Waddington). The filaments radiating from these diatoms were discovered by Mr. Siddall of Chester, and some controversy has arisen as to whether they are protoplasmic, pseudopodia, or silicious spines. They are readily seen with a low power, but require very oblique dark ground illumination, as used for high powers, to demonstrate them. *Mr. C. B. Williams:* British Protura. The Protura, first described by Silvester from Italy in 1907, and first recorded from England last year by Mr. Bagnall, are a group of primitive Arthropods the systematic position of which has been the subject of much discussion. Their chief affinities are with the Insecta or with the Myriapoda, and they have been considered by various authorities as members of these groups and as a separate class intermediate between the two. *Mr. H. G. Plimmer:* Blood parasites: new, or from new hosts.

Dr. S. Watson: Skull, mandible, shoulder girdle, and forelimb of Dicynodon, sp. nov. female individual. *Dr. D. H. Scott:* Sections of Upper Devonian plants showing structure. *Keeper of Geology, British Museum (Natural History):* Remains of a Palæolithic human skull and mandible, with flint implements and mammalian teeth, from a gravel at Piltdown, Fletching, Sussex. This collection was made by Mr. Charles Dawson, and is described by Messrs. Dawson and A. Smith Woodward in the Quarterly Journal of the Geological Society for March, 1913. The skull and mandible are regarded as representing a new genus and species of Hominidæ, named *Eoanthropus dawsoni. Prof. G. Elliot Smith:* The brain-cast obtained from the Piltdown skull, and other specimens for comparison. The cranial cast obtained from the Piltdown skull was shown alongside a series of specimens and drawings illustrating the form and constitution of the brain in primitive men, anthropoid apes, and other mammals supposed to be near the line of human ancestry. The objects of this comparative series are (1) to illustrate and help in the interpretation of the distinctive features of the most primitive human brain to which we have access at present, and (2) to elucidate the nature of the evolutionary process by which the human brain has been derived from that of an early mammal. A specimen was shown representing an attempt at the restoration of the features of the Piltdown man's brain. *Mr. Henry Balfour:* Stone implements of Early Palæolithic types from South Africa. A selected series of stone implements from South Africa, exhibiting marked similarity in form and technique to the Chellian and Acheulian implements of the Lower Pleistocene river-gravels of England and western Europe. The implements exhibited were collected partly in the neighbourhood of Kimberley and partly on the Zambezi (Victoria Falls) and the Maramba River. *Mr. C. Forster-Cooper:* Remains of fossil mammals from the Early Miocene deposits of Dera Bugti in Baluchistan. The bone beds around Dera Bugti are interesting from the fact that they contain the earliest remains of mammals as yet discovered in the East. From their situation on the probable line of migration from or to Europe and Africa, it is hoped that interesting comparisons may be made with the earlier or contemporaneous faunas of Europe and Africa. *Mr. H. Peake and Mr. E. A. Hooton:* Skulls and grave furniture from Saxon graveyard at East Shefford, Berks, explored 1912. This graveyard was discovered in 1890 during the construction of Lambourne Valley Railway. It was carefully explored in September, 1912, when twenty-six graves were found. It seems to date from the early part of the sixth century. *Prof. E. Hull:* Coloured map of the North Atlantic and bordering regions to show the submerged terraces and river valleys as determined by the soundings of the Admiralty charts.

NOTES.

THE Bakerian lecture of the Royal Society will be delivered by Sir J. J. Thomson, O.M., F.R.S., on May 22, upon the subject of "Rays of Positive Electricity."

DR. GISBERT KAPP, professor of electrical engineering in the University of Birmingham, has been appointed president of Section G (Engineering) of the British Association for the meeting to be held in Birmingham in September next.

THE Georg Neumayer gold medal was bestowed upon Prof. L. A. Bauer, director of the department of terrestrial magnetism, Carnegie Institution of Washington, for his various researches in terrestrial magnetism, at the celebration of the eighty-fifth anniversary of the Berlin Gesellschaft für Erdkunde, on May 3.

THE Newcastle City Council has decided to invite the British Association to meet in Newcastle in 1916. A deputation consisting of the Lord Mayor (Alderman J. F. Weidner), the Sheriff (Mr. G. T. de Loriol), and Sir W. H. Stephenson was appointed at the meeting of the council on May 7 to present the invitation at the meeting of the association in Birmingham next September.

THE first Wilbur Wright memorial lecture will be delivered by Mr. Horace Darwin, F.R.S., at the Royal United Service Institution, Whitehall, on Wednesday, May 21, at 8.30 p.m., under the auspices of the Aëronautical Society, which has raised a fund for the annual delivery of a premium lecture in order to commemorate the work of Wilbur Wright, who, with his brother Orville Wright, evolved the first successful power-driven aëroplane which carried its pilot.

THE Walker prize, which is awarded by the Boston Society of Natural History once in five years, has been awarded this year to Mr. Robert Ridgway, of the United States National Museum, in recognition of his investigations in ornithology, and particularly for his work on the birds of North and Middle America. This prize, the amount of which is 200*l.*, was, says *Science*, founded by the late Mr. W. J. Walker, a benefactor of the society, and is given in recognition of important investigation in natural history published and made known in the United States of America.

THE death is reported, in his seventy-eighth year, of Mr. W. M. Fontaine, a leading American authority in fossil botany. A Virginian by birth, tracing his descent from a Huguenot family, he fought on the Confederate side in the Civil War. He was afterwards professor of chemistry and geology at the West Virginia University, and later held the chair of geology and natural history at the University of Virginia for thirty-three years, retiring in 1911 with a Carnegie pension. Prof. Fontaine took part in the second Pennsylvania Geological Survey, and at various times contributed reports to the U.S. Geological Survey.

THE latest ice reports contained in the meteorological chart of the North Atlantic Ocean for May, issued by the Deutsche Seewarte, state that in the vicinity of the Newfoundland Bank the drift ice, consisting of bergs and field ice, had greatly increased, and up to the third week in April had advanced southwards to nearly latitude 43° N., and eastwards to 41½° W. longitude. According to a report from St. John's (Newfoundland), at the end of March such a large amount of ice is seldom seen so early in the season. On the east coast of Cape Breton Island (Nova Scotia) much difficulty was caused to navigation. The conditions near Quebec had, however, much improved.

THE fifth general meeting of the Alchemical Society was held on Friday last, May 9, at the International Club, Regent Street, S.W. The chair was occupied by the honorary president, Prof. J. Ferguson, professor of chemistry in the University of Glasgow, and a paper by the Ven. Dr. J. B. Craven, Archdeacon of Orkney, was read, entitled "A Scottish Alchemist of the Seventeenth Century: David, Lord Balcarres." The author has been permitted to examine what remains of Balcarres's library, and has found therein a MS. translation of the famous "Fama Fraternitas," antedating the earliest published translations. The paper also contained particulars of other interesting MSS. in this library, and concluded with an old Fifeshire legend showing the fantastic views which were once held concerning the Rosicrucians.

ON Tuesday next, May 20, Prof. T. B. Wood will deliver the first of a course of three lectures at the Royal Institution on recent advances in the production and utilisation of wheat in England; on Thursday, May 22, Prof. W. J. Pope will begin a course of three lectures on recent chemical advances: (1) molecular architecture, (2) chemistry in space, (3) the structure of crystals; and on Saturday, May 24, Prof. Rutherford will commence a course of three lectures on radioactivity: (1) the α rays, (2) the origin of the β and γ rays, (3) the radio-active state of the earth and atmosphere. The Friday evening discourse on May 23 will be delivered by Prof. S. P. Thompson on the secret of the permanent magnet; on May 30 by Dr. Owen Seaman on parody; and on June 6 by Dr. Francis Ward on reflection and refraction of light as concealing and revealing factors in subaquatic life.

IT is proposed to celebrate the centenary of the foundation of the Indian Museum in Calcutta next February. Originally founded as a branch of the Asiatic Society of Bengal at the suggestion of Wallich, the botanist, on February 2, 1814, the Indian Museum became a Government institution in 1867, after prolonged negotiations with the Government of India, which accepted the society's collections to form the nucleus of an imperial museum in Calcutta. A strong centenary committee has been formed with his Excellency, Lord Carmichael, the Governor of Bengal, as chairman, and Sir Asutosh Mookerjee, Vice-Chancellor of the Calcutta University, as vice-chairman. The committee has decided to publish an official history of the museum, to raise a special fund for the improvement of the public galleries, and to hold a reception in the museum on the anniversary of its foundation.

IN connection with the Panama-Pacific International Exhibition to be held in San Francisco in 1915, a

great display of horticulture is being arranged. The Horticultural Palace will provide an area of 207,000 sq. ft., and the building will be divided into three sections, namely tropical, semi-tropical, and temperate. In addition, about fifty acres will be reserved for outdoor nursery exhibits. The hall will be ready for the exhibits seven months before the opening of the exhibition, on February 20, 1915, and it is hoped that many of the plants will thus acquire the appearance of permanency before they are exposed to public inspection. In order to give extra novelty to the exhibition, the management offers a cup of the value of 1000 dollars for the best new seedling rose never previously exhibited. The rose which is awarded this prize will be named by the exhibition directors.

