THURSDAY, JULY 3, 1913.

AN EPITOME OF GEOMETRICAL CRYSTALLOGRAPHY.

Statische und kinetische Kristalltheorien. By Dr. J. Beckenkamp. Erster Teil. Pp. viii + 206. (Berlin: Gebrüder Borntraeger, 1913.) Price 9.60 marks.

THE style of this book recalls that of parts of the "Encyclopädie d. math. Wissenschaften." A summary is given of practically the whole of geometrical crystallography, both experimental and theoretical. There is included, for instance, an account of crystalline symmetry and structure theory, together with a description of the common types of twinning, habit, &c. Physical crystallography, including the optical, elastic, and electrical behaviour of crystalline media, lies outside the scope of the book.

It will be readily realised that so large a field cannot be adequately covered in 206 pages. The author confines himself almost entirely to the quoting of results. For example, formulæ are given to obtain the most probable values of the true angles between four crystal-faces from the observed angles, and also formulæ for calculating the angles between these four faces and the remaining faces; but no indication is given of the method of arriving at these results. Again, though the thirty-two crystal classes are described in detail, no proof is given of the fact that there are exactly thirty-two classes—and similarly throughout the treatise.

Dr. Beckenkamp is evidently interested in the history of crystallography; and he begins each section with a historical summary of work done on the subject-matter of that section from the earliest days of the science, with quotations from various authors and valuable references.

The book is illustrated by 303 excellent diagrams, well drawn, and easy to follow except for those illustrating the author's theory of molecular groups, which are on rather too small a scale to be clearly visible.

The style of the work is clear and interesting, and the book is divided into sections of a convenient length, so that the reader is not tired by over-concentration on a particular theme.

The book will be a useful addition to the literature of the subject, especially as a work of reference; but even the beginner will find it attractive, though he will require to supplement it by some work which goes into more detail. Perhaps the least satisfactory part is that dealing with the author's own structure theory. He has scarcely succeeded in making his point of view clear; and, in fact, the task of explaining a new structure theory of crystals in six pages without the assistance of a single mathematical formula would lie beyond the powers of any writer. But doubtless this will be remedied when part ii. appears.

HAROLD HILTON.

A HISTORY OF CHEMISTRY.

A History of Chemistry from the Earliest Times till the Present Day. By the late Prof. J. C. Brown. Pp. xxx + 543. (London: J. and A. Churchill, 1913.) Price 10*s.* 6*d.* net.

THE late Prof. Campbell Brown, of the Liverpool University, was in the habit of delivering annually a series of lectures on the history of chemistry to his senior students as part of their degree course, and he had the intention, on his retirement, of preparing these lectures for publication. His sudden and unexpected death while still in the occupation of his chair prevented him from personally realising his wish. Mrs. Campbell Brown, with the assistance of Mr. Henry H. Brown, and Prof. Brown's late chief assistant, Mr. W. H. Roberts, has, however, sought to give effect to his intention, and the present handsome volume is the result of their labours. Its compilation has obviously been a labour of love, and forms a fitting memorial to a singularly earnest, conscientious, and high-principled man who played a notable part in the educational history of Liverpool, and particularly in the creation and development of its University. Its preparation for press must have been a matter of no little difficulty, and the form in which it is now presented reflects great credit upon Mr. H. H. Brown and his coadjutor.

The original matter was largely in the form of notes, more or less complete, which the lecturer was accustomed to amplify and comment upon at the moment, and there is little doubt that, had Dr. Brown lived to complete the work, much additional matter would have been included. Possibly, also, some omissions and corrections would have been made in the light of more exact knowledge. The book makes no pretensions to research among original authorities, and it is obvious that the lecturer had been content to take his facts and interpretations from well-known sources, such as Thomson, Hoefer, Kopp, Meyer, Ladenburg, Berthelot, and others that might be named. In many cases the illustrations, as well as the phraseology, afford the key to the source of the statements. The book is eminently readable, and may be recommended to the student who

desires only a very general acquaintance with the main lines of the historical development of the science, without too much critical detail. Considering the immensity of the subject, a great amount of information has been packed into the five hundred pages of which the work consists.

The book is prefaced by a short biographical note in which the main features of Dr. Brown's character, and the chief incidents in what was practically a lifelong connection with Liverpool, are dealt with sympathetically. There is also an excellent and characteristic portrait of the professor by way of frontispiece. T.

REPRODUCTION AND DEVELOPMENT.

(1) *Vertebrate Embryology: Comprising the Early History of the Embryo and its Foetal Membranes.* By Dr. J. W. Jenkinson. Pp. 267. (Oxford: Clarendon Press, 1913.) Price 12*s.* 6*d.* net.

(2) *Problems of Life and Reproduction.* By Prof. Marcus Hartog. Pp. xx + 362. (London: John Murray, 1913.) Price 7*s.* 6*d.* net.

(1) DR. JENKINSON'S "Vertebrate Embryology" will be welcomed by all students of that subject in this country. Hitherto the only book on embryology of convenient size and suitable for elementary students has been Bryce's volume in "Quain's Anatomy," but this work is devoted almost exclusively to human embryology, and is avowedly intended for students of medicine rather than for those taking zoology for an honours degree in science. Dr. Jenkinson's book will not be without utility to the more advanced workers in the subject, including original investigators and teachers. To each chapter there is appended a short bibliography which affords a valuable guide to the literature.

In the first chapter, which is introductory in character, it is shown that the structural differentiation which occurs in embryonic development (and also in later life) takes place by movements either of single cells or of cell aggregates, and finally through the assumption by the cells of the histological characters peculiar to each kind of tissue. It is pointed out further that it is not a process of cell division which produces the differentiation, since differentiation already exists in the ovum prior to segmentation, and is, indeed, the real cause of the differentiations which subsequently manifest themselves. The second chapter is upon growth, and is illustrated by figures of growth taken mainly from the work of Minot, and showing the daily percentage increments in the weights of man and animals.

Chapters iii. and iv. are upon the germ-cells, and contain admirable accounts of the phenomena of spermatogenesis, oogenesis, and fertilisation. The author accepts the view that the germ-cells are not all formed in or from the germinal epithelium, but that the first to develop come from the endoderm or splanchnopleure (mesoderm) of the gut or yolk-sac, and reach their final resting-place by migrating there. There is no mention, however, of Miss Lane-Claypon's statements (at present unconfirmed) regarding the origin of ova from ovarian interstitial cells after the attainment of sexual maturity. The author states that the follicle cells are also probably derived from the germinal epithelium, but the recent work of Miss McIlroy is not quoted. In referring to the corpus luteum, the author says that this organ secretes a substance which appears to be necessary for the proper attachment of the embryo by means of the placenta. The theory has often been stated in this form, but it now appears to the reviewer that in a work like the present it might be better to assert merely that the hypertrophy of the follicle cells is functionally correlated with the contemporaneous uterine hypertrophy, which is a necessary factor in the growth of the placenta and the nourishment of the embryo, and cannot occur in the absence of luteal tissue in the ovary. The truth of the hypothesis stated in this general form seems to be beyond question, whereas the exact nature of the correlation is a problem which still awaits complete solution.

Space does not admit of more than a passing mention of the succeeding chapters; they deal with segmentation, the germinal layers, the early stages in the development of the embryo, the fœtal membranes, and the placenta. The chapter on the placenta is of especial interest, for Dr. Jenkinson writes with the authority of an original investigator. The physiological side of the subject is not neglected, and there are new and interesting details concerning the œstrous cycle. A word must be added in praise of the numerous illustrations, which, with very few exceptions, were drawn specially for this book.

(2) Prof. Hartog's work consists of a collection of essays contributed at various times during the last twenty-one years to different journals, and embodying his views on certain biological questions of importance. The majority of the articles are republished with little alteration, but the fourth chapter, in which the author's views on the physics of cell-division are put forward, has been almost entirely re-written.

The first chapter is entitled "Some Problems of Reproduction," and contains an account of the author's theory as to the significance of the polar bodies, which are regarded merely as the products of brood-divisions of the ovarian egg.

The author points out that "the abortion of certain members of a brood or group to the favour of others" is a phenomenon of frequent occurrence in nature, and he instances those flowers which produce more ovules than ever ripen into seed. According to his theory, the expulsion of the polar bodies is simply an incident recalling the past history of the race, and the physiological explanations are uncalled for. On this view the remarkable constancy of the phenomenon among the higher animals seems to be insufficiently accounted for, while the reduction processes remain imperfectly explained.

In the second chapter the author deals with the problem of heredity, and comes to the conclusion that at present the facts can only be elucidated by the light of mental, not material, processes. While inclining to the memory theories of Butler and Hering, he expresses himself also as favourable to an explanation assuming the succession of a series of complex chemical changes after the manner postulated by Delage or by J. T. Cunningham in his hormone theory of heredity. In the third chapter the author returns to the subject of brood formation and its relation to ordinary cell-division, and the various types of brood formation are briefly described. Chapter iv. first appeared under the title, "The Dual Force of the Dividing Cell," but in this work it has undergone much revision, and is headed "The New Force, Mitokinetism." In addition to the existence of a well-known physical force, and others the physical interpretation of which is uncertain (such as protoplasmic streaming), the author invokes the aid of a new force which he calls "Mitokinetism," besides assuming the existence of further forces which have no clear analogies either in physics or in biology. The whole chapter, though ingenious, is highly speculative, and consequently difficult to criticise in a short review.

In chapter v. Prof. Hartog returns to the subject of nuclear reduction, which is already touched upon in chapter iii. His view may be summarised in the statement that the process is a necessary consequence of cell fusion, instead of a preparation for it. The author appears to us to lay altogether undue stress upon the difference between the two theories. He points out that a reduction must take place somewhere, otherwise the number of chromosomes would go on increasing in geometrical progression. This is, of course, obvious, and since the reduction usually (though not invariably) takes place in the last division of gametogenesis, it appears to us legitimate to regard it as a preparation for zygotic union.

In the next chapter Prof. Hartog reverts to his views on fertilisation. He suggests that owing to the ambiguity of the term "fertilisation" it had better be replaced by "syngamy" when used in its strict morphological sense as the fusion of two cells or nuclei. He makes the interesting suggestion that the formation of the fertilisation membrane is the last relic of the time when the newly-formed zygote usually went into a resting condition.

In chapter vii. the author again gives the arguments in favour of the theory that acquired characters can be inherited, and in chapter vii. the case against a purely mechanistic interpretation of life is once more stated. Great stress is laid on the vital powers of readjustment and compensation under diverse conditions, and the possession of a spontaneity which is never possessed by machines, since these work for the mechanician, whereas the living organism works and adapts itself to its own racial needs.

The chapter on the biological writings of Samuel Butler is well worthy of perusal, and we feel indebted to Prof. Hartog for giving us a further insight into the fascinating personality of the author of "Erewhon." The last two chapters deal with education problems, and though not without interest, seem rather out of place in the present book. Though containing little that is new, the volume supplies a useful summary of the author's views on many subjects, and as such it forms a welcome addition to the "Progressive Science Series." FRANCIS H. A. MARSHALL.

FOUR ZOOLOGICAL TEXT-BOOKS.

(1) *Elementary Biology: Animal and Human.* By J. E. Peabody and A. E. Hunt. Pp. xiv+212. New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1912.) Price 4*s.* 6*d.* net.

(2) *An Introduction to Zoology.* With Directions for Practical Work. (Invertebrates.) By Rosalie Lulham. With Illustrations by V. G. Sheffield. Pp. xv+457. (London: Macmillan and Co., Ltd., 1913.) Price 7*s.* 6*d.* net.

(3) *Teachers' Manual of Biology.* By Prof. M. A. Bigelow. Pp. ix+113. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1912.) Price 1*s.* 8*d.* net.

(4) *A Manual of Zoology.* By Prof. R. Hertwig. Third American from the ninth German edition. Translated and edited by Prof. J. S. Kingsley. Pp. xii+606. (New York: Henry Holt and Co., 1912.)

(1) THE lively book by Messrs. Peabody and Hunt strikes a modern educational note, for the primary emphasis is placed on *practical values*. It is intended as a guide to school-

teachers. Animals are discussed in order to throw light on the biology of human life, in order to help towards healthy living. Everyday functions get a prominent place; bees, mosquitoes, and flies come to the front; the discussion of birds and fishes leads on to the question of their conservation; the Protozoa are used to illumine man's cellular processes; bacteria receive much attention. Precise practical work is, of course, insisted on as a discipline, and many of the conventional tasks are included. But there are as many which have a fresh practical turn.

The lessons on everyday hygiene, on foods, and on the use of alcohol and tobacco seem to us very sound, and, in short, what we like about the whole book is its persistent endeavour to bring the biological instruction into direct touch with human life. There is no risk that the study of pure science will be in this way endangered, and there is every likelihood that the education of the young citizen will be immensely improved. The book is generously provided with interesting illustrations, many of them photographs.

For future editions we would make the suggestion that the authors do not attempt to cover quite so much ground. Thus the paragraph on the relatives of the earthworm would be much better deleted unless more can be said, and there are many other cases where this book would be improved by recognising the necessity for others. We should like to express our appreciation of the wholesome view that "no study of human biology should be allowed to leave in the mind of the student the idea that he is merely a chemical engine adapted only for the generation of a certain amount of physical energy."

(2) Miss Lulham is to be congratulated on the success of her "Introduction to Zoology," which fills a distinct gap. It introduces the student to the study of living creatures (Invertebrates only) with habits and habitats and interrelations, and it has been written from experience. It abounds in valuable practical hints. There is a convincing reality about the book, and a real feeling of the open air, two qualities which are enhanced by the unusually skilful and spirited figures which have been prepared by Miss Violet Sheffield. This introduction should be of great value to teachers of nature-study, to students working alone, and to those who wish to supplement their more analytic and anatomical work by some sound œcology.