UNDER the title "Glorification de l'œuvre de Paul Schutzenberger," the *Revue Scientifique* of April 19 publishes a series of addresses delivered at the Ecole Municipale of Paris, on the occasion of the presentation to the city of Paris of a medallion, executed by M. Urbain, in commemoration of the life-work of the great chemist who was the organiser and first director of this famous school. Eulogies of Schutzenberger's purely scientific work were delivered by Profs. Haller, Noelting, and Matignon, whilst MM. Blondel, Lindet, and Scheurer dwelt on the very great influence he exerted on modern chemical industry by his investigations of the nature of dyes, and his discovery of hydrosulphurous acid and its application to indigo dyeing, which he effected in conjunction with M. de Lalande; the latter has within recent years led to the most important developments in the textile arts.

THE fine collection of Indian big-game heads and horns left to the nation at the close of last summer by the late Mr. A. O. Hume has been placed on exhibition as a special series on the walls of the second floor of the central hall of the Natural History Museum, above and near the statue of Sir Joseph Banks. Immediately over the statue are displayed the skulls of gaur, yak, and buffalo, while those of wild sheep occupy the wall immediately to the right, and those of ibex, wild goats, and markhor the corresponding position on the left. On the extreme right flank are displayed the blackbuck, chiru, gazelle, and nilgai heads, while on the left flank are arranged the serow, tahr, and takin. The wall to the left of the entrance to the upper mammal gallery is occupied by the magnificent series of deer antlers, while a portion of the wall facing the one behind the statue has been assigned to a few heads of African antelopes included in the collection. The exhibit adds a striking and attractive feature to the museum.

THE *Rassegna Contemporanea* (Anno vi., ser. ii., fasc. 6) contains an article on the date of the death of Christ by Pio Emanuelli. The Crucifixion took placed on the 14th day of Nisan, the first month of the Jewish year, and on a Friday. The month did not begin on the actual day of new moon, but on the evening when the thin sickle of the young moon was first perceived. The first problem to solve is therefore: How soon after the moment of new moon can the moon be seen? This has been investigated by Mr. J. K. Fotheringham, in the *Monthly Notices* for May, 1910, and by Mr. R. Courtenay, in *The Observatory* for June, 1911. The shortest possible interval after which the moon may be visible appears to be twenty-three hours, which, however, in certain circumstances may be considerably prolonged. Signor Emanuelli quotes these two papers, but does not give any particulars as to what he considers the smallest visible phase of the moon. He goes through the new moons nearest to the vernal equinox for the years A.D. 28 to 34 much in the same manner as done by Mr. Courtenay, and comes to the same result, that only A.D. 30, April 7, and A.D. 33, April 3, correspond to the 14th Nisan and also to a Friday. He decides for the year 30, as he says (without entering into explanations) that historical criticism excludes the year 33.

IN the May issue of *Man* Mr. T. A. Joyce describes a fine gold beaker from Lambayeque, Peru, now in the collection of Mr. James Curle. The technique, representing a warrior with his shield, shows considerable skill. It is beaten out of a single sheet of metal, without any trace of a join. The outline is elegant and harmonious, and the lines of the design, in spite of its conventional nature, are bold and effective. It seems to belong to the period which immediately preceded the conquest of the coast by the Inca, a period of technical progress but artistic decadence.

IN *The Scientific American* of April 19, Mr. E. J. Banks gives an interesting account of recent German excavations in Babylonia. Attention was principally directed to the mound at Babylon known as the Kasr. Babylon, after all, turns out to be a comparatively modern city as compared with those to the south. The expedition has discovered a black monolith brought in ancient times as a war trophy from the Hittite city of Karchemish. Dr. Koldewey's chief discovery is that of the palace of Nebuchadnezzar on the Kasr, of which practically only the foundations remain. At Amran, again, 40 ft. below the surface, he has found Esagil, the famous temple of Babylon. At Assur, Dr. Andrae and his successor, Dr. Maresh, have traced the city walls and several ancient palaces and temples. Excavation is now in progress at Erech or Warka, the home of the hero of the Gilgamish epic. Here discoveries of the greatest scientific interest may be expected.

AN illustrated report (Research Bulletin 28) has been issued by the University of Wisconsin Agricultural Experiment Station on avian tuberculosis, the authors being Messrs. Hastings and Halpin. While not very frequent, the disease is of some economic importance. The authors were able to infect guinea-pigs, hogs, and rabbits with the avian, but were unable to infect hens with the human, tubercle bacillus. Suggestions are made for the elimination of the disease from the flocks.

IN the Journal of the Washington Academy of Sciences for March 19 (vol. iii., No. 6), Messrs. Ayers and Johnson detail experiments on the destruction of bacteria in milk by the ultra-violet rays generated by a quartz mercury-vapour lamp. When the

milk was exposed in thin layers to the rays, a marked reduction in the bacterial content was obtained, but the experiments indicate that it would not be possible to sterilise milk completely by the ultra-violet rays. In some cases an abnormal disagreeable flavour was produced by the rays.

THE Alpine Club of Canada has set a good example to kindred bodies by publishing in *The Canadian Alpine Journal*, 1912, lists of the mammals (by Mr. N. Hollister), birds (by Mr. J. H. Riley), and plants (by Mr. P. C. Standley) of the Mount Robson district, Mr. Hollister also giving a note on the reptiles and amphibians.

WE have received the first five numbers of a new journal (or work), entitled *Java, Zoologisch en Biologisch*, by Dr. J. C. Konigsberger, published at Buitenzorg, the first number being dated 1911, and the other four 1912. Its object is apparently to give a general popular account of the leading features of the meteorology and fauna of the island, the fauna being divided into a coastal fauna, the fauna of the plains, and the fauna of the high mountains.

A RESTORATION and model of the skeleton of the gigantic carnivorous dinosaur Tyrannosaurus, from the Montana Cretaceous, form the subject of an article by Prof. H. F. Osborn in the Bull. Amer. Mus. Nat. Hist., vol. xxxii., pp. 91–92. Another paper on reptilian palæontology is to be found in the Annals of the Transvaal Museum, vol. iv., pp. 1–46, where Dr. E. C. N. van Hoepen describes and figures in great detail a remarkably fine skull of the Karroo dicynodont *Lystrosaurus* (*olim Ptychognathus*) *latirostris*.

THE *Aarsberetning* for 1912 indicates that the naturalists of the Bergen Museum have been engaged in arranging exhibition series to illustrate the osteology of vertebrates in somewhat the same fashion as those displayed in the hall of our own Natural History Museum, photographs of the new exhibits being included in the report. The work of the biological station has also been conducted with the usual energy; pictures and plans of a new vessel and a map of the hydrographical stations in the neighbourhood of Bergen accompany the report.

WE have received from the Government of India copies of three Forest Bulletins (Nos. 13–15), by Mr. R. S. Pearson, dealing respectively with "ligno" as a means of protecting timber from splitting while seasoning, with the strength of natural and plantation-grown teak, and with the technical properties of toon wood (*Cedrela toona*), and giving evidence of the enterprise and activity of the Imperial Forest Service officers at the Dehra Dun Institute of Forest Research. In No. 13, the author describes briefly the methods employed for seasoning timber, and some experiments made with "ligno"—a light-brown plastic substance of the consistency of thick paint which has been placed on the market recently. The application of this protective substance is based on the principle of retarding evaporation from cut ends of logs and thus preventing splitting; the result of the severe tests applied was that "ligno" was found to be very effective in retarding the seasoning process, though not absolutely preventing splitting. In No. 14 details are given showing that plantation-grown teak is as strong as that from natural forests; the figures for compression and shearing tests show that the percentage of moisture in the timber has no marked effect on the strength of teak, whereas it has a considerable effect when transverse strain is applied across the fibre. In No. 15 details are given showing that toon timber, after contracting considerably during seasoning, is very liable to absorb moisture and expand again when seasoned, this process of contraction and expansion continuing for several years, though becoming less marked in successive years; hence in order to prevent this excellent furniture timber from falling into disrepute it is only necessary to allow a longer time for seasoning.

THE Meteorological Chart of the North Pacific Ocean for May, published by the U.S. Weather Bureau, contains the concluding part of several articles on cyclonic storms and typhoons of that ocean by Mr. W. E. Hurd. They constitute a very useful summary of the subject, compiled from available sources, including quotations from Father Algué's valuable report on the cyclones of the Far East, and track charts for various months. It is pointed out in the Barometer Manual issued by the Meteorological Committee that the tracks of tropical storms of the North Pacific are very similar to those of the North Atlantic. "Typhoons of the China Sea originate to the eastward of the Philippines, Carolines, and Ladrones. In the lower latitudes the centres travel westward. Some pass over the mainland, some recurve to the eastward, and eventually reach the west coast of North America by way of Japan." Near the Philippines the rate of translation is from six to twelve miles an hour, but in the vicinity of Japan the speed is greatly increased. Since the establishment of telegraphic communication between the Philippines and the outlying islands the warning of approaching storms is very efficient. The "barocyclonometer," invented at the Manila Observatory, "for ascertaining the position, distance, and direction of advance of a cyclone," is both ingenious and important; it is said to be in general use among East Indian vessels.

A PAMPHLET of "Suggestions for Investigations in Human Geography in Britain" has been written by Dr. H. J. Fleure and Mr. W. E. Whitehouse, and is issued from the registrar's office in the University College of Wales, Aberystwyth. It claims for "human geography, the part of the subject which deals with man's relation to his physical environment," the status of "the main objective of geographical study." The authors' ideals of detailed local investigation on these lines are lofty and exhaustive: a list of no fewer than eighty suggested "sections for investigation" is laid down, and many of them, such as those involving philological and antiquarian research, would demand a special training, quite outside that afforded by geography alone, for the investigator. No doubt, however, in

such departments as these it is the authors' desire to impress the geographical point of view upon the specialists in other departments of knowledge. The geographical application of the authors' suggestions is not always clear—some of the details instanced in connection with fairs may serve as examples—and again, the geographer who attempts to take up such a topic as the "prehuman" condition of a given district is certainly liable to disappointment at the results obtainable. On these counts the impression may be felt that the writers of this pamphlet have spread their net too widely. They appear (and they are not alone) to forget their own definition of human geography, which has been quoted above. But if this be a fault it is far better than that of taking too narrow a view, and the pamphlet, criticism apart, must be regarded as profoundly suggestive, and as having been worked out with very great care.