Miss Lulham deals excellently with earthworm and starfish, pond-snail and prawn, but she is at her best when she comes to spiders and insects—to which much more than half the book is devoted. It will be a good thing for the study of natural history if this exceedingly educative "Introduction to Zoology" comes into widespread use, as it certainly ought to do. For it is unusually true to its excellent motto:—

Ἐν πᾶσι γὰρ τοῖς φυσικοῖς ἔνεστί τι θαυμαστόν.

(3) Prof. Bigelow's manual is really a sort of teacher's appendix to accompany "Applied Biology" and "Introduction to Biology," by Anna N. Bigelow and himself. He gives useful hints as to the best way of using the "Applied Biology" (without which this manual is of relatively little use), and advice in regard to material for practical work, methods, equipment, and literature. The orientation of the biological studies in relation to human life is a prominent feature in Prof. Bigelow's plan of instruction, and he is emphatic in regard to the indispensableness of the biological foundation. In regard to sex-hygiene, for instance, he says: "The most practicable step now possible in the world-wide movement for sex-education is the development of the full possibilities of the biological studies that touch the problems of reproduction."

(4) Prof. R. Hertwig's "Zoology" has passed through nine German editions and continues to be a favourite manual. It gives a general introduction to morphology and physiology and a systematic treatment of the various phyla, with special attention to particular types. Its virtues are general trustworthiness, clearness, and a judicious selection of essentials. Its deliberate defects are that it is too much pemmican and not very interesting, and that it says very little about the life of animals. Prof. Kingsley has prepared a revised American edition, especially adapted for American needs. It is to a considerable extent a new book, and it is a competent piece of work sure to be of great utility. It has been very carefully edited, and it includes not a few original figures. We cannot profess, however, to have any belief in the usefulness of the summaries of important facts given at the end of each phylum; many of the propositions are too terse to be true, and altogether they smack of the cram-book. J. A. T.

OUR BOOKSHELF.

Ueber einfache Pflanzenbasen und ihre Beziehungen zum Aufbau der Eiweissstoffe und Lecithine. By Dr. G. Trier. Pp. iv+117. (Berlin: Gebrüder Borntraeger, 1912.) Price 5·60 marks.

THIS work is a valuable contribution to plant chemistry by a well-known worker who, by his own researches, has considerably enlarged our knowledge in this special domain. He has found it possible to give a summary of recent work and theoretical views of a complex character which is extremely interesting but might easily have

been made a very dull affair. After briefly formulating the simple bases and amino-acids occurring in plants, the author proceeds to discuss their relationships and the probable way in which they are actually built up in the plant. He develops a simple hypothesis by which amino-ethyl alcohol (which he himself recently isolated as a product of the hydrolysis of lecithin) and amino-acetic acid are formed from glycol and glycollic acid, and regards these substances as the simple bricks from which the complex lecithins and proteins are built up.

In this synthesis the primary stage is a Cannizzaro transformation of glycollic aldehyde to the corresponding alcohol and acid, which the author regards as effected by an enzyme mutase, citing evidence in support of this view. It may, however, be suggested that this action is a direct effect of light, as in the case of many similar changes recently studied. Some of the author's views as to the manner in which complex alkaloids, for example laudanosine in the *iso*quinoline group, are built up from a single aromatic amino-acid are ingenious and very probable. Interesting chapters in the work deal with such questions as the biological significance of the betaïnes, the occurrence of methylation in the plant, the nature of the phosphatides and lecithins and the synthesis of the purine bases within the plant.

Some of the author's remarks on p. 70 with reference to the non-production of nicotinic acid in nature would appear to need modification owing to the discovery, since the work was published, by Suzuki and Matsunaga of this acid in rice-bran; this acid has great significance as derived from a β amino-acid.

The work would be greatly improved by equipping it with an index. W. A. D.

La Sécrétion Pancréatique. By Emile F. Terroine. Pp. 133. (Paris: A. Hermann et Fils, 1913.) Price 5 francs.

THIS little book on the pancreas forms one of a series of biological monographs which are appearing under the direction of Prof. Dastre, of the Sorbonne. The first chapters treat the subject historically, and show by what slow steps the early knowledge of this important organ was obtained, and the important character of Claude Bernard's pioneer work.

The bulk of the book is, however, taken up with a discussion of modern views, which were initiated by Pawloff and elucidated by the great discovery made by Bayliss and Starling of the part played by a chemical stimulus in stirring up the organ to activity. This material, called secretin, is formed in the intestine, and reaches the pancreas by the blood-stream; so that the mechanism may be described as a "humoral reflex" as against the nervous reflex which was formerly supposed to exist. Secretin is not the only chemical messenger in the body; physiologists now are acquainted with a considerable number of these "hormones," and their discovery has created a great revolution in our conceptions of physiological and pathological processes.

What secretin is chemically is not yet known; the culmination of the work in the unravelling of its composition is reserved for the future.

The pancreas is full of interest because it also possesses an internal secretion, but that aspect of the subject is not treated in the present volume.

Dr. Terroine's book is to be thoroughly recommended to all who desire a clear account of recent progress and present doctrines concerning pancreatic activity. W. D. H.

The Posture of School Children: with its Home Hygiene and New Efficiency Methods for School Training. By Jessie H. Bancroft. Pp. xii+327. (New York: The Macmillan Co., 1913.) Price 6*s.* 6*d.* net.

IT is beginning to be understood by parents and teachers that the complete education of children includes physical as well as mental training. The schools now no longer ignore the bodies of the pupils, but by medical inspection, graded physical exercises, which are remedial when necessary, and by careful sanitation, every effort is being made to make the children healthy in body as well as well trained mentally. In this useful undertaking doctors and teachers are cooperating, and one of the evidences of this joint endeavour is the appearance of numerous books intended to provide teachers with scientific and technical knowledge in an attractive form. The present volume is by the assistant-director of physical training in the public schools of New York City, and gives teachers guidance as to how to correct poor posture in the class-room, to prevent the various forms of curvature, and generally to assist normal growth.

Weather Signs and How to Read them. For Use at Sea. By W. Allingham. Pp. v+117. (Glasgow: James Brown and Son, 1912.) Price 2*s.* net.

THE author states that this booklet is a compilation written as an aid to the rising generation of mariners. Considered from this viewpoint we have no hesitation in saying that it will be found interesting and useful. Weather is closely connected with barometric pressure, air and sea temperature, state of sky, &c.; but the predominant factor is pressure. Several chapters are devoted to these subjects and to the construction and use of synoptic and synchronous weather charts; the advantage to sailors of charts of monthly average barometric values is referred to specially. The author makes it quite clear that he holds decided opinions on several subjects, some of which differ from generally accepted views, *e.g.* in the chapter dealing with cloud forms and signs he considers it difficult to accept as a working hypothesis the supposed connection between clouds and dust particles, at least many leagues from land. He also urges simplification in cloud nomenclature, "for under the present involved divisions clouds are doubtless as often described erroneously as they are correctly." The supposed influence of the moon on weather is justly ridiculed, and the work is brought up to date by useful details of the advantages derived from radio-telegraphy.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Ionisation of Gases in the Schumann Region.

IN NATURE for June 12, Prof. Lyman discusses the evidence relating to the ionisation of air in the Schumann region, and concludes that ionisation of air can be produced by wave-lengths longer than λ1700.

The reasons why I consider that λ1350 is nearer to the limiting wave-length at which the ionisation of air sets in are as follows:—Using a discharge in hydrogen as a source of ultra-violet light and transmitting it through a quartz window (0·3 mm. thick), I was unable to get any ionisation in filtered air. I only obtained big effects with a certain piece of fluorite as the window. Another piece of fluorite which did not transmit the ionising light was transparent to about λ1350. Prof. Lyman's researches show that the hydrogen discharge emits very intense ultra-violet light distributed over a large number of wave-lengths between λ1200 and λ1600. Hence, with thin quartz, there was plenty of light available down to λ1450, but it produced no effect in my experiments. Similarly, wave-lengths down to about λ1350 produced no appreciable effects.

Lenard and Ramsauer used a very intense aluminium spark as their source of light, and found that the light from it transmitted through fluorite produced enormous ionisation in air. On the other hand, the light when passed through quartz did not produce any effect. According to Prof. Lyman's photographs, the wave-lengths available from the Al spark in air are a strong group of lines near λ1300, some weak lines near λ1500, and strong lines near λ1600 and λ1720–λ1800. Thin quartz cuts out the group λ1300, but allows the others to pass. We are not told explicitly whether the spark in Lenard and Ramsauer's researches was ever placed close to the quartz window to avoid air absorption; if so, the λ1500 and λ1600 groups would be effective. Fluorite, on the other hand, transmits the λ1300 group as well, and Prof. Lyman considers that the ionisation observed is probably due to these lines. He points out that my interpretation of his remarks, viz. that λ1300 represents the longest wave-lengths which are effective in ionising air, does not represent his views correctly. He considers that Bloch's recent work on the ionisation of air by a mercury lamp indicates that wave-lengths longer than λ1750 are effective.

I expect it will be agreed that by air we mean the usual mixture of oxygen and nitrogen free from all the more condensable gases. Lenard and Ramsauer found that ordinary dust-free air was certainly ionised by the light transmitted through quartz from their powerful source. It was only when very drastic methods of purification were adopted that the air was no longer ionised by the light transmitted through quartz. Although Bloch used dust-free air in his experiments, there is no evidence that he took the rigorous precautions which Lenard and Ramsauer assert are necessary to get rid of all the impurities which give rise to ionisation with comparatively long wave-lengths. In Bloch's arrangement, the mercury lamp was totally immersed in the stream of air, and consequently all the light emitted was available for ionisation, and hence the traces of impurities have every chance to be ionised. Bloch does not give any details, but I think the supports, insulated wires, &c., connected with the lamp inside the ionisation chamber might act as sources of impurities in Lenard and Ramsauer's sense.

If we consider the quantum theory of radiation to apply to ionisation of gases by light, then the energy available in the quantum, hn, must exceed the work V_0e required to separate an electron from a molecule. Palmer's experiments (*Phys. Rev.*, xxxii., p. 1, 1911) may perhaps be taken to indicate that the oxygen accounts for most of the ionisation in air. Taking the longest wave-length which ionises air to be λ1350, and $h=6{\cdot}55\times10^{-27}$, and $e=4{\cdot}65\times10^{-10}$, we get $V_0=9{\cdot}2$ volts. Now the ionising potential for oxygen according to Frank and Hertz is 9·0 volts. To maintain that λ1800 is nearer to the long wave-length limit implies that the quantum theory is not applicable to ionisation by light, for there is no reason to doubt the accuracy of the experiments of Frank and Hertz.

A. LL. HUGHES.

Cavendish Laboratory, Cambridge.

The Microtropometer.

MANY roads to progress in physical investigation are brought to an abrupt end through the lack of measuring instruments of sufficient sensitiveness. In the attempt to bridge over one of these disabling chasms the writer was led to the following device, which appears capable of some development. The principle can be illustrated with reference to a particular case. Suppose we have a Boys's radio-micrometer, which we will call the secondary instrument. If we project on to the vane of this an image of a Nernst lamp filament the beam of light from the mirror of the instrument may be deflected through one thousand scale divisions. Suppose now that the image of the filament is 1 mm. wide, and that it is projected by the mirror of another radio-micrometer, which we may call the primary one.

It is evident that a movement of this primary image through a distance of 1 mm. can produce a movement of the beam of light from the secondary instrument through 1000 mm. Hence, a movement of the image of the filament cast by the primary instrument through 0·001 mm. would give a deflection of about 1 mm., and a movement of the primary image through 1/1,000,000 mm. would move the secondary image through one-thousandth of a mm. If now the secondary instrument be made to throw a similar image on to a tertiary radio-micrometer, the motion will again be magnified one thousand times, so that an original movement of a millionth of a mm. produces a final movement of 1 mm. Evidently by increasing the number of instruments in arithmetical progression we increase the magnification in geometrical progression.

I have applied the method to two radio-micrometers with very satisfactory results. The principle, however, can be applied to any instrument in which a beam of light is used as an indicator—*e.g.* the primary instrument may be a galvanometer, an electrometer, a double-thread-suspension mirror, or a string-galvanometer (in the last case the image of the string taking the place of the image of the filament). The secondary instruments may be radio-micrometers, thermo-couples, bolometers, selenium cells, or other detectors of radiation. It will appear, therefore, that the principle is one capable of wide application to cases in which great sensitiveness of measurement is required—from wireless telegraphy to physiology. In fact, we may say that any existing instrument which uses light as an indicator can be made more sensitive.

Practical difficulties arise from the impossibility of obtaining any instrument with absolutely constant zero; moreover, fluctuations in the intensity of the energy stream from the source of radiation, represented by the Nernst filament, would cause trouble

where great magnifications were desired. This last difficulty might to some extent be surmounted by using as a secondary instrument the two strips of a bolometer, so that fluctuations would make proportional changes in both strips, whereas a deflection gives a differential effect. Experiments, however, on the application of the principle are in progress.

G. A. SHAKESPEAR.

The University, Birmingham, June 24.

Wireless Antennæ.

IN recent issues of NATURE several correspondents, in referring to the fact that a metal bedstead or a few wires stretched a few feet above the ground will make a wireless antenna, have overlooked a most important point, viz. that with such an antenna the ordinary methods of tuning are quite useless.