A PARTY of students, under the direction of Prof. K. Honda, made some interesting simultaneous observations at different stations during August, 1912, on the seiches of Lake Inawasiro (Japan). The lake, which is near the well-known volcano Bandai, is about 12 km. long and 10 km. wide, and has a mean depth of 51½ metres. The limnimeters show that there were two oscillations of considerable amplitude with mean periods of 19·11 mins. and 8·89 mins., corresponding to the uninodal and binodal oscillations of the lake. A model of the lake was constructed, and the water in it was made to oscillate by means of a vibrating rod. The periods of the oscillations in the model correspond to periods of 19·53 and 9·11 minutes in the actual lake, while the forms of the nodal lines were clearly shown by means of aluminium powder with which the surface of the water was dusted.

A USEFUL method of calculating the mean variation by the aid of a calculating machine is given by Prof. Knight Dunlap in the current number of *The Psychological Review*. If in a given series of N terms, with average M, P terms be greater and R terms be less than the average, then the mean variation may be calculated from either of the two formulæ,

$$\frac{\Sigma P - P.N}{\frac{N}{2}} \quad \text{or} \quad \frac{R.M - \Sigma R}{\frac{N}{2}}.$$

"By the use of the calculating machine, great accuracy may be obtained with the minimal expenditure of time and energy," if such methods as the above are followed, which dispense with the numerous subtractions of the older method.

FROM the report of the joint committee appointed by the Institution of Electrical Engineers, the Institution of Gas Engineers, the Institution of Municipal and County Engineers, and the Illuminating Engineering Society, on street lighting, with which Mr. Trotter opened the discussion of the subject at the last meeting of the Illuminating Engineers, and from the reports of the discussion which have appeared in the technical Press, it seems possible that the measurement of the minimum illumination of a plane 39 in. above the ground will eventually be accepted as the criterion of good or bad lighting of a street. The classification proposed by the committee is as follows:—Class A, minimum 0·01; B, 0·025, C, 0·04; D, 0·6; E, 0·10 foot-candle.

WHEN a curve is drawn in the ordinary way to represent the effect of light upon a photographic plate, the part of it that represents the effect of the shortest exposures is exceptional in that it shows a gradation that is less steep than the part that follows it, and gradually approximates to it. This exceptional part was called by Messrs. Hurter and Driffield the "period of under-exposure," and plate-makers were advised to reduce it as much as possible, and photographers to avoid it. But this "period" cannot be eliminated, and therefore in practical work it remains, as it always has been, of very great importance, although Messrs. Hurter and Driffield dismissed it with but little consideration. After an interval of more than twenty years, Mr. F. F. Renwick, of Ilford, Ltd., has taken up the study of this particular period, and in the April number of the Journal of the Royal Photographic Society there is published a paper upon it that he recently communicated to the society. Mr. Renwick finds that the "under-exposure period" is not so disadvantageous as some theoreticians have endeavoured to prove it to be, and to a certain extent he justifies the practical workers who utilise it to the utmost. He shows the nature of this part of the density curve in many various plates and printing papers, giving full details, and points out that as the curve in printing papers is of the same general character as that in the negative, the gradation error of the latter is, more or less, compensated in printing.

To the *Revue générale des Sciences* of March 30 M. Ch. Maurain contributes an article on "Les Etudes d'Aérotechnique à l'Institut de St. Cyr." The recently founded aëronautical laboratory at St. Cyr differs fundamentally in its methods from that of almost all other existing institutions for aëronautical research, and its apparatus is designed for the purpose of "approaching as closely as possible to the practical conditions of aërial locomotion." By this is meant scientific experimental research on full-scale models at full speeds, and some work of a preliminary character on wing surfaces has already been accomplished. The work is being extended to experiments on large propellers, and provision is being made for the construction of a measuring apparatus sufficiently strong to be able to carry a complete aëroplane. The apparatus is mostly out in the open, and consists essentially of a track more than three-quarters of a mile in length, along which electrically-driven carriages can be run at speeds up to fifty miles per hour. The measuring apparatus is attached to the carriage, and during the eight or ten seconds in which the speed is maintained constant the forces and couples on the model under test are automatically recorded. Concurrently with these experiments, measurements are being obtained on aëroplanes in flight, and on small models held in a current of air. The latter experiments on small-scale models are expected to give information as to the conversion factors for scale which may become important as the science of aviation develops.

RED Book No. 173 of the British Fire Prevention Committee contains an account, with photographs, of tests on reinforced concrete doors. These doors were constructed to the designs of Commandant Welsch, ex-chief officer of the Ghent Fire Brigade. No. 1 door had a T iron rim and expanded metal and flat-iron reinforcement filled in with concrete; this door was hung on runners and made to slide, and was fixed on the outside of an opening. No. 2 door was similar to No. 1 door, but fixed on the inside of an opening. In No. 3 test two doors as described above were used, one on the inside and one on the outside of an opening. In No. 3 test, the doors were subjected to the action of a fire of 150 minutes' duration at temperatures gradually increasing to about 2000° F., followed by the application of water for two minutes on the fire side. In thirty-two minutes the outer face of the outer door was too hot to bear the hand, and in 140 minutes the lower half of the door had bulged outwards. In seventeen minutes cracks appeared all over the fire side of the inner door and continued to increase; in 107 minutes this door came away from the runner at one top corner; in 150 minutes the door fell forwards into the interior of the hut. On water being applied, the inner face of the outer door was eroded where struck by the jet. The tests afford some very useful lessons and give information which should lead to the design of an efficient fireproof reinforced concrete door.

THE report of the council and the proceedings of the Hampstead Scientific Society for the year 1912 show that the work of the society, which was founded in 1899, not only expanded greatly during the year, but increased in value. It is hoped that during the present month the work "Hampstead Heath: its Geology and Natural History," prepared by members of the society, will be published. The Mayor and Borough Council of Hampstead have invited the South-Eastern Union of Scientific Societies to hold its annual congress at Hampstead this summer, and the meetings will be held from June 4 to 7. Thirty-two meetings were held during the year, besides six summer outdoor meetings and a course of four lectures to juveniles during the Christmas holidays. Among the list of lecturers during the year we notice the names of the president of the society, Prof. W. M. Flinders Petrie, and of Profs. A. Fowler and A. W. Porter. The report records a deficit on the general working of the society, due to the heavy expenditure involved in the maintenance of the meteorological station, which has now three years of unbroken meteorological records to its credit.

AMONG the most recent additions to the admirable series of "The People's Books," which Messrs. T. C. and E. C. Jack are publishing at 6*d*. net each, are three volumes dealing with subjects of science and technology. Dr. P. Phillips writes on the "Science of Light," and intends his book to be a companion to that on "Radiation," already published in the series. In between eighty and ninety small pages he deals with the propagation, reflection, refraction, dispersion, interference, and polarisation of light, and also explains diffraction and the electromagnetic nature of light waves. The treatment is necessarily slight, but the volume will prove useful even to students of physics, because of the outline history of the science which it contains. In a volume on "British Birds," Mr. F. B. Kirkman gives descriptions of 187 of the commoner species and their nests and eggs. Mr. A. W. Seaby has provided 111 illustrations, which, though small, give a good idea of the birds described. The third book is on "Gardening," and is by Mr. A. C. Bartlett, who has confined his attention to descriptions of the chief gardening operations and the propagation of plants by cuttings, grafting, budding, and other methods.

OUR ASTRONOMICAL COLUMN.

A NEW FAINT COMET (1913*a*).—A Kiel telegram of date May 7 reports the discovery of a comet of magnitude 9·5 on May 6, at 15h. 5m. mean time, Nice, by M. Schaumasse, of the Nice Observatory. Its position when discovered was given as R.A. 20h. 54m. 44s., and declination +9° 52′, and it was moving in a north-easterly direction.

A Kiel circular of May 10 gives the following elements and ephemeris, computed by Kiess and Nicholson:—

T = May 17·91 G.M.T.
ω = 57° 28′
Ω = 317° 0′
i = 26° 26′
q = 1·440

		α				δ	
		h.	m.	s.		°	′
May 15	...	20	16	12	...	+19	0
,, 19	...	19	48	37	...	+24	13
,, 23	...	19	11	22	...	+30	7

The comet rises this evening about 9.20, and should be capable of being seen with telescopes of moderate power in the early morning hours.

THE PHYSICAL APPEARANCE OF MARS.—It is well known that observers of the planet Mars are divided into two schools, one believing that the so-called canals are really long, continuous, and narrow streaks, the other looking upon them as the summation of a complexity of detail revealing irregular streaks and presenting frequent interruptions and condensations. In the current number of *Knowledge*, Mr. Antoniadi, a strong advocate of the latter view, communicates an interesting article on the subject of these Martian markings, and puts forward his explanation of the divergency of ideas of observers on their appearance. Large *versus* small aperture is his main reason; thus he writes:—"The student who passes many consecutive hours in the study of Mars with medium-sized instruments is liable to catch rare glimpses of straight lines, single or double, generally lasting about one-quarter of a second. Here we have a vindication of Schiaparelli's discoveries. But their deceitful character will obtrude itself on the observer using a large telescope, when, in the place of lines, he will behold steadily either a winding, knotted, irregular band, or the jagged edge of a half-tone, or some other complex detail." The article is illustrated by a fine set of drawings of the planet made in 1911, the observations being made with the 33-in. refractor of the Meudon Observatory.