A piece of wire netting suspended a few feet above the ground makes a most effective aërial, and enables one to receive loud signals from long-distance stations, but signals from Eiffel Tower, C'eethorpes, &c., will all be mixed up, and the ordinary tuner will not separate them effectively. It seems to me that this proves that the usual theory of the waves travelling through space in the air above the earth's surface and being cut by the aërial does not *wholly* account for the facts.

Wireless signals that are feeble when the surface of the earth is dry, becoming much stronger after rain, and the well-known fact that these waves travel much better over sea than over land, all seem to indicate that the aërial waves are *at least* supplemented by waves that travel along the surface of the earth, and that the wire netting, bedsteads, &c., act as counter capacities, allowing these waves to flow from the earth through the receiver. The capacity of a small piece of wire netting near the ground is much greater than a very extensive aërial high up.

Canterbury. A. LANDER.

The Occurrence of "Anomalocera pattersoni," Temp., in Mounts Bay.

IT is stated by Mr. L. H. Gough ("Report of the Plankton of the English Channel," 1903), that the copepod *Anomalocera pattersoni*, R. Temp., may generally be regarded as an oceanic species. Gough's observations tended to show that Gran was correct in assuming this to be the case, although Cleve considered the species to be neritic. Sars, in his "Crustacea of Norway," speaks of the occurrence of this copepod "off the south and west coasts of Norway, generally congregated in great shoals," but throughout the reports published in connection with the international fishery investigations, no record occurs of its similar abundant occurrence in the English Channel.

It is interesting to record, therefore, that during an intensive survey of the planktological conditions of Mounts Bay, performed from the s.y. *Mera* on June 2, an extensive shoal of the species was met with at the surface on a position 50° 4′ 20″ N. × 5° 27′ 55″ W. The product of a five minutes' haul with the coarse tow-net amounted to 34·75 c.c. of material, of which at least three-fourths was made up of Anomalocera, both in its adult and developmental stages. The visitation of this copepod, in association with several other oceanic forms of phyto- and zooplankton, to a comparatively close inshore position may possibly serve as an indication of somewhat abnormal hydrographical conditions, but unfortunately no physical observations are yet to hand to enable a comparison to be formed.

HAROLD SWITHINBANK.

S.y. *Mera*, R.Y.S. G. E. BULLEN.

Artificial Hiss.

LORD RAYLEIGH'S "sound more like an *f* than an *s*" (NATURE, May 29, p. 319) is due, according to Köhler's observations (*Zeits. f. Psych.*, 64, p. 93), to a slightly too high pitch. A Galton whistle, set for a tone of 8400 v.d., will give a pure *s*.

E. B. TITCHENER.

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THE BICENTENARY OF THE BOTANIC GARDEN OF ST. PETERSBURG.

THE bicentenary of the foundation of the Imperial Botanic Garden at St. Petersburg was celebrated with unusual pomp on June 24. The history of the garden, its share in the botanical exploration of north, central, and east Asia, and the practical completion of its reorganisation on modern and truly liberal lines justified the festive character of the proceedings. They were initiated on the eve of the jubilee by a special service, attended by the staff of the garden, in the Peter-Paul's Cathedral, and the laying down of a wreath of roses at the tomb of Peter the Great, the founder of the garden, and on the following morning by a little shower of honours for the director and his staff.

The principal ceremony took place in the afternoon in a building attached to the old herbarium, in the presence of a brilliant gathering, including the Princes Peter and Alexander of Oldenburg, Prince Gagarin, representing Princess Eugenia of Oldenburg, under whose patronage the garden is placed, the Ministers of Agriculture, Commerce, Justice, Public Cults, and Marine, and other prominent officials, and a large number of delegates from the Russian academies, universities, botanic gardens, and kindred institutions, and from foreign countries. The solemn meeting was preceded by a Te Deum, and formally opened by the Minister of Agriculture, Mr. Kriwoshein. A rescript from the Emperor was read, in which it was announced that the garden would henceforth be known as the Imperial Botanic Garden of Peter the Great. Then followed an eloquent address by the director of the garden, Prof. A. Fischer von Waldheim, in which he traced the history of the garden and its present organisation and object; the reception of the delegates, and the presentation of medals and souvenirs commemorating the jubilee.

The next day was reserved for the inspection of the garden, museum, and laboratories, and in the afternoon a visit to Peterhof, where the guests experienced an exceptionally cordial reception. In the evening the festivities came to a conclusion with a gala performance in the opera house in the Narodni Dom.

Most of the botanical gardens and many of the other botanical institutions sent their congratulations, whilst Bulgaria, Denmark, England (Kew and Chelsea), Germany, and Sweden were represented by delegates.

The garden was founded by Peter the Great about 1713, so that it is practically as old as the

capital itself. The site selected for it was on one of the islands in the Neva, low-lying, boggy land, and the object the cultivation of medicinal plants mainly for the army and navy. Hence it was called the Apothecaries' Garden, and the island itself Apothecaries' Island. Among those attached to it were Siegesbeck and Falk, well known from their connection with Linnæus. In 1823, however, the garden was put on an entirely new footing by Alexander I., who raised it to the rank of a scientific institution under the title Imperial Botanic Garden. His first director was F. E. L. Fischer (1823–1850), who had already risen into notice through his successful management of the famous garden at Gorenki, near Moscow. Thanks to his wide connections with botanists and botanical gardens outside of Russia—he was *inter alia* a personal friend and life-long correspondent of William Hooker—and his active encouragement of botanical research in the Russian Empire, he was able in a short time to build up a very large collection of living and dried plants.

After Fischer's retirement in 1850 the history of the garden was of a somewhat varied character. From 1830 to 1863 it was under the ministry of the Imperial Court, and there was at times a danger of its becoming reduced to a nursery for table decorations for the Court; but when, in 1863, it was transferred to the Ministry of Agriculture it was definitely saved from that fate, and it soon regained, and, in fact, eventually exceeded, its old reputation under the double directorship of Trautvetter and Eduard Regel, and afterwards under Regel's undivided control. If Regel, by training and taste, inclined more towards horticulture and a lighter conception of the aims of phytography, his collaborator and colleague, the scholarly *botanicus primarius* and academician C. Maximowicz, excelled through the rare thoroughness and comprehensiveness of his taxonomic work. Both were fertile writers, and the exploration of Turkestan, Siberia, and Central Asia, which in those days proceeded with such marvellous energy, found in them most able interpreters. Maximowicz died in 1890, and Regel followed him soon.

After the short directorship of Batalin, the present director, A. Fischer von Waldheim, until then professor of botany in the University of Warsaw, was appointed in 1897. With him a new era began. It has so far resulted in the comprehensive reorganisation of the establishment and its transformation into a great national institution for the study of pure and applied botany, comparable to the institutes of Kew and Dahlem, although less universal in its range in so far as it is expected to serve in the first place the special interests of the Russian Empire. To quote from the official French guide, published on the occasion of the jubilee, the Imperial Botanic Garden of Peter the Great is intended for the study of the plants which form the flora of Russia and the adjoining parts of Asia, of economic botany, plant anatomy and physiology, of plant parasites and the means to fight them, for seed control, and the cultivation and testing of plants of practical importance for agriculture, horticulture, industries, and medicine, and finally for the popularisation of the botanical sciences.

The garden covers an area of fifty acres, of which thirty go to form what is called the "Park," or garden proper, whilst 7·5 acres are under glass and more than twelve are occupied by buildings. The scientific staff consists of the director, three chief botanists, one chief conservator, five conservators, two assistant conservators, and one librarian. For purely administrative purposes the director has at his disposal a secretary, a cashier, an "intendant," a clerk, and two assistant clerks, these officials forming the "chancery," or director's office. The garden work is superintended by two head gardeners, with two assistants and thirty-five gardeners. There are about fifty "fixed" labourers of both sexes, and about as many artisans, guards, porters, and inferior hands. The Botanic Garden comprises, beside the "Park" and the glasshouses, the following distinct departments:—the herbarium, the museum, the library, the zoological laboratory, the seed control station, the phytopathological station, the "seminarium," or depôt for seeds, gathered in the garden or sent in by travellers and explorers, or received in exchange or by purchase, the "chancery," and the school for gardening.

A splendid new building for the herbarium and library has just been completed, whilst another for the museum collections, and on a similarly large scale, is to be commenced next year. The garden has also its own electric station and electric engineer. It is not possible here to enter into any details concerning those departments, but it may be mentioned that the herbarium and the library, both of which are among the richest in the world, will no doubt remain for long the most valuable portion of the establishment and the centre of its activity. The herbarium is the recipient of the collections of the numerous expeditions organised by the Colonisation Commission (since 1908), and devoted to a grandly planned botanical survey of the Asiatic possessions of the empire. As a similar survey is in course for Russia proper, a collection is building up probably quite unique in its completeness and representative character. A considerable addition to the staff is contemplated, and concurrently an increase of the budget of the garden to 160,000–170,000 roubles (16,000*l.*–17,000*l.*).

This brief account would be incomplete without a word of admiration for the liberal and far-seeing spirit in which the jubilee was conceived, and the whole-hearted sympathies with which everyone, from the representatives of the Imperial Family and the Government down to the last delegate, joined in the recognition of the national importance of the work done by the establishment, and still more of the work which is to go forth from it in the future. There was not much boasting, but a joyful expectation of new and greater achievements. O. S.

THE DAWN OF WESTERN CIVILISATION.[1]

THE volume before us is the final contribution to our knowledge of the Baoussé-Roussé Caves. It may be recalled that volumes dealing with the history, the geology, the palæontology, and the anthropology of the deposits in these caves have been reviewed already in NATURE.[2] To complete the picture it was necessary that we should know the archæology, and this the volume now under notice supplies. From the nature of the subject with which it deals it can be well understood that the volume is in no way inferior in interest or importance to those which have preceded it.

The deposits in the caves are, from the viewpoint of the archæologist, assignable to the Mid-Moustier, the Superior Moustier, and the Mid-Aurignac periods; neither the first nor the last phase of the Aurignac culture is represented. The caves therefore afford evidence of having been occupied at two distinct periods, with a considerable interval of unknown length during which they were not occupied by man.

As to the first or Moustier period, it is significant that the worked stones are of an undoubted Moustier pattern, but yet they are not all associated with the remains of a Moustier fauna. In the Grotte du Prince, for example, five foyers have been distinguished, the stones from which only differ in the character of the material which was used. Of these five foyers, however, the two lowest are associated with the remains of animals which lived during the Chelles period, species which denoted a warm climate—the hippopotamus, the *Rhinoceros Merckii*, the *Elephas antiquus*; the third foyer was associated with a mixed Chelles and Moustier fauna, whereas the two upper foyers only yielded remains of the latter fauna. It thus results that in this cave we have a Moustier culture contemporaneous in part with a Chelles fauna, a contradiction which provokes the question whether in such a case it is more justifiable to attach importance to the industrial stage reached by man in his development or to the associated fauna, suggestive as it is of climatic and geographical conditions. Although much might be said in favour of either view, we agree with M. Cartailhac that, in this instance at least, it is safer to base our conclusions on the character of the implements, particularly as we should expect the Chelles fauna—a fauna of a warm climate—to linger longest in the south of Europe, where it might well be contemporary with the Moustier fauna in a more northern latitude.

As to the second or Aurignac period, we are glad to find M. Cartailhac availing himself of the opportunity afforded him to give in a separate chapter an excellent résumé of the history and of our knowledge of the Aurignac phase from the days of Lartet and Gabriel de Mortillet to the present day when, thanks to the brilliant work of Abbé Breuil, we may consider the Aurignac period as firmly and permanently established. The particular interest in the period lies in the fact that, owing to the greater variety of the tools, the presence of ornament, and the first definite appear-

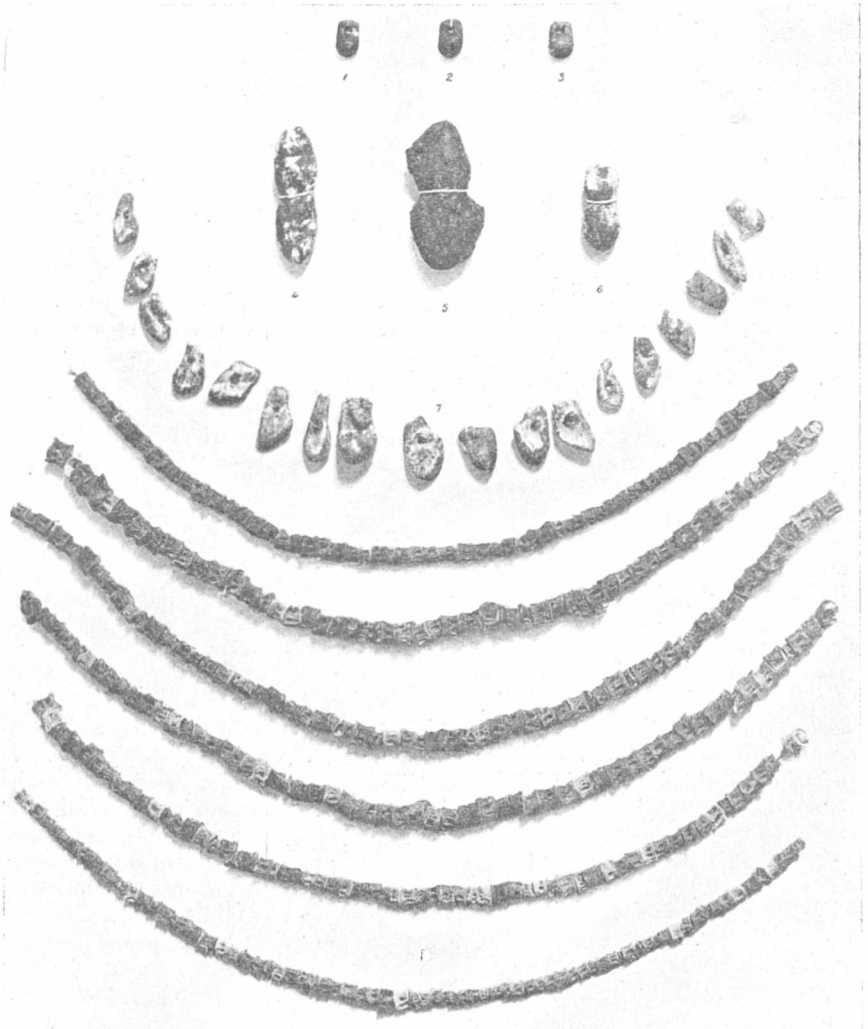


FIG. 1.—Necklaces of the Aurignac period.

[1] "Les Grottes de Grimaldi (Baoussé-Roussé)." Tome ii., Fascicule ii. Archéologie. By Emile Cartailhac. Pp. v+215-324+plates xii-xxiii. (Imprimerie de Monaco, 1912.)

[2] October 10, 1907; July 27, 1911.

ance of grave furniture, we are permitted a more intimate insight into the life and habits of Palæolithic man.

It is an interesting yet readily intelligible reflection that, although the mass of the deposits postulates a long period during which the layers gradually accumulated, although the fauna changed considerably during that time, yet the same weapons are found in the upper as in the lower beds. The explanation, of course, is that at all periods the dwellers in the caves were hunters, and the same weapons were required, although the animals which they hunted might and actually did differ. Another conclusion to which we can, we think, with reason arrive is that there was no very great lapse of time between the end of the Moustier period and the middle of the Aurignac period; in other words, the first of the divisions into which this last period has been divided does not, at Grimaldi at any rate, appear to have been of sufficient length to have made its presence felt.

It is to the middle of the Aurignac period that the graves, of which there were no fewer than thirteen, should be ascribed. Further, the graves were clearly of the same date, judged by the character of the associated relics, although it is curious to find the methods of burial were not identical; for example, the dead were in some cases disposed at length, at other times they were found in contracted positions.

Like its predecessors, the volume is perfectly produced and illustrated. An admirable bibliography concludes the volume, and the fact that the literature dealing with these caves covers a period stretching from 1786 to 1912 is perhaps sufficient evidence of their infinite power to stimulate interest and investigation.

The text of the volume at present under review, while as strictly scientific and accurate as possible, is warmed by many sympathetic references, M. Cartailhac having, from his lifelong labours in this field of archæology, acquired no little affection for these long-forgotten followers of the chase, no little insight into their habits and life.

WILLIAM WRIGHT.

THE DIVINING ROD.

WITHIN the last few years many experiments have been performed in various countries to test the claims of water diviners, and among those who have published papers on the subject are Graf Karl von Klinckowstroem, of Munich, and Dr. Armand Viré, director of the Laboratory for Underground Biology in Paris. A series of experiments at Guildford has also been organised by the editor of *The Sanitary Record and Municipal Engineering*, under the auspices of a number of scientific men, including Prof. Henry Adams, Dr. Herbert Lapworth, and Dr. Samuel Rideal.

Graf von Klinckowstroem, in a paper published in parts 1, 2, and 3 of the *Zeitschrift des Vereines der Gas- und Wasserfachmänner in Oesterreich-Ungarn* for 1913, gives, in the first instance, an account of certain supposed successes in water-finding, which Dr. Achille Poskin, of Spa, has gathered together from various sources. These are not very interesting, as the observations do not appear to have been controlled by impartial witnesses possessing some knowledge of scientific methods.

But Dr. Poskin also includes an account of five experiments undertaken by him, in which the diviners indicated places where water was found. Dr. Poskin believes that he himself possesses the power of detecting water by means of the divining rod. In any case, it is quite certain that "dowsers" are frequently successful in indicating points where water is subsequently found; the real question is, whether these indications are produced by anything outside themselves, or whether they are purely subjective.

In the same paper Graf von Klinckowstroem has translated into German a paper describing my own experiments, accounts of which were published in *The Times* and in *The Journal of the Royal Society of Arts* in 1911. He admits that the experiments were performed with all reasonable care, and without any prejudice, but he describes them, using stronger language than I did, as a fiasco for the diviners who were tested, and then gives a number of possible reasons why the experiments may have failed. He does not give enough weight to the fact that in every case the experiments were conducted under conditions which the dowser in question thought reasonable, and were directed to test powers which he alleged he possessed. This seems to be the only reasonable way of attacking the question from a scientific point of view; it is not for the investigator to say what the dowser can do, or under what conditions he can do it, but when the dowser has stated what his powers are, to arrange an experiment which shall test the alleged powers.

M. Armand Viré (*La Nature*, April 19, pp. 332–338) has conducted a series of experiments in order to ascertain whether the diviners could determine the existence of underground cavities which did not contain water; the results given by M. Viré include a considerable number of "successes," but he passes over too lightly the cases in which the indications given by the diviners are inaccurate. It will be interesting to await the result of an experiment which he proposes to undertake later, in order to discover the shape and extent of caves or grottoes the existence of which has not yet been proved, and the plans for which will only be prepared after the diviner's plans have been reduced to paper.

The series of experiments recently performed in the neighbourhood of Guildford have now been completed, and the committee of investigation has published its report. The members point out that, while there appeared to be some evidence that certain persons may be sensitive to underground water, their sensitiveness "is not sufficiently definite and trustworthy to be of much practical value." They also allude to the lack of

agreement with each other which the results show, and they take this as evidence that the movements of the rod are due to subjective and not to objective causes. These are precisely the opinions formed as a result of my own series of experiments; and it may still be assumed that no adequate evidence has been produced in favour of the existence of something acting outside the dowser which causes his twig or other indicator to move when it is over water.

In *La Nature* for May 10 (p. 379), M. Gustave Le Bon has published an article recording the success of certain diviners in discovering the metals contained in five envelopes (viz., aluminium, copper, silver, lead, and zinc); but, as he admits, the method of experiment was not satisfactory, since he thinks he may unintentionally have given signs of approval while the diviners consulted together as to what metals were contained in the envelopes, and since the method of procedure involved the displacement of the envelopes by the diviners, thus giving them an opportunity of forming an opinion based on the different weights, &c., of the metals. He also mentions that M. Coupaux, who performed similar experiments, only had one success out of five, but that the diviners objected to these experiments because the metals were enclosed in glass tubes, and, as they allege, the glass prevents their feeling the influence of the metals.

On the whole, M. Le Bon is of opinion that there is enough evidence to warrant further examination into the claims of diviners; he thinks, however, that the commission appointed by the Académie des Sciences to examine into the question so far as it relates to the discovering of springs ought to do more, and he asks that this commission may also undertake experiments similar to those which he has performed. My own experiments in this direction went to show that the experienced diviners with whom they were tried were not able to discover gold or silver by means of their rods; for though one diviner scored a remarkable success in a single instance, he was absolutely wrong in the other experiments of the same kind which he performed. Nevertheless, this single success (fortuitous as I believe) confirmed an intelligent friend who witnessed it in his belief that the powers of the diviners are real! J. WERTHEIMER.

DR. P. L. SCLATER, F.R.S.

ZOOLOGISTS throughout the world will join with their English brethren in lamenting the death on June 27—albeit at the advanced age of eighty-four—of Dr. Phillip Lutley Sclater, F.R.S. The second son of the late Mr. W. L. Sclater, of Hoddington House, Hants, the deceased naturalist was born in 1829, and received his education first at Winchester and subsequently at Corpus Christi College, Oxford, where he graduated first class in mathematics, and subsequently became honorary fellow of his college. In 1855 he was called to the Bar as a member of Lincoln's Inn, and in 1875 he acted as private secretary to his brother, the Hon. G. Sclater-Booth (afterwards Lord Basing), when President of the Local Government Board. So early as 1850 he had commenced to write on zoology. Soon after his call to the Bar he devoted himself mainly to natural history, and he was elected secretary to the Zoological Society of London in 1859, which important post he retained till 1902, when advancing years led to his voluntary resignation.

During the greater part of that prolonged period Dr. Sclater was the ruling spirit of the society, and it was to his organising capacity and untiring energy that the menagerie in Regent's Park attained the pre-eminent position it occupied, both as a zoological centre and a place of popular resort, at the time of his retirement. He was also editor of the society's numerous publications, to which he communicated an extraordinary number of valuable papers and memoirs; and it was during his term of office that the Proceedings became entitled to rank as one of the very foremost zoological journals in the world.

But the executive and scientific work connected with the Zoological Society by no means sufficed to absorb all the energies of its secretary, for in 1859 he became editor of the *Ibis*, a then newly started ornithological journal, and held that post until 1865, to resume it, in conjunction with the late Mr. Howard Saunders, in 1883, and to hold it, either alone or associated with others, throughout the rest of his working career. Dr. Sclater was also one of the founders of the British Ornithologists' Union, of which body he long occupied the presidential chair. Of even more importance, perhaps, was Dr. Sclater's share in the foundation and maintenance of the "Zoological Record," as without that wonderful work of reference zoology at the present day would be an absolute impossibility.

Dr. Sclater was also one of the pioneers—if not the actual founder—of the modern science of geographical distribution; and it is to him that we owe such now familiar terms as "Palæarctic" and "Nearctic," which are excellent examples of the classic form of scientific nomenclature in which he delighted.

The prodigious amount of scientific work, more especially in ornithology, produced by Dr. Sclater may be inferred from the fact that a record of his career published some years ago contains entries of something like 1200 different papers and memoirs. From a popular point of view one of the most attractive works with which he was connected was Wolf's "Zoological Sketches," while his monographs of various groups of South American birds are models of their kind.

For the greater part of his long life Sclater was a man of intense activity and energy, and only during the last few years did he show signs of failing health. Injuries received in a carriage accident a few weeks ago hastened the termination of a long life devoted to the advancement of zoological science. R. L.

NOTES.

THE window in Westminster Abbey in memory of Lord Kelvin will be unveiled at the 3 p.m. service of the Abbey on July 15.

WE are informed that the following have been elected life honorary members of the Geological Society of South Africa:—Dr. J. S. Flett, F.R.S., assistant director, Geological Survey of Great Britain; Dr. A. Lacroix, professor of mineralogy, Natural History Museum, Paris; and Prof. E. Weinschenk, Alte Akademie, Munich, Bavaria.

THE death is reported, in his seventy-seventh year, of Mr. W. A. Conklin, director of the zoological department of the Central Park, New York, from 1865 to 1898. After the latter date he was engaged in importing wild animals into the United States. From 1878 to 1893 he edited *The Journal of Comparative Medicine and Veterinary Archives*.

IN the article on the Birmingham meeting of the British Association that appeared in NATURE on June 12 it was stated that an organised programme of the field work in connection with the Geological Section had been prepared by Dr. T. Groom, with the supervision of Prof. Lapworth. We now understand that this is not the case. The excursions in connection with the Geological Section have been organised by Prof. Lapworth, and not by Dr. Groom.

AN earthquake occurred in southern Italy shortly before 10 a.m. on June 28, strong enough to damage buildings in several villages of the province of Cosenza. No lives were lost, though more than twenty persons were injured by falling masonry at Rogiano Gravina. The shock was felt at Messina and Naples, which are respectively about ninety and 150 miles from the epicentre. The province of Cosenza includes one of the more pronounced seismic regions of Calabria, in which originated the severe earthquake of February 12, 1854, and, in part, the still more destructive shock of September 8, 1905.

It is proposed to commemorate in 1914 the seventh centenary of Roger Bacon's birth (1214) by erecting a statue (by Mr. Hope Pinker) in his honour in the Natural History Museum at Oxford, and by raising a fund for the publication of his works. An influential committee, with Sir Archibald Geikie, K.C.B., P.R.S., as chairman of the executive, has been formed to carry these purposes into effect. Roger Bacon was the champion of experimental science and the advocate of positive knowledge at a time when logic reigned supreme; and we are glad that his important place in the history of science is to be made more widely known. The committee proposes:—(1) To hold a Roger Bacon commemoration at Oxford in July, 1914, when the statue will be unveiled, and addresses will be given by distinguished scholars; (2) to issue a memorial volume of essays dealing with various aspects of Roger Bacon's work, written by specialists in the various subjects; (3) to arrange for the editing and printing of Roger Bacon's writings, so far as funds will allow. The first volume (now in the press) will contain his unpublished treatise and commentary on the pseudo-Aristotelian "Secretum Secretorum," edited by Mr. Robert Steele. The second volume will probably contain the medical treatises, an edition of which is being prepared by Dr. E. T. Withington and Mr. A. G. Little. The committee points out that other volumes should contain a complete edition of the "Opus Tertium" (fragments of which were printed in 1859, 1909, and 1912); the "Quaestiones" on Aristotle's physics and metaphysics, and on the "De Plantis"; the "Communia Mathematicae," and perhaps the "Computus Naturalium; while new and critical editions of the "Opus Majus," of the fragmentary "Opus Minus," and of the less important "De Naturis Metallorum" and "Tractatus Trium Verborum" are desirable. A general committee (of which the Chancellor of the University of Oxford has consented to be hon. president) is being formed, consisting both of collaborators in the editorial work and of subscribers. Subscriptions in aid of the foregoing objects should be sent to the secretary of the executive committee, Colonel Hime, 20 West Park Road, Kew.