THE NATIONAL OBSERVATORY OF ATHENS.—Vol. vi. of the *Annales de l'Observatoire National d'Athènes* contains a series of valuable contributions published under the direction of Prof. Demetrius Eginitis, the director of the observatory. It is only possible here to state the titles of the memoirs and sets of observa-

tions, as the volume covers more than 300 pages, and is illustrated with numerous plates. The memoirs deal with Halley's comet during its last return; observations of the major planets; Nova Lacertæ; the earthquake in the Gulf of Corinth on May 30, 1909; and, finally, with the study of seismic disturbances in Greece during the years 1909–11. The second portion of the volume deals with observations for the same period, and these include equatorial and meridional observations, meteorological observations made at the observatory and at departmental stations, and, lastly, a catalogue of earthquakes observed in Greece during the same year.

FREQUENCY OF PROMINENCES ON EASTERN AND WESTERN LIMBS OF THE SUN.—Mr. Evershed has examined statistically a mass of very complete material of prominence observations, both visual and photographic, to inquire into the question as to whether one limb is more prolific than the other (Kodaikanal Observatory Bulletin No. 28). In his examination he has gone thoroughly into the question of the methods of observation for both kinds of records in order to make certain that the results were in no way affected by any kind of systematic bias in favour of one limb over the other.

The result of the inquiry is that there is a distinct predominance of frequency at the eastern limb. Briefly summarised, the different records led him to the following conclusions. The Kodaikanal observations for 1904–11 displayed as regards numbers for each year a nearly constant excess of east over west, the average percentage of east being 52·70. The Kenley and Catania series for 1894–1905 exhibited also an eastern excess averaging 50·8 per cent of the whole number recorded; for the period 1906–11 the Catania observations displayed an eastern excess of 54·26 per cent. At Kodaikanal during 1905–11 the larger prominences showed a smaller eastern excess than the smaller prominences, the percentages being 51·16 and 53·60 respectively. In the case of profile areas of prominences a small average excess of eastern areas is observed. The eastern excess as regards numbers is about the same for prominences in equatorial regions up to 30·5° lat. as for those in higher latitudes.

Mr. Evershed directs attention to a slight evidence of planetary action similar in effect to that of the earth in the case of Venus only among the major planets, and also to an annual periodicity in the eastern predominance with maxima in January and August and minima in April and November. In a supplementary note he points out that metallic prominences and those showing displacements of the hydrogen lines show a much greater preponderance of east over west, the percentages in these cases being 59·9 and 57 respectively. As all the observations were made visually there is the possibility of bias in favour of the eastern limb.

EVENING EDUCATIONAL WORK IN LONDON.[1]

A VERY valuable and interesting survey of the progress of technical, scientific, and commercial education in evening classes in the London polytechnics, technical institutes, and continuation schools has recently been presented to the Education Committee of the London County Council by Mr. R. Blair, the education officer of the council.

The provision now made of instruction in evening classes in London is of remarkable range and extent. It comprises tuition, at almost nominal fees, in all stages of science, technology, arts and crafts, commercial subjects, economics, and literature, in well-equipped institutions from qualified teachers. The London evening student has now far greater educational facilities open to him than are offered in even the most progressive provincial towns, especially in the matter of securing university recognition for his work, if of a sufficiently high standard.

Some idea of the magnitude, the complexity and the importance of the educational work carried on in evening classes in London is given in the following numbers taken from the report:—

The approximate number of evening students enrolled in 1910–11 was as follows (p. 60):—

(1)	In the polytechnics	25,000
(2)	In technical institutes and schools of art maintained by the L.C.C.	10,000
(3)	In commercial centres	30,000
(4)	In ordinary evening schools	100,000
(5)	In other institutions, settlements, &c. (estimated)	30,000
		195,000

Deducting one-third of this number as "ineffective" students through irregular attendance, &c., it is clear that a large amount of intellectual and educational work is being steadily carried on, which must of necessity play an important part in the economic and social development of the people of London.

A curious fact is the increasing proportion of adult students, *i.e.* above twenty-one years of age, in attendance at evening classes. In 1910–11 the probable number of such students was 80,000, "more than twice the number of pupils of all kinds in all the public secondary schools of London."

The gross annual cost of maintenance of evening teaching in London may be approximately estimated at 400,000*l.*, of which about one-half is expended by the polytechnics and the technical schools.

Illustrations are given on p. 12 of the report of the direct value of the work of London technical institutions to the local industries, especially the Leathersellers' College at Bermondsey in its relation to tanning, the Northampton Institute at Clerkenwell to the optical industries, and the L.C.C. School of Photo-engraving and Lithography with respect to the "three-colour" process. In addition to their industrial and technical work, a considerable amount of purely scientific research emanates from the London polytechnics each year, an excellent account of this branch of their activities being given in pages 42 to 47 of the report.

In a memorandum by Mr. A. E. Briscoe (divisional inspector) upon the "Polytechnics and Technical Institutes," it is stated:—"A good deal of very uninformed criticism is directed against instruction in evening classes; it is often urged that such work cannot be effective; that attendance must be irregular; that students are frequently too tired physically and mentally to make the best use of the time available, and that they are also ill-prepared by their previous education. There is some truth in these contentions, but those who urge them . . . their views would be materially altered if they would but spend a week in a close inspection of the work that is actually done. . . . The first thing that would strike them would be the eagerness to learn. . . . The evening student has less time for study, but he makes more effective use of it. He has practical knowledge that forms an excellent basis. . . . In many institutions evening students are doing work in their subjects quite equal to that required for a university degree."

[1] Report on Eight Years of Technical Education and Continuation Schools (mostly evening work). Presented to the Education Committee on December 11, 1912, and ordered to be printed. London County Council Education Committee: P. S. King & Sons. Price 2*s.* 6*d.*

In finally summarising the position of evening education in London, Mr. Blair concludes with the following passage (p. 24):—"A large increase of students in higher institutions, a large extension of premises and improved equipment, a large increase all over in attendance hours per student . . . an increased representation of masters and workmen on advisory committees, with a corresponding increase in the interest of employers, and of expert criticism of work done, all support the view that the period 1904–12 has been characterised by great expansion in quantity and quality of work."

Since the publication of the report referred to above the education committee of the council has decided upon a comprehensive scheme of reorganisation of the evening continuation schools, which are in future to be termed "institutes" instead of "schools." The main features of the scheme are the specialisation of the functions of individual schools depending upon the social, educational, and industrial demands of the respective districts, the appointment of a number of "responsible masters" for evening work only, the increased provision of non-vocational education, and definite coordination with higher institutions, such as the polytechnics. It is mainly in respect to the last point that the organisation of London evening education has compared very unfavourably of recent years with the organisation in a number of provincial towns.

The junior technical institutes will be definitely linked up in future with the neighbouring polytechnic. The principal (or head of department) of the higher institution will have the right to visit the junior institute in an advisory capacity, and to offer advice upon the appointment of the staff and upon the framing of courses and syllabuses. Standing local committees will be formed consisting of the principal and heads of departments of the polytechnic and "responsible masters" of the junior institutes, in order to cement the relationship between the two types of institutions.

The new scheme as a whole is thoroughly sound, and, if carried out, as there is every reason to expect will be the case, it will undoubtedly have far-reaching, beneficial effects upon London education.

J. WILSON.

LAW OF THE PAY-STREAK IN PLACER DEPOSITS.[1]

EXPLANATIONS of the eccentricities of the pay-streak in placer deposits have long been considered difficult to furnish. Geikie, Beck, Posepny, Locke, Lindgren, and many others have all discussed the subject and acknowledged the fact. Eight years' residence and study of placer phenomena in the Klondike gold-bearing region of Canada on the part of Mr. J. B. Tyrrell have enabled him to formulate a natural law respecting the location of the pay-streak, not only in the Klondike, but also in any placer region of the world.

An accurate knowledge of the structure and growth of a valley, comprising the different phases of its history in detail, always presents geological facts and deductions capable of broad and general application, and these are generally recognisable without great difficulty. After considering the nature and rate of erosion and sedimentation in a given valley under normal stream action, the formation of a V-shaped valley and its transformation into a U-shaped one, and the presence of flood-plains and terraces, the laws governing the formation and position of the pay-streak in an alluvial plain in the bottom of a valley may be stated as follows:—

(1) It was formed in the bottom and at the mouth of the V-shaped valley which was the young representative of the present valley.

(2) It marks the position formerly occupied by the bottom of that V-shaped valley.

(3) The gold contained in it was washed out of the surrounding country and collected into approximately its present position before the gravel of the flood-plain (or terrace) was deposited over and around it.

The practical application of this discovery of identifying nature's way of hydraulicing and storing the gold in the bottoms of the valleys must be welcome to all economic geologists and mining engineers.

Mr. Tyrrell holds that some 30,000,000*l.* of gold has been recovered to date from the Klondike region, and that an equal amount no doubt remains to be extracted. Some 900 ft. thick of rock-formations have been removed from the Klondike country, and 130 cubic miles of gravel scattered over the 800 square miles of placer deposits, making only one-hundredth of a pennyworth of gold per ton of original rock concentrated by nature.

H. M. A.

[1] "The Laws of the Pay-streak in Placer Deposits." By J. B. Tyrrell. Trans. Inst. Min. and Metallurgy, pp. 593–605. (London, 1912.)

THE UPPER AIR DURING FÖHN.

DR. H. VON FICKER has made notable additions to our knowledge of Föhn by his contributions on this subject to the Transactions of the Vienna Academy. His researches showed that the Alpine Föhn is the local manifestation of an extensive phenomenon which is revealed almost simultaneously in places of the same altitude over a large region. In a paper in the *Sitzungsberichte* of the Vienna Academy, May, 1912, he describes observations on Föhn during three balloon ascents from Innsbruck in 1910 and 1911. It was found impossible to make ascents at the time of actual Föhn at the surface owing to the very gusty character of this wind. In one ascent only was the balloon over the mountains at the time of Föhn, and then it was the plaything of the vertical currents, which, however, were kind enough to spare the balloonists actual disaster. At one time the balloon was carried downwards 900 m. and up again 1100 m. in the course of five minutes, indicating vertical currents of five metres per second or more. Such information is clearly of importance to aviators, apart from its bearing on the elucidation of the meteorological phenomenon.

The general conclusions of von Ficker are that before the outbreak of Föhn at the surface, it is blowing over the cold air in the valleys and plains, the surface of separation between the two currents being frequently marked by strato-cumulus cloud. When the Föhn current crosses the ridges and valleys at right angles it descends on the lee side and ascends on the windward side, with a partial clearing of the cloud in the region of descending air. Föhn is usually dissipated by the coming of a north-west wind, the change probably being of the nature of a line-squall. The vertical temperature gradient during Föhn was usually less than the adiabatic gradient for dry air, except when the balloon was carried up and down in the vertical currents, but it was greater than the normal gradient. The change of wind direction with altitude was normal, the south-east wind of the lower layers changing to south and south-west winds at higher levels up to 3–4 km. The value of the discussion is enhanced by the results of ascents at Munich and observations at Zugspitze (3000 m.) which the author was able to incorporate by the courtesy of Dr. Schmauss, who is keenly enthusiastic about all upper-air investigation.

E. GOLD.

ACTIVE NITROGEN.[1]

EVERYONE has heard of ozone, the active modification of oxygen which is produced when this gas is subjected to electric discharge. I hope to show you to-night that nitrogen can also be made to assume an active state under suitable experimental conditions. We will begin with an experiment (Fig. 1) which will serve to introduce the subject.

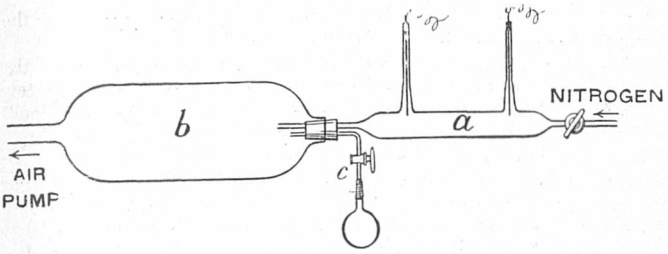


FIG. 1.

A rapid stream of rarefied nitrogen gas passes through the tube *a* at a pressure of a few mm. of mercury, and on its way the gas is sparked through by a series of high-tension electric discharges from a Leyden jar. It then issues as a jet into the large vessel *b*, where it is seen to be brilliantly luminous, the stream of gas being visible as a whirling cloud of brilliant yellow light. Notice that this light is of a different colour from that of the electric discharge in the former vessel.

Why does the gas remain luminous in this way for an appreciable time after the electric discharge has passed through it? The view which I shall develop this evening is that the discharge has split the nitrogen molecules into single atoms. Nitrogen atoms in this condition are uneasy, and are anxious to find partners again. But to do this takes time. The reunion of the nitrogen atoms is attended with the emission of the yellow light which you see, and this continues so long as the process of pairing off is incomplete.

Preliminary even to considering this theory, we must be certain that nothing but nitrogen is necessary to the success of the experiment, and that no other substance intervenes. Some experimenters in Germany have recently expressed the opinion that traces of oxygen are concerned. I am satisfied, however, that they are entirely mistaken. The nitrogen used in the experiment you have just seen has been standing in contact with phosphorus until the phosphorus no longer glows in the dark. If I added a 1/100,000th part of oxygen to the nitrogen, the phosphorus would begin glowing again quite perceptibly. So we may be sure that there is not that amount of oxygen present: and I do not think it is reasonable to attribute these brilliant effects to a smaller amount. Again, we may inquire what is the effect of adding oxygen intentionally? I find that the addition of 2 per cent. of oxygen is enough to obliterate the phenomena altogether. Much more might be said on the subject, but we must pass on.

It is convenient for some purposes to experiment in a different way. We have here two similar glass globes containing rarefied nitrogen. I can induce an electric discharge in them without electrodes by putting them in this coil of wire, through which a Leyden jar is constantly discharging. When I withdraw them you see that they are brilliantly luminous, and that they remain so for several minutes after stimulation. By holding them alternately in the exciting coil we can get them about equally bright, and you see that the luminosity of each decays at about the same rate. Now I stimulate them equally again, and cool one down by immersing it in liquid air. It shines brightly for a moment, but soon becomes quenched. I withdraw it, and you can compare it with the other, which is still brightly luminous.

This experiment shows that cooling the gas shortens the period of luminosity. Let me show you next that the brilliance is increased by cooling. I have exhausted this bulb to a suitable degree, and cool the neck by immersion in liquid air, contained in a transparent vessel (Fig. 2). You see how much brighter the cooled portion is after excitation than the rest of the bulb. There is no doubt a certain ambiguity in this form of experiment, because cooling a portion of the vessel causes a local concentration of the gas in that portion. I must ask you to take it from me that special experiments have proved that this cause is not enough to explain the greatly increased brightness you have seen. The reunion of nitrogen atoms occurs, then, more quickly the lower the temperature. This is a unique instance of a chemical action being quickened by cooling. In all other cases heating accelerates the action. Plausible objections may be made to this statement, but I must content myself now with saying that they admit of answer.

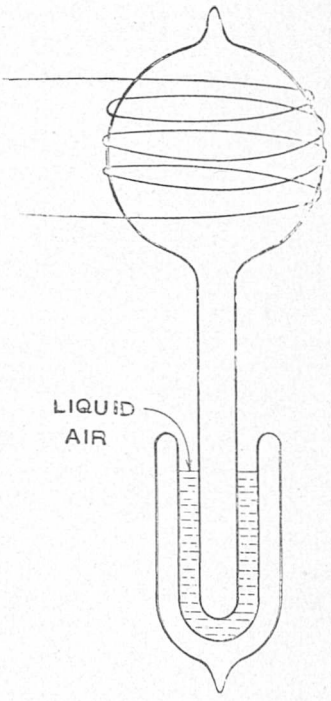


FIG. 2.

When oxygen and hydrogen unite, the union may occur in two distinct ways. It may occur with luminosity throughout the volume of the mixture, as when the gases are exploded, or, again, it may occur at the surface of a solid such as clean platinum. In the latter case there is no luminosity.

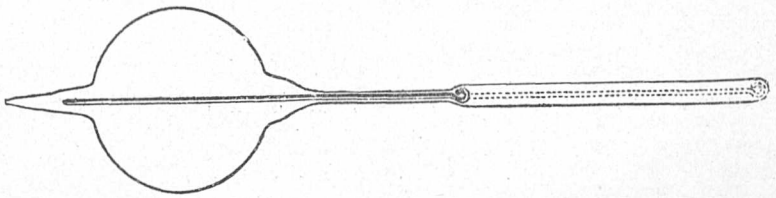


FIG. 3.

Similarly, active nitrogen atoms may reunite in the volume of the gas with luminosity—this we have seen already—or the combination may occur without luminosity at a suitable surface. Oxidised copper

[1] Discourse delivered at the Royal Institution on Friday, February 28, by the Hon. R. J. Strutt, F.R.S.

affords such a surface. This bulb (Fig. 3) can be made to glow like those you have seen before, by inserting it into a coil; and if the copper wire is situated in the side tube the glow lasts a long time, for the gas has as yet no access to it. But if I excite the gas again, and turn the bulb round so as to drop the oxidised wire into it, you see that the luminosity is extinguished in a fraction of a second. Combination of the nitrogen atoms occurs much more quickly at the surface, so that the whole quantity of active nitrogen present is almost instantly used up. Incidentally, the experiment illustrates the extremely rapid diffusion of the gaseous residuum in an exhausted vessel, for every particle of the active nitrogen must evidently find its way to the surface of the wire in the fraction of a second.

We pass now to consider the effect of nitrogen in this condition on other substances. The yellow glow we have studied so far is due to the recombination of nitrogen atoms, and accordingly it shows a nitrogen spectrum, though with very curious modifications.

If we offer to the monatomic nitrogen other substances, it will often unite chemically with them, which, of course, cold ordinary nitrogen will not do. I go back to the apparatus used in the first experiment, and admit some acetylene by a stopcock (*c*, Fig. 1). The jet of active nitrogen now enters an atmosphere of acetylene, and you see that the character of the light is at once changed; it has become lilac. I turn off the acetylene and substitute chloroform vapour. We now get an orange light. This may appear very different, but the difference is unessential. The spectrum is in each case that characteristic of cyanogen and its compounds, only the violet portion of this spectrum is more intense with acetylene, the red portion with chloroform.