THE Historical Medical Museum now open in Wigmore Street, Mr. H. S. Wellcome's magnificent collection, is one of the most interesting sights of London. All ages and all countries have been ransacked to make it complete; we go from Babylon to here, and from the dawn of the art of healing to now. Medicine, like man himself, is of lowly origin; we have to keep reminding ourselves that evolution is creative wisdom, not blind force, alike in the one case and in the other. On the threshold of the museum we are met by hideous idols, and all the ugliness of witch-doctors and devil-dancers; and there, in the midst of all these savageries, is an exquisite model of the Wellcome Floating Tropical Research Laboratory, and a long array of the latest and rarest germs under microscopes. We stand in the hall of statuary, and look past a most unspeakable "ancient Mexican deity of healing" to Apollo and Æsculapius; or we study the weaved-up follies of charms, amulets, and talismans, until we find—it is an error of judgment—a crucifix among them. The museum is a fine place to wonder and think in—so many hundreds of instruments now discarded and labelled and put under glass; so many appliances become curiosities; so many ways of healing deserted. Then comes the dismal thought that a hundred years hence all our present apparatus will likewise be useless:—

> "It makes me mad, to see what men shall do—
> And we in our graves—"

Truly, one must take a pinch of philosophy, and a pinch of faith, to keep one's head in this museum. With these, it is possible to receive such a history lesson as will not be forgotten for many years.

A STANDING Committee of the House of Commons on June 26 discussed a Bill to prohibit experiments upon dogs. The chief operative clause in the Bill proposes to enact that "from and after the passing of this Act it shall be unlawful to perform any experiment of a nature causing or likely to cause pain or disease to any dog for any purpose whatsoever, either with or without anæsthetics, and no person or place shall be licensed for the purpose of performing any

such experiments." Strenuous opposition was offered to the Bill on behalf of medical science. An amendment was carried postponing the coming into operation of the Act until January 1, 1914. Sir F. Banbury, who has charge of the Bill, agreed to consider the incorporation of an amendment to leave out from "anæsthetics" to the end of the clause and insert "except on such certificate being given as is mentioned in the Cruelty to Animals Act, 1876, that the object of the experiment will be necessarily frustrated unless it be performed on a dog, and that no other animal is available for such experiment." The effect of that would be to bring the dog within section 5 of the Cruelty to Animals Act, and it is in harmony with the majority report of the Royal Commission. The Committee is to resume the consideration of the Bill as we go to press.

YALE University proposes to hold a centenary celebration next November in commemoration of the geological work of James D. Dana. A series of lectures will be given which will be published later in a Dana memorial volume on problems of American geology. The lectures will be given on the Silliman Foundation, and the dates will be announced after the opening of the next academic year. We learn from *Science* that the lecturers and their respective subjects are as follows:—Introduction: The geology of James Dwight Dana, Prof. W. N. Rice, Wesleyan University. (1) Problems of the Canadian Shield: The Archeozoic and its problems, Prof. F. D. Adams, McGill University; the Proterozoic and its problems, Prof. A. P. Coleman, University of Toronto. (2) Problems of the Cordilleras: The Cambrian and its problems, Dr. C. D. Walcott, Smithsonian Institution; the igneous geology and its problems, Prof. W. Lindgren, Massachusetts Institute of Technology; the Tertiary structural evolution and its problems, Dr. F. L. Ransome, United States Geological Survey; the Tertiary sedimentary record and its problems, Dr. W. D. Matthew, American Museum of Natural History.

The National Geographic Magazine for April takes the form of an admirably illustrated monograph, describing the results of the Yale University Expedition to Peru in 1912, under the charge of Prof. H. Bingham. The most important result was the discovery of the great deserted city, Machu Pichu, on the Urubamba River, north-west of Cuzco. The national legends indicate that the original home of the Incas was at a place called Tampu Tocco, "the temporary abode with windows," which has now been identified with Machu Pichu, the principal temple of which contains three remarkable windows, through which the three Inca groups are said to have emigrated. The inaccessible position of the city rendered it possible for the Incas to conceal its existence from the Spaniards. The wonderful megalithic masonry constructed in the pre-metallic age, the strange temples in which the cult of the sun and auguries from sacred serpents seem to have been practised, the remarkable burial caves in which the corpses were interred in a crouched posture, the bronzes and pottery, are all described in Prof. Bingham's report. It constitutes a record of important archæological discoveries conducted in a most inaccessible region under extreme difficulties. The investigation of this district opens out a new chapter in the ancient history of Peru.

IN Bankfield Museum Notes, second series, No. 2, the keeper, Mr. H. Ling Roth, issues another of his useful monographs on primitive industries—"Ancient Greek and Egyptian Looms." After an investigation of the facts, supplemented by illustrations and comments derived from a wide survey of the evidence, he comes to the following conclusion. The ancient Egyptians had two forms of loom: the earlier or horizontal form, still surviving in a modified form in Egypt and Seistan; second, the vertical, a later but not universally later form. In the Greek loom the type was upright, the warp threads being kept taut by weights, and similar to the form in central and northern Europe. It probably was provided with a heddle, but this is not certain: a spool was used; the weavers were women, and the weft was beaten upwards or away from the weaver. There seems to be no connection between the Greek and Egyptian types. But in form of looms used by the two peoples the Egyptians were considerably in advance of the Greeks. An interesting part of the monograph is the experiments made by modern skilled weavers to work these primitive machines.

THE introduction of the string galvanometer and its improvement by Prof. Einthoven, of Leyden, have furnished physicians with a new weapon in the exploration of the heart's activity. It is now possible by the use of this sensitive instrument to record photographically the electrical changes which accompany cardiac activity, and the variations these undergo in heart disease furnish the observer with absolutely sure signs of the character of the ailment. The older methods of observation (the stethoscope, &c.) will still remain in use, for, unfortunately, the outfit for obtaining the electro-cardiogram cannot be placed either in the waistcoat pocket or even in a top-hat. It demands a special laboratory and an expensive installation. Electro-cardiography will therefore still remain a method limited to large institutions or to a few specialists. We have received from the Cambridge Scientific Instrument Co., of Cambridge, an interesting catalogue of the apparatus they supply for the purpose, which contains instructions as to the way to use it. Specifications for complete outfits are given, but the cheapest is more than 200*l*.

THE current number of *The Quarterly Journal of Microscopical Science* (vol. lix, part 1) bears striking testimony to the excellent work done by the Glasgow school of embryologists, under the leadership of Prof. Graham Kerr. Miss Monica Taylor contributes a very valuable account of the development of the remarkable South American eel-like fish *Symbranchus marmoratus*, with some beautiful illustrations. Nothing has hitherto been known of the development of these remarkable fishes, but abundant material was collected by Dr. Agar in the Gran Chaco in 1907, upon which Miss Taylor's work is based. There are no fins in the adult fish, but the larva has well-developed pectorals, which are used mainly as respira-

tory organs and drop off bodily when the perfect branchial respiration is established. Miss Jane I. Robertson, from the same school, contributes a useful memoir on the development of the heart and vascular system of *Lepidosiren paradoxa*, which will be welcomed by comparative anatomists. The University of London is also to the fore in embryological research, as witnessed by a memoir on the reproductive cycle in the marsupial *Dasyurus viverrinus*, by Prof. J. P. Hill and Dr. C. H. O'Donoghue.

THE variations in the common fresh-water nerite (*Neritina fluviatilis*), which are illustrated by a coloured plate, form the subject of a paper by Dr. R. Hilbert in the 34 *Bericht Westpreuss. Bot.-Zool. Vereins*. These variations, which are very marked, are associated not only with locality, but also with environment, which is likewise extremely variable; some of these molluscs living in water with strong springs, some in small, slow brooks, others in rapid streams or large rivers, and yet others in calcareous, brackish, and even thermal waters. These different stations and physical conditions constitute, in the author's opinion, the starting points of the numerous variations in form and colour so characteristic of the species.

AFTER a considerable, but unavoidable, delay, the concluding portion of the late Mr. J. E. Robson's "Catalogue of the Lepidoptera of Northumberland and Durham" has been published in the Natural History Transactions of Northumberland, Durham, and Newcastle-upon-Tyne, vol. xv., part 2, this issue forming the completion of the old series. In an introduction to the minute moths of the group Tineina, which forms the subject of this part of the work, the author remarks that two or three species of that group which occur in the area under consideration are unknown elsewhere in the British Isles. "One insect, *Acrolepia vetuletella*, has not been recorded elsewhere than in the county of Durham, though I believe a solitary example was taken . . . at Richmond, in Yorkshire. Another, *Lithocolletis insignitella*, . . . has not been taken in England except between Hartlepool and Castle Eden, where it occurs in enormous numbers."

THE *Bulletin International* of the Academy of Sciences of Bohemia (Česka Akademie Císaře Františka Josefa) for 1912 brings the progress of scientific work in Bohemia before a wide circle that must remain ignorant of the national language. The papers in this volume are in one case in French, and in all other cases in German, and the majority deal with mathematical or geological inquiries. B. Němec continues his studies on fungi, and L. Pračka provides two papers on variable stars. V. Rosický has made a complete examination of seventeen crystals of miargyrite ($Ag_2S.Sb_2S_3$), resulting in the measurement of twenty-three new forms from the Bohemian specimens alone. F. Slavík directs attention to the formation of aragonite at ordinary temperatures in mine-waters at Příbram. B. Ježek describes a new rhombic thallium mineral, orbaite, from Macedonia, based on the acid HAs_3S_5, with the composition $TlAs_2SbS_5$. A. Hofmann and F. Slavík report on gold and on telluride ores in quartz-veins near the Bavarian border, where mining was carried on so far back as the thirteenth century. R. Sokol has studied the terraces of the Elbe valley, and J. Woldřich goes beyond Bohemia to the Carpathians above Dobschau, where, in examining mountain structure, he has found interesting traces of a flora that is probably of Devonian age.

VOL. xlvii. of the *Nouveaux Mémoires de la Société Helvétique des Sciences Naturelles* is occupied by two important papers. E. Ganz writes on the stratigraphy of the Middle Cretaceous of the northern Alps of Switzerland, beginning with the "Schrattenkalk" (Barrémian), and ending with the Cenomanian "Seewerkalk." Many geologists will remember the fine cliff-sections of these series in the Säntis area, and the contrast between the scenery presented by them and that on the margin of our Surrey Downs. On p. 140 the author reminds us of the sandy character of the lower Albian and of the clays of the upper Albian in both the Alpine foothills and the south of England. He adopts "Gault" as a stratigraphical and not a lithological term, embracing the Albian and the Gargasian series when these cannot be divided on a map. Since the latter includes the zones of the English Lower Greensand down to the base of the Sandgate Beds, and also, at the top, the *Schloenbachia rostrata* beds of the Upper Greensand, this "Gault" is closely synonymous with the serviceable "Selbornian" of Jukes-Browne, and with "Albian" as used by certain authors. The second memoir is a morphological study by C. Bärtschi of "Das westschweizerische Mittelland," the lowland stretching from the Lake of Geneva to that of Constance. Here the great extension of the Rhone glacier has left abundant traces. The remarks on drumlins and kames will especially interest British readers.

THE meteorological chart of the Indian Ocean for July, issued by the Meteorological Office, contains useful notes on the cyclonic storms of that region. It is pointed out that in this month the south-west monsoon dominates the meteorological conditions over the Bay of Bengal and the Arabian Sea; intelligence received from the Indian Meteorological Department showed that towards the end of May the prevailing weather conditions in those districts were quieter than usual for the time of year. The tracks laid down on the chart show that the storm centres move to the westward or north-westward across the north of the Bay of Bengal. In the Arabian Sea the monsoon at times attains a force of eight or nine of Beaufort's scale, or from thirty to forty-four miles an hour, but such cyclonic disturbances are generally of little importance. Cyclonic storms are said to be practically non-existent in July in the South Indian Ocean; details of their behaviour in that part during the cyclonic season, November to May (NATURE, October 31, 1912), are also referred to in the chart now under report.

IN the issue of *The Manila Times* for May 20 last, which has been sent to us, is published the report of

Father Jose Algue, head of the Weather Bureau of the Philippine Government, of the typhoon which lasted from May 4 to May 10, and caused great destruction over a large area. The first warning of this typhoon was given by the observatory of the Weather Bureau on May 4, and it was sent to the observatories of Hong Kong, Shanghai, Tokyo, and to the secondary station of the eastern Visayas. Frequently during each of the succeeding days throughout which the typhoon raged Father Algue was able to keep in touch with important observing stations, and to give instructions as to the exhibition of appropriate signals and information as to the progress of events. The telegrams sent to Hong Kong and to the other observatories of the Far East gave an account of the course of the typhoon within the archipelago; thus, for example, the telegram sent at 9.40 a.m. of May 6 read as follows: "The typhoon is at present close to meridian 122° E. and parallel 12° N., moving W.N.W.," while the message sent at 8.40 a.m. of May 7 said: "The typhoon is close to meridian 120° E. and parallel 13° N., moving W.N.W." While the vortex of the typhoon was crossing the islands of Samar and Leyte the area of hurricane winds was approximately fifty miles in diameter. Within this area both the winds and the sea were extraordinarily violent. The rapidity of the fall of the barometer was so great in the China Sea that there was a fall of 20 millimetres in one hour.

DR. L. W. AUSTIN, of the United States Naval Radiotelegraphic Laboratory, contributes, in the June number of the Journal of the Washington Academy of Science, a short article to the discussion of the cause of the difference in strengths of day and night signals. The data accumulated in his department during the last three years render it improbable that the difference is due to a decrease of absorption of the waves in the upper atmosphere after the withdrawal of the sun's rays. With arc oscillations it is repeatedly found that when the night signals are weak at the receiving station with the usual wave-length of 4100 metres, a change of the wave-length to 3950 metres strengthens them and *vice versâ*. This, in the author's opinion, points to an explanation depending on the interference of waves travelling along near the ground, with waves which have been reflected from a surface forty or sixty miles up, at which the conductivity of the atmosphere changes with more or less suddenness. In the daytime this stratification is broken up by convection and by the ionisation produced by the sun's rays.

IN the *Verhandlungen* of the German Physical Society for May 30, Dr. E. Goldstein, of the physical laboratory of the Berlin Astronomical Observatory, gives a preliminary account of a new line spectrum belonging apparently to helium. It appears that Dr. Goldstein first observed the spectrum in 1907, and in the intervening years has obtained many specimens of purified helium from Prof. Dorn, Sir W. Ramsay, Drs. Heuse and Scheel, and others, and has convinced himself that the lines are due to the helium itself or to some other elementary gas, and not to any compound. The new spectrum is characterised by the great number of close lines on each side of the yellow helium line. Prolonged cooling in liquid air has no effect on it, and up to a certain point increase of pressure of the gas increases its intensity with respect to the ordinary series spectrum. Dr. Goldstein regards the new spectrum as bearing the same relation to the series spectrum as the second spectrum of hydrogen bears to the series spectrum of that gas. A photograph of the spectrum with the scale of wave-lengths is given, but the author proposes to publish his more accurate measurements in a subsequent paper.

WE have received from the Norton Company, of Worcester, Massachusetts, pamphlets describing articles for laboratory use made with the material "alundum." This substance is stated to be practically pure fused alumina, prepared from bauxite by means of the electric furnace. Its high melting point (2050° C.) renders it of value as a refractory agent in high-temperature work, and the manufacturers claim that this property, together with good thermal conductivity, makes alundum very efficient—for example, as a material for cores and muffles in electric furnaces. Crucibles, tubes, combustion boats, and similar apparatus are also described. For fashioning into articles the alundum is ground to various degrees of fineness and mixed with what are rather vaguely referred to as "materials of a ceramic nature," the mixture being subsequently fired. The finished products are therefore more or less porous. Within limits, the porosity can be varied to allow of the substance being used in making such articles as filtering tubes, filter plates, and thimbles for fat extraction. Sometimes the absorbent nature of the material would be a drawback, but for many purposes alundum products may prove useful in the laboratory.

IN *The Biochemical Bulletin* (vol. ii., No. 6, p. 237) Mr. Vernon Krieble, in a paper on the synthetic action of emulsin, states that emulsin, freshly extracted from sweet almonds, when allowed to act for three and a half hours on amygdalin, gives rise to lævo-mandelonitrile, whereas the emulsin from bitter almonds gives a dextro-mandelonitrile. No experimental details are given in the brief note quoted; these will be published later.

WE have received a copy of a lecture recently delivered before the Institute of Chemistry by Mr. C. A. Hill, on the function and scope of the chemist in a pharmaceutical works. Mr. Hill gives a useful account of the nature of the manufacturing operations involved in the preparation of pharmaceutical chemicals and drugs, and illustrates his descriptions by means of photographs of actual plant; the character of the analytical work in such an establishment is described in general terms, and the possibilities of investigation, either in connection with the improvement of working processes or of a more purely scientific character, are briefly indicated.

PROF. WALDEN has contributed to the June issue of the Bulletin of the St. Petersburg Academy some further data in reference to the relationship between

conductivity and fluidity. He had already shown that, in the case of tetraethylammonium iodide, the product $\lambda_\infty \times \eta_\infty$ = const., the values of λ_∞ and η_∞ varying sixteen-fold, whilst the product varied only by 2 per cent. Similar experiments are now described with six additional salts, namely $N(CH_3)_4I$, $N(CH_3)_4NO_3$, $N(CH_3)_4CNS$, $N(C_5H_{11})_4I$, piperidine picrate, and triamylamine picrate, fourteen organic solvents being used altogether in the different experiments. The same remarkable constancy of the product $\lambda_\infty \eta_\infty$ was noticed in every case, whilst the two picrates gave the same constant when the measurements were extended to aqueous solutions.

A SET of a new series of Contoured County Hand Maps, issued by Messrs. G. W. Bacon and Co., Ltd., at 1*d.* net each, has been received. The maps will be of real service in those schools, fortunately an increasing number, where the teaching of geography is based upon practical exercises worked by the pupils themselves. The maps will make it possible for children to appreciate the importance of the relief of an area in determining its geographical character.

A COMPLETE catalogue of the books in the Central Lending Library at Coventry is being issued in five parts. The first part, which has been received, is concerned with scientific subjects and various arts. The catalogue is divided into an author and title index, a class list, and a subject-index. The librarians may be congratulated upon a careful piece of work which should prove very useful to readers using the library.

PARTICULARS of some of the most efficient forms of optical lanterns and accessory apparatus are stated in an illustrated catalogue just published by Messrs. Reynolds and Branson, Ltd., of Leeds. Prominence is rightly given to the Stroud and Rendell science lanterns, which can be adapted to many purposes, and are equally useful for the projection of lantern-slides, apparatus, or practical experiments in science teaching. The "Rystos" petrological micro-polariscope is an instrument designed by Dr. Dwerryhouse to project upon the screen sections of minerals and rocks as nearly as possible under the conditions in which they are seen under the microscope. The notes given in the catalogue on the arrangement of lantern and accessories for various demonstrations illustrate the flexibility of lantern apparatus for purposes of instruction.

THE Year Book for 1912 of the Carnegie Endowment for International Peace has now been issued. In a letter dated December 14, 1910, addressed to the trustees of the endowment, Mr. Carnegie said:—"I have transferred to you as trustees of the Carnegie Peace Fund, 2,000,000*l.* of five per cent. first mortgage bonds, the revenue of which is to be administered by you to hasten the abolition of international war, the foulest blot upon our civilisation. Although we no longer eat our fellow-men nor torture prisoners, nor sack cities, killing their inhabitants, we still kill each other in war like barbarians. Only wild beasts are excusable for doing that in this the twentieth century in the Christian era, for the crime of war is inherent, since it decides not in favour of the right, but always of the strong." The year-book details the steps which up to the present the trustees have taken to secure the objects aimed at by the fund. The numerous reports—of the executive committee, the secretary, and of the directors of the various divisions into which the work of the trustees is divided—all show that strenuous and successful efforts are being made in many parts of the world to educate peoples in the desirability of abolishing war as a means of settling disputes.

OUR ASTRONOMICAL COLUMN.

A SOLAR OBSERVATORY FOR NEW ZEALAND.—For many years it has been felt that the European and American Solar Physics Observatories should be supplemented by similar observatories in that great stretch of longitude which at present is not represented. The establishment of Kodaikanal was a tremendous advance in the right direction, and a further successful step was taken by the founding of the new observatory in Australia; the latter, we hope, will soon be in active operation. By the generosity of Mr. Thomas Cawthron, of Nelson, New Zealand, this chain of stations will be carried still further east by about 25° of longitude, for he has offered to build, equip, and endow a solar observatory in the vicinity of Nelson. The climate of Nelson seems admirably suited for such a station. The choice of the actual site is, according to a communication from Miss Proctor, in the hands of Sir Robert Ball, who has been requested to send a representative to select that which is most advantageous, and also to give estimates regarding the equipment. Let us hope that this, the "Cawthron Solar Observatory," will soon be in active operation also, thus completing the girdling of the earth from the solar physics point of view.

A CURIOUS ASPECT OF JUPITER'S THIRD SATELLITE.—J. Guillaume communicates to the *Comptes rendus* for June 9 an interesting observation relative to the appearance of Ganymede, Jupiter's third satellite, near the end of its transit across the planet. Instead of the regular circular disc which it usually displayed, he noticed on May 24 last that it had a gibbous form, reminding him, as he says, of Mars at the epoch of quadratures, and, furthermore, that it showed a very white north polar spot with a grey zone smaller in the eastern part than in the western part. These details were more apparent when the satellite was projected on the disc than when off it. M. Guillaume remarks that he has seen this appearance several times in 1890 and 1893 with a reflector of 0·216 metre aperture, but never in such a conspicuous manner as on May 24, when he was using the equatorial coudé (aperture 0·320 metre) at the Lyons Observatory.

THE STAR CLUSTERS IN PERSEUS, N.G.C. 869 AND 884.—In vol. ii., No. 2, of the *Astronomische Abhandlungen* of the Hamburg Observatory in Bergedorf, Dr. B. Messow publishes the discussion with the results of the mean positions and brightness of 649 stars in the two clusters in Perseus N.G.C. 869 and 884, after his measures of two photographic plates. The plates were secured on October 3, 1899, by Herren Eberhard and Ludendorff, with the small photographic refractor (34 cm. aperture, 3·4 m. focal length) of the Astrophysical Observatory at Potsdam, and the exposures lasted five minutes each under good observing conditions.

Towards the end of the memoir he makes a comparison with ninety-six stars of the same cluster, taken by Rutherford during the years 1870–74 and measured by Miss Young, and he finds that they agree within very small limits, with the exception of one star. Omitting this, and two others which were measured only on one of his two plates, the differences Young minus Messow were as follows:—

$$D_\alpha = 0^s.000s. \qquad D = +0''.01$$

A further investigation of the differences between Young and Messow as regards proper motion leads the latter to state that the two star clusters have not altered their position in space. The memoir concludes with a catalogue of the positions of the 649 stars for 1899–1900, together with their estimated and measured magnitudes.

OXFORD UNIVERSITY OBSERVATORY.—From the thirty-eighth annual report of the Savilian professor of astronomy we learn that the Cambridge ledgers containing the corrections to the Cambridge meridian observations from all the separate plates taken at Oxford have now been completely revised and discussed for magnitude equation. It has been found that the observations of faint stars are affected by considerable and rapidly changing errors, such as Prof. Arthur Searle found at Harvard. To enable this work to be accomplished, the work on differential star places had to be temporarily put aside. We are further informed that two zones (+64° and +63°) of the Vatican plates have been completely reduced with the exception of one doubtful plate in zone +63°. This plate has since been repeated at Rome.

THE THIRD INTERNATIONAL ROAD CONGRESS.

THE Permanent International Association of Road Congresses, which held its first meeting in Paris five years ago, completed its third congress in London on Saturday last. The attendance of home and foreign members and visitors was far greater than at either of the two previous meetings, and there is no doubt that both in the quantity and quality of the matters discussed, and the general interest taken in the road inspections and in the road-making apparatus shown at the exhibition, this congress showed a marked advance on the two previous ones.

Too much was attempted. Papers on nine important questions had been invited, and the response was such that more than 120 papers replying to the questions alone had been received, to be translated into the three official languages—English, French, and German—and summarised for discussion by carefully selected reporters. The discussions were on these summarised reports, and as the resolutions voted on after their discussion reach 4500 words in English, 5500 in French, and about the same in the German readings, it will be seen that much has been attempted.

The questions on which papers were invited were the following:—(1) The planning of new streets and roads; (2) the best types of surfacing to be adopted on bridges; (3) the great question of bituminous construction of macadamised roads; (4) wood paving; (5) the best methods of lighting streets and highways; (6) the causes of deterioration of road surfaces noted since 1908; (7) the regulation of fast and slow traffic; (8) the functions of road authorities; (9) finance and the incidence of taxation necessary for the upkeep of the roads.

In addition, communications on many important subjects were invited, but on these, although many of them contained much valuable data, there was no time for discussion.

The resolutions discussed and voted on are really condensed summaries of the average opinions contained in the papers, and therefore have a certain value as indicating the general trend of well-informed opinion on road matters in the year 1912, for on account of the time necessarily occupied in the preparation, printing, translation, and summarising most of the conclusions arrived at last week were based on papers written nearly a year ago.

It was, of course, inevitable that a great mass of the contributions came from countries where road construction and road problems are not in a very advanced state, so that the real interest to the more scientific members present lay in the opportunities that these meetings give for personal discussion of the problems which are now presenting themselves in this most interesting branch of engineering.

All who are studying the modern road development which is called for by the steady demand for door to door transport of passengers, as well as goods, know that the question of the time is how to produce road surfaces which are efficient from the point of view of reducing so far as possible the running cost of the vehicles which use them, at the lowest cost for road construction and annual maintenance.

It is almost unnecessary to repeat what has been so often urged, that road engineering demands as intimate a study of the action of the wheel rolling on the road surface as has been devoted to the same question on railways, with such marked economy in the cost of railway transportation. On account of the widely varying type of the vehicles running on the roads and of the great variety of their means of propulsion, and of the fact that for many years to come horse-drawn as well as mechanically-propelled vehicles will use the same road surface, the problems of construction and maintenance are certainly more complicated than those of the railway.

At the informal meetings of the more scientific of the engineers who visited London last week many interesting views were interchanged which cannot fail to further the science of road engineering, as has been found to be the case at the international meetings of the Iron and Steel Institute, where such informal discussions have always been the real feature of the meetings.