Since we get the cyanogen spectrum without having any cyanogen compound originally present, we may suspect that some such compound has been formed. Let us pass from suspicion to proof. Using chloroform vapour from a bulb containing the liquid (see Fig. 1), we pass the gases through a vessel in which a test-tube is inserted. This test-tube contains liquid air, and any condensable constituent is frozen out on to its external surface (Fig. 4). After a few minutes' run, we take out the test-tube and dip it in a solution of potash. I now add a mixture of ferrous and ferric salts and excess of hydrochloric acid. I pour out the liquid on to this white porcelain dish, and you see that abundance of prussian blue has been formed. This proves the presence of some cyanogen compound.

We can get the same result with pentane, ether, benzene, or almost any other organic vapour. With these the amount of cyanogen formed is much the same, but the cyanogen spectrum, curiously enough, is far less conspicuous. Benzene, for instance, almost quenches the nitrogen glow, and little can be seen of the cyanogen spectrum either. In most cases it appears that hydrocyanic acid is formed, but the orange cyanogen glow, only obtained in compounds containing much chlorine, is probably due to the formation of chloride of cyanogen in addition. This, when absorbed in potash, forms a cyanate, which has been detected chemically.

In the case just considered, the spectrum observed, when active nitrogen is mixed with another substance, is that of the product of the action. In some cases, however, the spectrum developed is that of the substance originally introduced. I admit some of the vapour of perchloride of tin: you see the brilliant blue glow. I introduce a drop of the liquid chloride on a wire loop into the flame of a Bunsen burner, and you see the same blue colour, though less advantageously. The brilliance of the luminous effect does not seem to give any trustworthy indication as to whether much chemical action is going on. If, for instance, we admit bisulphide of carbon vapour to the active nitrogen stream, we do not get very brilliant effects of luminosity—nothing striking enough to be worth showing you—but none the less interesting chemical actions are going on. The tube in which the action occurs gets covered with the dark blue transparent deposit, which I show by projection on the screen. This substance is a known compound of nitrogen and sulphur, originally investigated by Mr. Burt in 1910. If the gases are condensed farther on in the tube by liquid air, we get a second deposit of brown colour, which can be identified as the brown polymeric carbon monosulphide studied by Sir James Dewar and the late Dr. H. O. Jones. You see, then, that the chemical action is completely traced. Active nitrogen takes part of the sulphur from carbon disulphide, leaving carbon monosulphide.

The behaviour of active nitrogen with metallic vapours is of interest, though it has not yet been very

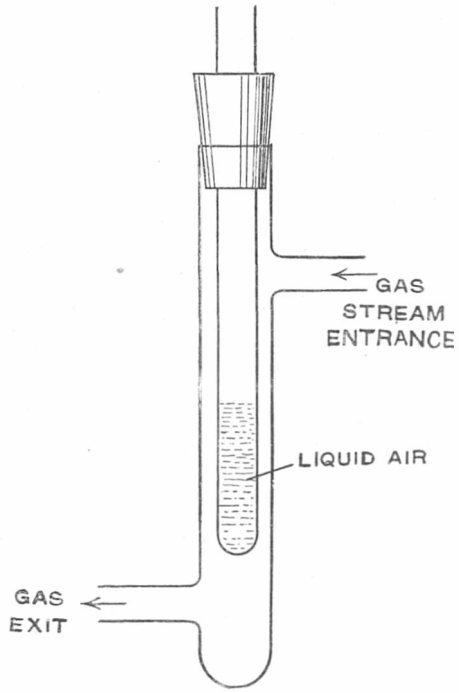


FIG. 4.

completely studied. I select the case of mercury to show you. We pass the stream of glowing gas through this tube, which contains a small pool of mercury. While the mercury is cold, the yellow glow passes on unaffected. I apply heat, and green mercury light, of the colour familiar in the mercury-vapour lamps used in electric lighting, is apparent, when active nitrogen mingles with mercury vapour. Soon the tube gets obscured, except when I am actually heating it, by a dirty-looking solid deposit containing much metallic mercury.

I wish to convince you that an explosive compound of nitrogen and mercury has been formed. For this purpose, to save the trouble of dismounting the tube already used, we will take a similar one prepared beforehand. I heat the mercurial deposit moderately over a Bunsen burner, and, if you will kindly be quite still for a moment, we shall hear a distinct crackling sound, as the explosive compound decomposes. At close quarters it is easy to see flashes of light accompanying the minute explosions, but these can scarcely

be shown to an audience, as the opaque deposit over the greater part of the tube obscures them.

It has only been possible this evening to bring forward a selection of the results of two years' work on this subject at the Imperial College, with generous help from colleagues, and facilities provided by the governors.

Let me conclude by reading to you a prophetic passage from one of Faraday's letters to Schönbein :—"What of nitrogen? Is not its apparent quiet simplicity of action all a sham? Not a sham, indeed, but still not the only state in which it can exist. If the compounds which a body can form, show something of the state and powers it may have when isolated, then what should nitrogen be in its separate state? You see I do not work; I cannot. But I fancy, and stuff my letters with such fancies (not a fit return) to you."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

A NEW chair of bacteriology is to be founded in Edinburgh University under a bequest from Mr. Robert Irvine, of Royston, Granton. At his death, eleven years ago, Mr. Irvine bequeathed 230 shares of 10*l.* each in a company for developing the resources of Christmas Island for the purpose of establishing the chair when the interest from the shares should reach 25,000*l.* or 30,000*l.* The accumulated dividends on these shares now reach more than 30,000*l.* It is understood that 25,000*l.* will go towards the maintenance of the professorship, and that the remaining 5000*l.* will be used in providing the class-rooms, laboratories, and the necessary equipment.

ATTENTION has already been directed to the progress which has been made in the provision of well-equipped laboratories for the study of electrical technology and kindred subjects in the University of Hong Kong. Prof. C. A. Middleton Smith has sent us an exhaustive list of engineering and other equipment which has been presented to the University by public-spirited manufacturing firms. Their generous support of the cause of higher technical education in the distant parts of the Empire is sure to be productive of excellent results, and is worthy of emulation by other firms. The greatest support seems to have been received for the department of heat engines, and the authorities in Hong Kong hope that more offers of apparatus will be received from firms interested in electrical engineering. A complete equipment is required for experiments in all branches of electrical work, and an appeal is made to manufacturers that this branch of engineering shall be represented worthily in the equipment presented to the University. It is impossible here to mention each of the gifts which have been made, but as indicative of the substantial character of the gifts, the complete spectrographic outfit presented by Messrs. Adam Hilger and Co., and the Sankey's hand-bending testing machine given by Mr. Casella, may be mentioned.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, April 25.—Prof. C. H. Lees, F.R.S., vice-president, in the chair.—W. R. **Bower** : A graphical method of optical imagery. The paper contains a development of optical imagery based on elementary geometry, including limiting positions, but excluding cross-ratios, centres of perspective, &c. The method adopted is useful for teaching the properties of optical systems to those who are not essentially students of pure mathematics, and can be satisfactorily used by those capable of draughtsmanship with mathematical instruments.—Dr. C. V. **Burton** : The spectroscopic resolution of an arbitrary function. An ordinary grating has periodic rulings, and a spectrum obtained by means of it is characteristic of the radiation entering the spectroscope-slit. But if the radiation is homogeneous, while the distribution of the rulings is arbitrary, we obtain a spectrum characteristic of the grating. It is thus found to be theoretically possible to resolve spectroscopically a given arbitrary function $\phi(x)$ into its harmonic constituents. The theory of the proposed method of resolving functions is discussed, and is as complete as that of ordinary spectroscopy, while in one respect it is more simple; for, since the light entering the spectroscope-slit is entirely of one wave-length, the comparison of intensities of spectral lines (whether visually or photographically) is facilitated.

Linnean Society, May 1.—Prof. E. B. Poulton, F.R.S., president, in the chair.—Prof. P. **Groom** and W. **Rushton** : The structure of the wood of East Indian species of Pinus.—Dr. Winifred **Brenchley** : Branching specimens of *Lyginodendron oldhamium*, Will.—A. C. F. **Morgan** : A problem in Weismannism.—Mrs. L. J. **Wilsmore** : *Sphenopus marsupialis*.—Papers on collections made by the Percy Sladen expedition to the Indian Ocean :—Miss Helen L. M. **Pixell** : Polychæta of the Indian Ocean, with some species from the Cape Verde Islands. The Serpulidæ, with a classification of the genera Hydroides and Eupomatus. —S. **Hirst** : Report on the Arachnida of the Seychelles. —Miss Marjorie **Lindsay** : *Gypsina plana*, Carter.—A. **Grouvelle** : Nitidulæ, Heterocidæ.—A. **Raffray** : Pselaphidæ de l'Archipel des Seychelles.—Dr. K. **Jordan** : Anthribidæ of the Seychelles.—S. **Maulik** : Hispinæ from the Seychelles.—Dr. K. **Jordan** : Certain changes in nomenclature of Lepidoptera proposed by Dr. Verity.

Zoological Society, May 6.—Dr. Henry Woodward, F.R.S. vice-president, in the chair.—Dr. F. E. **Beddard** : The anatomy and systematic arrangement of the Cestoidea. This paper, the tenth of the series, contained an account of two species of tapeworms found in a Dongolan genet, both of which were described as new, one being made the type of a new genus.—J. A. **Milne** : Pacific salmon : an attempt to evolve something of their history from an examination of their scales. Reasoning from the similarity of their appearance to the scales of the other Salmonidæ, the author pointed out that all the migratory species except *Onchorhynchus kita* remain for at least a year in fresh water before proceeding to the sea—in the Fraser River district, at any rate. He also showed the scale of a quinnat, and pointed out that it was scarcely possible to avoid the conclusion that that fish had already spawned once before it was captured.—Miss Kathleen **Haddon** : Notes on *Peripatoides woodwardii*, Bouvier. This paper was based on material collected in Western Australia, consisting of twenty specimens, male and female, ranging in size from 17 to 46 mm., thus considerably exceeding in length those described by Prof. Bouvier. Various types of coloration are exemplified, some being blue-green with small yellow spots, while others have the yellow pigment increased so as to give a tawny appearance to the animal; a dark variety of this latter type also occurs.—J. C. F. **Fryer** : Field-observations on the enemies of butterflies in Ceylon. It was concluded (1) that in Ceylon, with the exception of the

wood-swallow, birds are not formidable enemies to butterflies; (2) that owing to the propensity of the wood-swallow for members of the genera Danais and Euplœa, a resemblance to them would be not a safeguard but a danger.

Mathematical Society, May 8.—Prof. A. E. H. Love, president, in the chair.—Prof. W. **Burnside**: Some properties of groups the orders of which are powers of primes. Prof. H. S. **Carslaw**: The Green's function for the equation $\nabla^2 u + k^2 u = 0$.—Prof. W. H. **Young**: The usual convergence of a class of trigonometrical series.—W. F. **Sheppard**: (1) Factorial moments in terms of sums or differences; (2) fitting of polynomials by the method of least squares.—S. **Lees**: The effect of internal friction on stress-strain relationships for elastic solids.

Royal Astronomical Society, May 9.—Major Hills, C.M.G., F.R.S., president, in the chair.—Rev. A. L. **Cortie**: The mode of propagation of the sun's influence in magnetic storms. The author considered that the rays which proceed from the sun are not single kathode rays, as frequently assumed, but divergent. The solar corona as photographed at the eclipses of 1893, 1898, 1905, and 1908 showed systems of diverging rays apparently connected with spot groups. The study of these led to the conclusion that the mode of propagation of the influences which condition magnetic storms from the sun has the form of rays diverging from the foci of sun-spot disturbances. The sun-spots would not directly cause the storms, but rather condition them, perhaps by rendering the upper atmosphere a better electrical conductor.—H. **Kimura**: The harmonic analysis of sun-spot relative numbers.—H. H. **Turner**: The harmonic analysis of Wolf's sun-spot numbers, with special reference to Mr. Kimura's paper.—J. **Jackson**: The discordance between the observed and predicted positions of Jupiter's eighth satellite. The author made an appeal for further observations during the present year, which is a favourable occasion, as the satellite is now as much as 3° from the planet; the observations would have to be made in southern latitudes owing to the position of Jupiter.—R. A. **Sampson**: The correction of the field of a Newtonian reflector. The various defects of spherical aberration, coma, astigmatism, curvature of field, and distortion were separately dealt with, and an arrangement of three lenses was suggested, which would render the field of a Newtonian reflector practically perfect.—C. V. L. **Charlier**: An investigation on the motion of the stars.—**Royal Observatory, Greenwich**: The photographic magnitudes determined with the Greenwich astrographic equatorial; corrections depending on distance from the plate-centre.

PARIS.

Academy of Sciences, April 28.—M. F. Guyon in the chair.—A. **Haller** and Edouard **Bauer**: The methylation of *iso*valerone by means of sodium amide and methyl iodide. Tetramethyl*iso*valerone or 2:3:3:5:5:6-hexamethyl-4-heptanone. The di-, tri-, and tetramethyl*iso*valerones were isolated from the crude product of the reaction between sodium amide, *iso*valerone, and methyl iodide. The tetra-derivative was reduced to the corresponding alcohol by means of sodium and ethyl alcohol.—A. **Laveran** and M. **Marullaz**: Contribution to the morphological study of *Toxoplasma gondii* and of *T. cuniculi*. From the morphological point of view the differences between *T. cuniculi* and *T. gondii* are not sufficiently marked to justify their distinction into two species.—M. **Gouy** was elected a non-resident member, M. **Schwoerer** a correspondant for the section of mechanics (in the place of the late M. Dwelshauvers-Dery), and Prof. W. M. **Davis** a correspondant for the section of geography and navigation (in the place of the late Sir George Darwin).—M. **Simonin**: Results of the discussion of the observations made during the eclipse of the sun of April 16–17, 1912. From a discussion of all the available observations it is concluded that the first external contact was observed on the average six seconds too late, and the last contact three seconds too soon; the observations of the interior contacts appear to be free from systematic error.—G. H. **Hardy** and J. E. **Littlewood**: The Fourier's series of a squared function capable of summation.—Louis **Roy**: The movement of viscous media and quasi-waves.—Albert **Turpain**: The application of highly sensitive galvanometers to geodesy. A description of a special type of galvanometer capable of registering the time signals of the Eiffel Tower.—J. M. **Lahy**: The rectification of records deformed by the circular movements of the inscribing point.—Georges **Claude**: The absorption of neon by the electrodes of luminescent tubes. Neon is characterised by a remarkable resistance to absorption by the electrodes, as compared with helium or nitrogen. This fact is of practical importance in connection with the use of neon tubes for lighting purposes.—Ed. **Chauvenet** and G. **Urbain**: The density of the double salts. The case of the chlorides of copper and ammonium.—Jean **Bielecki** and Victor **Henri**: The quantitative study of the absorption of the ultra-violet rays by ketones, diketones, and the ketonic acids.—A. **Guyot** and A. **Kovache**: The action of formic acid upon the colouring matters derived from triphenylmethane.—Gustave **Chauveaud**: The evolution of the conducting apparatus in Veronica.—Raoul **Bayeux**: The comparative resistance of the dog and the rabbit to intravenous injections of oxygen. In proportion to its weight, the dog can tolerate in its veins a quantity of oxygen more than twenty-five times greater than a rabbit.—H. **Charrier**: Some modifications of the muscular tissue at the moment of sexual maturity in *Nereis fucata*.—Bernard **Collin**: A new Ellobiopsis, a parasite of *Parallobiopsis coutieri*. F. **Picard** and G. R. **Blanc**: A bacillary septicæmia in the caterpillars of *Arctia caja*.—R. **Marcille**: The use of ammoniacal salts in vinification. Musts deficient in volatile nitrogen and requiring an undue length of time for complete fermentation can be made to ferment normally by the addition of ammonium phosphate or sulphate.—H. **Dorlencourt**: Study on the urinary elimination of morphine injected into an animal not previously treated with the drug. A small proportion of morphine injected into the rabbit is always eliminated by the kidney. The morphine is recovered from the urine, unchanged, traces only of oxydimorphine being detected.—Ph. **Glangeaud**: The eight eruptive phases of the volcano of Puy de Côme.—M. **Aubert**: Beynes in prehistoric times.

May 5.—M. F. Guyon in the chair.—Armand **Gautier** and Paul **Clausmann**: Fluorine in the animal organism. The skin and its appendages. A method for the exact determination of minute amounts of fluorine was worked out by the authors and described about a year ago. This method is now being applied to the systematic examination of various parts of the body for the amount of fluorine. The results for the skin, hair, dental enamel, and nails are given in the present paper.—M. **Bazin** was elected a non-resident member.—Charles **Nordmann**: The effective temperatures of the stars. A comparison of the results obtained for twelve stars by Rosenberg and the author. Although