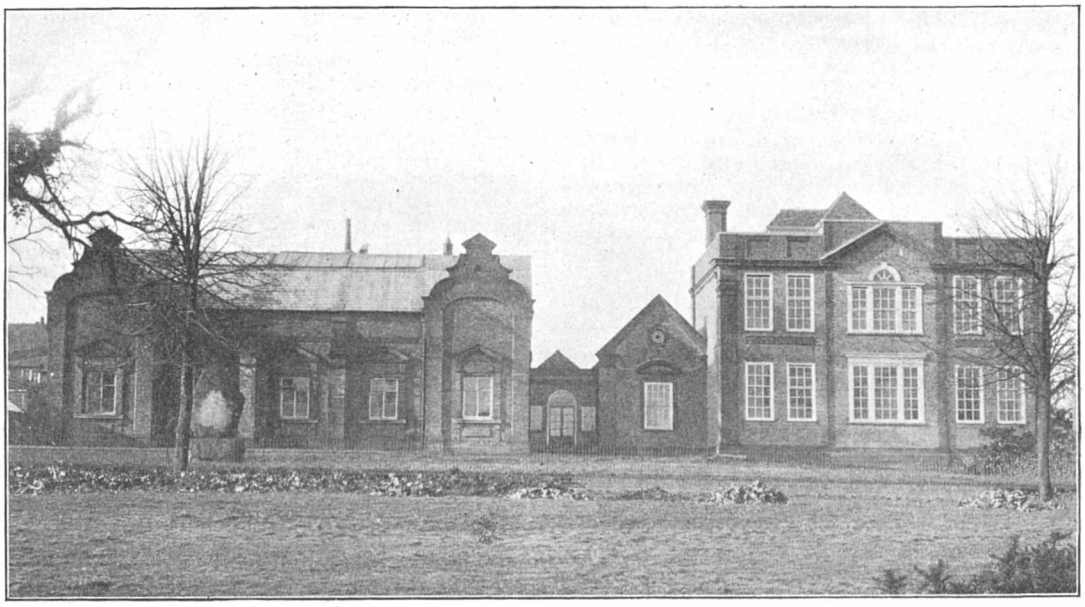
On account of the abundant supply of bituminous binding material provided by the tars and pitches from our gasworks, England has made an exceedingly good start in the science of binding road surfaces with tarry matter. On the other hand, America made her first road developments by using the bitumens which are either obtained from natural deposits or as the residuals from the distillation of some of the earth oils. Quite recently the demand for the various forms of petroleum for power and heating purposes has increased the production of the bituminous residuals, and it is likely that the low cost of freight will enable America to supply these residuals to English road engineers as a formidable rival to the tars and pitches which have been in use up to the present.

One of the most interesting features to the scientific members of the congress has been the inspection of the trial lengths of roadways laid down by our Road Board to enable various road materials, such as the roadstones, the tars, and bituminous binders, to be tested under fixed and regular conditions of heavy traffic at Sidcup, Wandsworth, Fulham, and on other roads and streets in and near London. In addition, the latest scientific development of road apparatus was shown to the members of the congress at the National Physical Laboratory at Bushy, where

the "road machine" was shown in action; this machine having been designed to reduce the time necessary to test road materials from many months down to a corresponding number of hours. The machine was only completed a few weeks ago, but the few tests already made on improved road surfaces have already directed attention to several interesting phenomena which had long been suspected by road engineers, but were incapable or difficult of proof on the ordinary roadway on account of the great variations in weather, traffic, and other matters which render accurate comparative tests difficult, if not impossible.

OPENING OF THE NEW WING AT ROTHAMSTED.

ON Friday, June 27, the new wing of the Rothamsted laboratories was opened by the Right Hon. Walter Runciman, President of the Board of Agriculture, in presence of a large and distinguished company, which included Earl Grey, Earl Denbigh, Earl Rosse, Lord Lucas, Prof. H. E. Armstrong, Mr. G. W. Lamplugh, Dr. W. N. Shaw, Sir William Tilden, Sir David Prain, Dr. G. J. Fowler, Dr. J. A. Voelcker, and others.



The new wing (on the right) adjoining the old one-storey building of the Rothamsted Experiment Station.

In his opening remarks the chairman (Sir John Thorold) stated that the wing now ready for opening was the third great advance during the last few years at Rothamsted. The first was made in 1906, when Mr. J. F. Mason gave the James Mason Bacteriological Laboratory, and provided funds for its maintenance; the second was made in 1907, when the Goldsmiths' Company gave a grant of 10,000*l.* towards soil investigations; and the third became possible when the Government instituted the Development Fund, out of which part of the cost of new buildings could be met.

In declaring the buildings open, Mr. Runciman sketched out the history of the Rothamsted Experiment Station from its beginning in 1843 to the present time. The experiments grew out of some pot trials made by Lawes as a young man in the late 'thirties. The first result was the discovery of superphosphate, which alone had proved of almost incalculable benefit to the world, markedly increasing the yields of some of the British and Continental crops, and rendering possible the economic growth of wheat in Australia. Feeding experiments on animals came later, and proved of fundamental importance both to farmers and physiologists. During the fifty-seven years of their partnership, Lawes and Gilbert had investigated most of the important problems connected with British agriculture, and laid the whole community under a great debt of obligation to them. The work thus begun had expanded considerably under Mr. Hall's directorship (1902–12), and the growth was such that the new wing was already full, and the director, Dr. Russell, was preparing plans for new buildings to be erected in commemoration of the centenary of the birth of Sir John Lawes (1814) and Sir Henry Gilbert (1817). Mr. Runciman expressed the hope that the centenary fund would be well and widely supported.

Mr. J. F. Mason, M.P., who followed, recognised that farmers had evolved an admirable system of agriculture, but pointed out that every industry benefited by scientific aid. He instanced the steel industry as one in which science had done great things. Already science had done much for agriculture, and there is every reason to suppose that it will do more.

Earl Denbigh and Sir Hildred Carlile both paid high tributes to the work that is being done at Rothamsted in relation to British agriculture, while Earl Grey emphasised the enormous part that has been played by science in the development of Canadian agriculture.

The buildings were then inspected. They include a large soil laboratory and directors' room on the ground floor, a botanical laboratory, library, and chemical laboratory on the first floor, and a glass-house for water cultures on the roof. Special rooms are provided in the basement for polarimeter work and for soil incubations. The laboratory is served throughout with electric current, which is generated in an adjoining dynamo and battery house. The total cost of the building and fittings is about 3400*l.*, and the expenditure on the new farm (which has been taken over to supplement and extend the old experimental fields) is about 3200*l.* Towards this the Board

of Agriculture has made a grant of 3100*l.* out of the Development Fund, and has also promised an annual maintenance grant of 2500*l.* from the same source. These grants are made on the "pound for pound" principle, *i.e.* they are given subject to an equal amount being raised from other sources. The Society for the Extension of the Rothamsted Experiments was founded for the purpose of collecting subscriptions, and is now making a further appeal. Subscriptions and donations should be sent to the secretary, the Rothamsted Experiment Station, Harpenden.

It is hoped to raise 6000*l.* as the centenary fund, and thus to qualify for a further grant of 6000*l.*, making a total of 12,000*l.*, a sum which it is estimated will give buildings and appliances adequate for some years to come.

THE GLASGOW MEETING OF THE INSTITUTION OF NAVAL ARCHITECTS.

THE Institution of Naval Architects held a successful and largely attended summer meeting in Glasgow on June 23–27. An interesting series of visits to works and excursions had been arranged, that to Messrs. Beardmore's shipyard, and the excursion to Arran with which it was combined, proving particularly enjoyable. While most of the papers dealt with purely technical matters, one or two were of more general interest.

In a paper on safety of life at sea, Mr. Hillhouse summed up the present state of affairs from the point of view of the naval architect. Apart from careful navigation the three factors on which we have to rely are wireless telegraphy, subdivision of hulls, and a sufficiency of boats. Of these, the adequate subdivision of hulls presents very serious constructional difficulties, and offers few advantages in the case of fire, while it is almost impossible to provide sufficient small boats and to guarantee that they shall all be usable in the moment of emergency. The one thing on which we can insist is careful navigation, although this may involve some reduction in speed.

Dr. S. J. P. Thearle directed attention to a number of cases in which cracks have developed in the shell plating of a steel vessel at points removed from rivet-holes and from the edges of the plate. These have been found to occur only in the vicinity of a frame unsupported by any beam, and are evidently due to "fatigue" following alternate stressing of the plate by "panting."

In a paper on the effect of form and size on the resistance of ships, Mr. J. S. Baker dealt with the effect of an increase in the length of the parallel portion of a vessel and of fullness of form. The problem was first attacked from a theoretical point of view on the assumption of stream-line flow; the distribution of pressure around the hull was computed; and a law deduced for the speed at which transverse wave-making occurs. These results were compared with those obtained from model experiments, and from these the author deduces an expression for the most economic length of parallel body to be associated with a given entrance and run.

Prof. A. H. Gibson and Mr. Hannay Thompson read a paper dealing with the theory of "suction," or interaction between passing vessels, and with an extensive series of experiments carried out to investigate this important question. The vessels used were respectively 90 ft. and 30 ft. in length, displacing respectively 96 and 2·6 tons. The experiments were divided into two sets, one dealing with the behaviour of the vessels when moving at different distances apart and at different speeds with helms lashed amidships, and the other dealing with the helm angles necessary to maintain a straight course and with the forces and moments operative to produce deflection of the course under similar conditions. The experiments were carried out in deep and open water, and the authors conclude that even in these circumstances interaction is a very real danger to navigation under certain conditions. The danger would appear to be greatest when the larger vessel is passing the smaller in fairly close proximity at a speed not greatly in excess of that of the smaller. In such circumstances, particularly if the larger be at the time accelerating with a view of drawing out of range of the smaller, the latter may be drawn into collision, except in so far as prevented by the helm, from distances as great as three or four lengths of this vessel. With the vessels within one length of each other the helm required to keep the smaller on its original course varied with its longitudinal position relative to the larger, and with their relative speeds. When all circumstances favoured interaction a helm angle of as much as 20° was necessary to prevent collision. Generally speaking, since the helm effect increases somewhat more rapidly than that of suction, a vessel is more easily controlled against these forces at high than at low speeds.

An interesting paper by Mr. A. Cannon records the results of experiments with an apparatus designed by Sir H. Biles on principles laid down by Colonel Russo, R.I.N., to investigate the effect of internal loose water upon the rolling of a ship amongst a regular series of waves, while a paper by Mr. Lloyd Woodward, dealing with the theory of the same subject, forms a useful supplement to this. The experiments point to the conclusion that, generally speaking, the addition of free water decreases the angle of roll, and always does so if its quantity is limited. If, however, the quantity is fairly large, and particularly in short and high waves, the effect is to increase the angle, and under a certain combination of wave-lengths and height the angle may become dangerous. Further, these large angles are attained in a very few rolls, and it is quite possible for them to be attained in an actual ship, although the resistance to roll may be very great.

In a paper which was taken as read, Prof. L. Gümbel dealt with the cavitation of screw propellers, concluding that the tendency to cavitation not only increases with a diminution in the depth of immersion and with the amount of dissolved air in the water, but also depends very largely on the pitch of the propeller, on the angle formed by the feather edge in the cross section of the blade, and on the amount of slip. As regards the latter point, the limit of slip which may take place without cavitation is reduced as the speed of the vessel increases. On the other hand, the occurrence of cavitation is not dependent on the surface pressure over the blade area. A small angle at the emersion edge is more easily obtained with a broad-bladed propeller than in one with narrower blades. In this fact lay, in the author's opinion, the secret of the success that had been obtained with turbine screws with broad blades. Since, however, broad blades involve increased friction, an attempt should be made to so form the cross section as to get a narrow blade with the minimum possible angle of emersion.

Other papers descriptive of the results of trials on modern vessels propelled respectively by geared turbines and by Diesel engines enable an interesting comparison to be gained between the performance of these types of motor. In the turbine installation of 2400 b.h.p. the steam consumption was only 12·55 lb. per shaft h.p., the ratio of effective h.p. to shaft h.p. attaining a maximum value of about 58 per cent. at

about 480 revolutions per minute. With the Diesel engines, of 1000 h.p., the remarkably low consumption of 0·37 lb. of oil per shaft h.p. was obtained.

In the concluding paper of the meeting Messrs. Reid and Mavor made out an excellent case for electrical propulsion in conjunction with Diesel engines in the type of large canal barge or freighter used to such an extent on the great inland waterways of North America. The efficiency of such a vessel depends very largely on the ease and rapidity with which it can be manœuvred, reversed, accelerated, and backed, during its frequent passages through the locks on these waterways, and this puts the direct-coupled Diesel engine, under present conditions, out of court.

THE NATIONAL PHYSICAL LABORATORY

OPENING OF NEW BUILDING.

THE new building at the National Physical Laboratory, Teddington, was opened by the Right Hon. A. J. Balfour on the day of the annual visitation, Thursday, June 26. The opening ceremony was held in the structure designed for the new wind-channel for aëronautical work. A large and distinguished company foregathered, including Sir Archibald Geikie, who presided, Colonel Seely (Secretary of State for War), Lord Rayleigh, Lord Allerton, Lord Welby, Viscount Esher, Lord Montagu of Beaulieu, Sir Oliver Lodge, Sir Wm. Crookes, Sir Wm. Ramsay, Sir John Brunner, Sir Albert Spicer, and Dr. R. T. Glazebrook (director of the laboratory).

The chairman, in his opening remarks, referred to the amazing growth of the laboratory and the place it had taken as one of the most important national institutions in this country.

Dr. Glazebrook dwelt on the noble liberality of the friends who had so splendidly supported the laboratory in the past, and Lord Rayleigh emphasised the fact that funds were still needed for equipment purposes. Lord Rayleigh went on to express the hope that in the future larger funds would be available to enable greater attention to be paid to research in pure science, as well as to work calculated to further the immediate ends of industry.

Mr. Balfour gave an interesting and thoughtful address dealing largely with the national advantages of the study of pure science. In the course of his address he remarked:—

Measuring is the very life-blood of physical science. It lies at the root of almost all great discoveries and their application to practice. It is impossible not to acknowledge the benefit which mankind has received by the command which science has given us; and measurements and testing are absolutely essential to science. The great features of a national laboratory are its impartiality, its ability to bring an adequate staff and adequate machinery to bear on problems, and the standard of perfection which it sets for instruments and which serves as an ideal for manufacturers to work to. The advantages to industry are beyond all doubt and beyond all question.