the methods used were based on different principles, with one exception (α Lyra), the agreement in the estimated temperatures is close, the differences being of the order of the experimental error. The results agree with the thermal classification of Sir Norman Lockyer, deduced from the qualitative study of stellar spectra.—J. **Guillaume**: Observations of the sun made at the Observatory of Lyons during the first quarter of 1913. Observations were possible on sixty-five days, and tables are given showing the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—Th. **Anghelutza**: Some remarks on the exponential development of Cauchy.—G. **Bouligand**: Green's function for an indefinite cylinder.—M. **Hadamard**: Remarks on the preceding note.—J. de **Boissoudy**: The constant of the law of radiation.—G. A. **Dima**: The influence of the valency of the metal on the photoelectric effect of metallic compounds. In all the cases examined the compound in which the metal has the smallest valency appears to have the greatest photoelectric power.—Louis **Riéty**: The electromotive force produced by the flow of solutions of electrolytes through capillary tubes. Data are given for solutions of varying concentrations of potassium chloride, nitrate and sulphate, potash, hydrochloric and sulphuric acids.—C. **Gutton**: The determination of the time required for the establishment of electrical double refraction. The times found ranged from 0·6 to 1·4 hundred-millionth of a second. These are of the order of Maxwell's time of relaxation, and agree with the theory that double refraction is the result of a molecular orientation.—H. **Magunna**: A mechanical means for keeping tuning-forks or plates in continuous vibration.—Em. **Vigouroux**: The transformations of the alloys of iron and silicon. A discussion of a recent paper by G. Charpy and A. Cornu concerning the transformation point A_2.—G. **Reboul**: Chemical reactions and radii of curvature. It has been shown by the author that the chemical action of a gas on a solid depends on the form of the latter, the action being greatest at the points where the curvature of the solid is greatest. It is now found that if two copper wires of different diameter are placed close together in an atmosphere capable of forming a compound with the copper, the fine wire appears to exert a protective action on the coarser wire, the former only being attacked.—Camille **Matignon**: The preparation of barium. An intimate mixture of barium oxide and silicon in the proportion 3BaO : Si is heated in a steel tube to 1200° C.; barium is formed, and distils into the cooler portion of the tube. The yield is good, and the metal proved to be of 98·5 per cent. purity. Ferrosilicon with 95 per cent. silicon can replace the silicon.—M. **Hanriot** and A. **Kling**: The action of reducing agents on the chloraloses. Sodium and aluminium amalgams were used as reducing agents; compounds containing one and two atoms of chlorine were isolated and described.—A. **Wahl** and P. **Bagard**: Syntheses in the indigo group.—Marcel **Lantenois**: The preparation of carbon tetraiodids. Two methods were found practicable, the interaction of carbon tetrachloride and lithium iodide and the action of hypochlorite upon iodoform in strongly alkaline solutions. An advantageous method of purifying the crude product is given.—C. **Gaudefroy**: Dehydration figures.—Aug. **Chevalier**: The botanical origin of commercial Gabon woods.—J. **Beauverie**: The question of the propagation of rust in the Graminaceæ. The presence of mycelium, uredospores, or teleutospores of rusts in the interior of the seeds of cultivated Graminaceæ is very common, and it is necessary to take this fact into account in the study of the question of the propagation of rust.—E. **Perrot**: Observations on the preparation of cocoa. Improvements are suggested on the method of preparing the cocoa bean for the market in current use.—A. **Pinard** and A. **Magnan**: Researches on sexuality in births.—Henri **Béclère**: Pressure and thermometry in cryotherapy. An iron-constantan thermocouple has given good results, not only in determining the temperature in the freezing mixture (solid carbon dioxide), but also the temperature at the surface of application.—Pierre **Girard**: The osmotic relations of the red corpuscles with their medium: rôle of the electric state of the wall.—Auguste **Lumière** and Jean **Chevrotier**: The action of oxidising agents in general and alkaline persulphates in particular on the tetanus toxin. Remarks on a recent note by Marcel Belin. Details are given of the success attained in the treatment of tetanus by injections of sodium persulphate.—Jacques **Surcouf**: The transmission of the larvæ of *Dermatobia cyaniventris* by a mosquito.—Albert **Robin**: The retention of chlorides in the liver and the blood of cancerous subjects.—E. **Voisenet**: Cream of tartar as a food for the ferment causing bitterness in wine. The *Bacillus amaracrylus* can utilise sugars and glycerol as food, but is inactive in presence of tartaric acid and its salts.—G. **Malfitano** and Mlle. A. **Moschkoff**: Pseudo-crystals of starch and crystals of glucose.—H. **Labré** and R. **Maguin**: Contribution to the study of the conditions of precipitation of albumen by picric acid. Working with a constant excess of picric acid, the relation between the amount of albumen present and the quantity of picric acid combined with it is not a linear one, but can be represented by an equilateral hyperbola. The phenomenon would appear to be one of adsorption, but it can be made the basis of a practical method for the estimation of albumen.—Jean **Chautard**: The origin of petroleum at Wyoming.—J. **Bosler**: Magnetic storms and hysteresis phenomena.

BOOKS RECEIVED.

Ma Leçon—Type d'entraînement complet et utilitaire. By Lieut. G. Hébert. Pp. 208. (Paris: Vuibert.) 1.75 francs.

La Sécrétion Pancréatique. By E. F. Terroine. Pp. 133. (Paris: A. Hermann et Fils.) 5 francs.

I Fenomeni Magnetici nelle Varie Teorie Elettromagnetiche. By Silvio Magrini. Pp. 165. (Bologna: N. Zanichelli.)

The British Empire with its World Setting. By J. B. Reynolds. Pp. viii+200. (London: A. and C. Black.) 1*s*. 4*d*.

English History Illustrated from Original Sources, 1715–1815. By H. E. M. Icely. Pp. xv+101+viii+107. (London: A. and C. Black.) 2*s*.

Elementary Algebra. By C. Godfrey and A. W. Siddons. Vol. ii. Pp. xi+227–530+xlvi. (Cambridge University Press.) With answers, 2*s*. 6*d*.; without answers, 2*s*.

Four-Figure Tables. By C. Godfrey and A. W. Siddons. Pp. 40. (Cambridge University Press.) 9*d*. net.

The Seashore I Know. Edited by W. P. Westell and H. E. Turner. Pp. 80. (London: J. M. Dent and Sons, Ltd.) 8*d*. net.

Continuous Beams in Reinforced Concrete. By B. Geen. Pp. iv+210. (London: Chapman and Hall, Ltd.) 9*s*. net.

Die deutschen Salzlagerstatten. By Dr. C. Rie-

mann. Pp. 97. (Leipzig and Berlin: B. G. Teubner.) 1.25 marks.

Die neueren Warmekraftmaschinen. II., Gaserzeuger, Grossgasmaschinen, Dampf- und Gasturbinen. By Prof. R. Vater. Pp. vi+116. (Leipzig and Berlin: B. G. Teubner.) 1.25 marks.

Introductory Electricity and Magnetism. By C. W. Hansel. Pp. xv+373. (London: W. Heinemann.) 2*s*. 6*d*. net.

Sex Antagonism. By W. Heape. Pp. 217. (London: Constable and Co., Ltd.) 7*s*. 6*d*. net.

Dent's Practical Notebooks of Regional Geography. By Dr. H. Piggott and R. J. Finch. Part ii., Asia. Pp. 64. (London: J. M. Dent and Sons, Ltd.) 6*d*. net.

The Conception of a Kingdom of Ends in Augustine, Aquinas, and Leibniz. By E. H. Stokes. Pp. iv+129. (Chicago: University of Chicago Press; Cambridge University Press.) 3*s*. net.

Handwörterbuch der Naturwissenschaften. Edited by E. Korschelt and others. Lief. 41 and 42. (Jena: G. Fischer.) 2.50 marks each Lief.

Canada. Department of Mines. Geological Survey. Memoir No. 17E. Geology and Economic Resources of the Larder Lake District, Ont., and Adjoining Portions of Pontiac County, Quebec. By M. E. Wilson. Pp. vii+62+xi plates. (Ottawa: Government Printing Bureau.)

Manual of Qualitative Analysis: Reagent and Combustion Methods. By W. F. Hoyt. Pp. vi+35. (London: Macmillan and Co., Ltd.) 1*s*. 3*d*. net.

The Oxford Geographies:—An Introduction to Plant Geography. By Dr. M. E. Hardy. Pp. 192. (Oxford: Clarendon Press.) 2*s*. 6*d*.

Mineral and Aerated Waters. By C. A. Mitchell. Pp. xiii+227. (London: Constable and Co., Ltd., 8*s*. 6*d*. net.

The Pathology of Growth. Tumours. By Dr. C. P. White. Pp. xii+235. (London: Constable and Co., Ltd.) 10*s*. 6*d*. net.

DIARY OF SOCIETIES.

FRIDAY, MAY 16.

ROYAL INSTITUTION, at 9.—The Pygmies of New Guinea: Captain C. G. Rawling.

PHYSICAL SOCIETY, at 8.—Some Experiments to Detect β rays from Radium A.: Dr. W. Makower and Dr. S. Russ.—Dust Figures: Dr. J. Robinson.

SATURDAY, MAY 17.

ROYAL INSTITUTION, at 3.—Humphrey Internal Combustion Pumps: H. A. Humphrey.

TUESDAY, MAY 20.

ROYAL INSTITUTION, at 3.—Recent Advances in the Production and Utilisation of Wheat in England: Prof. T. B. Wood.

ROYAL STATISTICAL SOCIETY, at 5.—The Census of Ireland, 1911: Sir W. J. Thompson.

ZOOLOGICAL SOCIETY, at 8.30.—Notice of Some Important Works on Zoological Nomenclature Now in Progress: Rev. T. R. R. Stebbing.—Observations on the South African Rhynchocephaloid Reptile Euparkeria and Allied Genera: Dr. R. Broom.—Experiments on the Metamorphosis of the Axolotl (*Amblystoma tigrinum*) conducted in the Society's Gardens: E. G. Boulenger.—Some Cases of Blindness in Marine Fishes: G. E. Bullen.—The Patella in the Phalacrocoracidæ: Dr. R. W. Shufeldt.

WEDNESDAY, MAY 21.

ROYAL GEOGRAPHICAL SOCIETY, at 8.45.—Reception of Members of Captain Scott's Antarctic Expedition. Lecture by Commander E. R. G. R. Evans, R.N.

ROYAL METEOROLOGICAL SOCIETY, at 4.30.—Determination of the Radiation of the Air from Meteorological Observations: E. Gold.—Results of Monthly and Hourly Cloud-form Frequencies, at Epsom, 1903–1910: S. C. Russell.

AËRONAUTICAL SOCIETY, at 8.30.—Wilbur Wright Lecture.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Annual Exhibition of Microscopic Aquatic Life.

THURSDAY, MAY 22.

ROYAL SOCIETY, at 4.30.—Bakerian Lecture: Rays of Positive Electricity: Sir J. J. Thomson.

ROYAL INSTITUTION, at 3.—Recent Chemical Advances. I. Molecular Architecture: Prof. W. J. Pope.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Annual General Meeting.

CONCRETE INSTITUTE, at 4.30.—Annual General Meeting.

INSTITUTION OF MINING AND METALLURGY, at 8.

FRIDAY, MAY 23.

ROYAL INSTITUTION, at 9.—The Secret of the Permanent Magnet: Prof. S. P. Thompson.

SATURDAY, MAY 24.

ROYAL INSTITUTION, at 3.—Radio-activity. I. The α Rays and their Connection with the Transformations: Prof. E. Rutherford.

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