But the successes of the future of industry depend on the abstract of purely scientific investigations of the present, and it is to the labours of the man of science working for purely scientific ends, and without any thought of the application of his doctrines to the practical needs of mankind, that mankind will be most indebted as time goes on. The general public does not realise that it is to the results of pure science that we have owed in the past, and shall owe more and more in the future, all great advances in industrial knowledge and practice. Still less does it realise that the man of science who is working continuously towards that end is only half a man of science, and is not likely to do his scientific work nearly so well as if he were simply and solely occupied in advancing that branch of knowledge with which he is connected.

When these important truths have sunk into the public mind, we may see, as a reflection of that new conviction, a different attitude adopted by those who have to settle what expenditure should be presented to Parliament for its sanction, and the attitude which Parliament itself may take in the face of such suggestions. The growth of this great institution during its very few years' existence justifies us in looking forward to a great and glorious future for it. The thanks of the public are due to the brilliant and hard-working staff of the laboratory who, under no small difficulties, are the real authors of the triumph which we are met to celebrate.

After the opening ceremony, an inspection was made of the new building, and visitors wandered at will through the various departments of the laboratory, in which a series of interesting demonstrations had been arranged.

The new building marks the completion of a scheme for the erection of laboratories for metallurgy and optics, and of a building for administration purposes. The late Sir Julius Wernher made himself responsible for the funds for the metallurgical laboratories, and for the rest, the Treasury, the 1851 Commissioners, and some of the City Companies have made generous contributions.

One of the main objects for which the new laboratories have been erected was to enable the testing work, until recently carried out at Kew Observatory, to be transferred to Teddington. Kew Observatory is in future to devote itself purely to meteorological objects—it is now, in fact, the central observatory of the Meteorological Office—while the testing of instruments of all kinds will be undertaken exclusively at Teddington.

The new building provides accommodation for the administration and optics departments, together with workshop and packing rooms. The optics wing is designed to accommodate the optical testing work hitherto carried out at Kew and in a suite of rooms at Bushy House. The latter rooms are now occupied by the thermometer-testing observers from Kew, while the remainder of the Kew test-work has been housed in the metrology department.

The new building, of which we show an illustration, is a three-storey structure built of purple Surrey bricks with red brick facings. The architecture is of the Queen Anne period, and the structure bears a general resemblance in style to Bushy House, alongside which it stands, and which, it will be recalled, formerly housed the whole of the work of the laboratory. The new building impresses one as being generously lighted and very substantially built, and reflects great credit on the architect, Mr. W. D. Caröe, and on the clerk of the works, Mr. R. Allen Jane.

Great care has been bestowed on the fireproof qualities of the building; the floors and stairs are of ferro-concrete throughout, and generous provision has been made for fire hydrants. This feature is, of course, doubly important in a building one of the functions of which is to house important records.

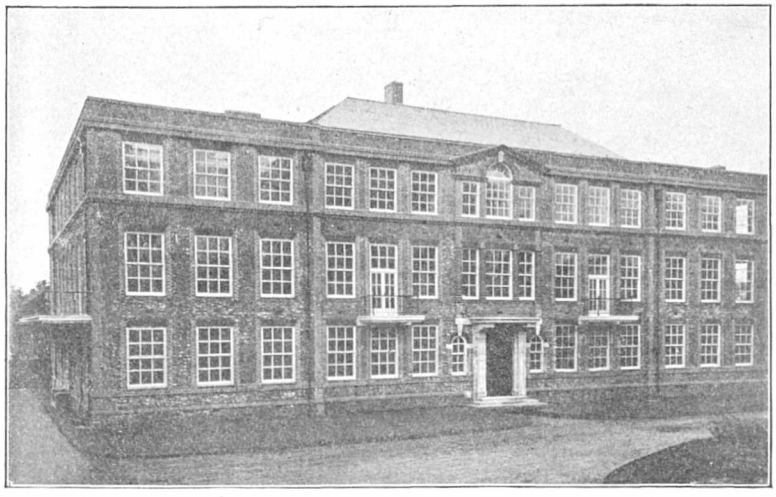
The ventilation is controlled by a large fan on the roof, communicating by ducts to extractors in the ceilings of the different rooms. Fresh air is admitted through louvres behind steam-heated radiators provided with suitable baffle plates.

The corridors throughout are covered with Dolo-

ment patent flooring; the woodwork is chiefly oak, the effect of which is altogether admirable.

To take the central block of the new building first. Opening on to a large central hall on the ground floor are the accountant's offices and strong-room, reception-rooms for visitors, and a telephone exchange room; on the first floor are the director's room and the secretarial offices; on the second floor, *inter alia*, the "White Library," a publications room, and a lecture theatre. The library is being furnished by the Drapers' Company in memory of the late Sir William White, to whose good-will and energy the laboratory owes a great deal. A brass memorial tablet records that "The Worshipful Company of Drapers of the City of London, mindful of the last wishes of Sir William Henry White, K.C.B., F.R.S., gave to the Laboratory the bookshelves in this library." The fittings are being carried out in old oak, and the library, with its panelled walls, recesses, and gallery, brings to mind some of the college libraries at the older universities.

It is anticipated that the new lecture-room will afford facilities for meetings of scientific societies, for many of which an annual visit to the laboratory has become a recognised function. It is hoped also that



New building of the National Physical Laboratory.

opportunity will be afforded to the members of the staff of hearing distinguished visitors at a fortnightly or monthly colloquium.

The central block is isolated from the north and south wings by fireproof doors.

On the ground floor of the optics division are two large semicircular arch-shaped tables made of cast-iron. One of these is vertical and the other horizontal. They are used to test the accuracy of graduation of theodolite circles and sextant arcs. One face of each table is machined, and to it are bolted at definite angles collimators pointing to the centre of the semicircle. The tables rest on isolated masses of concrete weighing some 20 tons; and to avoid troubles due to seasonal and extraneous temperature changes, the tables and supports are hollow throughout, and are kept at uniform temperature by circulating water through them. In the same room is a tilting table with standard wedges for testing clinometers. The photometer and spectacle-lens benches are mounted in an adjoining room, along one end of which is a movable partition which can be removed when extra long-focus process lenses are being tested.

A rapid and convenient system of light-tight blinds is a noteworthy feature of the fittings. The testing of microscopes is conducted in an adjoining room.

On the first floor, a group of rooms is allotted for testing terrestrial telescopes. One of these can be completely darkened for the purpose of examining the parallelism of the axes of binoculars, or the illumination of cross wires. Test objects and scales of various forms, and at distances up to 400 yards, have been erected.

A long ferro-concrete balcony (which, by the way, was cast in one mould complete) extends along the outside of the first floor. This will enable open-air tests to be made on instruments.

On the second floor, the equipment for examining photographic lenses is grouped in adjoining rooms. Here are, for example, the Hunter apparatus for obtaining a numerical estimate of definition; the Beck bench for measuring focal length, astigmatism, curvature of field, &c. The testing of photographic shutters is carried out here, by the use of vibration galvanometers tuned to resonance with electrically-driven tuning-forks or vibrating bars.

Next is the room devoted to spectroscopy, and in particular to the examination of refractometers and spectrophotometers. A feature of the room is a large roller shutter by means of which the room can be readily divided into two. The shutter is provided with suitable apertures, to fit the various instruments under test, and will be brought into use when it is important that the eyes of the observer should not be exposed to bright lights during the test.

The remainder of the rooms are given up to the general photographic work of the laboratory. There is an unusually well-designed and ventilated suite of dark-rooms with light-trapped doors and the like. Other rooms are specially designed and illuminated for photographing apparatus and diagrams.

The roof of the building is flat and asphalte-covered, and on it at one end is arranged an observatory. This is to be fitted with a telescope with an equatorial mounting, and a dome. The telescope is designed so that object-glasses sent for test can be mounted as in actual use.

The north wing contains the packing-rooms and the associated clerical offices, together with store-rooms and wood and metal workshops. Arrangements have been made here for the engraving of instruments with the familiar NPL mark—outward and visible sign that an instrument has passed its tests. Copious provision was necessary for dealing with the packing and unpacking of cases containing instruments, the handling of which under the old arrangements was fast becoming a problem owing to the volume of stuff which had to be dealt with. There is a large Waygood lift, to which leads a sunk track for wide rubber-wheeled trolleys. Thus these latter can be run on the lift, and so to the various corridors and rooms. There is a second lift to the workshops. In this block, a common-room for the laboratory boys has been provided.

The foregoing description will perhaps give an idea of the admirable manner in which the new building has been designed for its work.

DEATH BY ELECTRIC CURRENTS AND BY LIGHTNING.[1]

DEATH BY ELECTRIC CURRENTS.

I BELIEVE that no loss of human life from industrial currents of electricity occurred before 1879, though currents strong enough to have caused death were employed in lighting the operatic stage in Paris (at the first performance of Meyerbeer's "Le Prophète") so long ago as 1849, and in lighthouses on and off the coast of England in 1857. In 1879 a stage carpenter was killed at Lyons by the alternating current of a Siemens dynamo that was giving a voltage of about 250 volts at the time. The man became insensible at once, and died in twenty minutes; artificial respiration was not applied. The first death in this country took place at a theatre in Aston, outside Birmingham, in 1880, where a bandsman short-circuited a powerful electric battery, became insensible, and died in forty minutes. Since that date the annual number of deaths from electric shock has steadily increased, particularly during this century, in which the industrial employment of electricity has extended so widely, and is now quite large. In the ten years 1901–10 the Registrar-General's returns show a total of 183 such deaths in England and Wales, the population having risen from 32½ to 36 million during that period. In the three years 1901 to 1903 there were twenty-five deaths; in 1908, twenty-five; in 1909, twenty-nine; in 1910, twenty-six. Only two of these 183 victims were females, because women are so much less exposed to contact with dangerous electric currents than are men. Many deaths by electricity occur annually on the Continent, though I can only bring forward a few scattered figures to prove it. In Germany, thirty-three were killed in 1908; fifty-two in 1909; forty-six in 1911. In Austria eleven were killed by electricity in 1907; ten in 1910; ten in 1911. In Switzerland, twenty-one were killed in 1905; nineteen in 1906. I think it probable that about 200 persons are killed by electricity annually over the whole of Europe. As regards the United States of America, where electricity is so very extensively employed, I have not been able to find any statistical records. So long ago as 1888 Brown estimated that during the past five years some 200 people had been killed by handling live electric wires. One must remember that in America life is held very cheap, and that safeguards and protective legislation tend to be regarded as undue restrictions upon industry and commerce. I imagine that not fewer than 200 persons are accidentally killed by electric currents every year in America. As a rule, only a single person is killed by electricity in any single accident; but in an accident occurring in 1909 at Olginate, a village in Lombardy, ten people were killed outright by a three-phase current at 3000 volts, one was saved by artificial respiration, and about a dozen more were severely injured (Hoest).

The interest of men of science, of physicians and pathologists, in such deaths was first shown in France. In 1882 the celebrated French medico-legal expert and pathologist, Brouardel, made a careful *post-mortem* examination of a man killed in Paris at the Tuileries by a 250-volt alternating current, and he decided that death was fulminating, due to the electric discharge, and directly caused by arrest of the heart. Bourrot at the same time examined a second and similar case *post mortem* and came to the conclusion that death was due to violent excitation of the vagus nerve and consequent arrest of the heart, with the result that the heart could not resume its functions, and death by asphyxia followed. In 1885 a man killed instantaneously by electric shock at the Health Exhibition in London was examined forty hours after death by Sheild and Delépine. *Rigor mortis* was marked; extreme fluidity of the blood was observed, even the right heart being free from clots. The authors came to the conclusion that "No doubt the vital spots at the base of the brain are in such cases markedly implicated."

During the last twenty years a great many *post-mortem* examinations have been made in cases of sudden death by electric shock. Burns of greater or less superficial extent are generally seen at the points where the electric current has entered and left the body. In the second place, abnormal fluidity of the blood has often been found *post mortem*; in this, those cases of sudden death by electric shock resemble cases of sudden death by asphyxia. In the third place, no pathological changes are regularly found in the heart muscle, although there are good reasons for believing that in most instances death is directly due to paralysis of the heart. In the fourth place, the central nervous system often shows neither macroscopical nor microscopical changes of importance, except in the cases where relatively large quantities of electricity have passed through the body for long periods of time. In a word, the *post-mortem* evidence as to the cause of death by electric currents in industrial accidents is generally negative, but may suggest asphyxia in some cases, in others organic vascular and nervous lesions in the brain and cord.

It is upon the evidence obtained by the experimental electrocution of animals that most of our knowledge as to the modes of death by electric shock rests. No electrical apparatus capable of producing currents strong enough to kill animals was invented before about the middle of the eighteenth century. At that time electricity suddenly developed into a popular and spectacular science in France and Germany, just as in the middle of the nineteenth century table-turning, spiritualism, and clairvoyance were popularly taken up all over England and America with the greatest energy. In neither case was much real scientific progress made by this arousal of popular interest; birds, beetles, and other living creatures were electrocuted by frictional electricity by Gordon (1745), Gralath (1746), Nollet (1749), and many others (Benjamin). It was noted that the birds exhibited ecchymoses where the electric sparks struck them, much like the ecchymoses seen on persons killed by lightning (Nollet). Priestley in 1767 killed kittens and dogs with the discharges of condensers, and tried without success to resuscitate a kitten by artificial respiration, distending the lungs by blowing with a quill into the trachea. Abildgaard (1775), using condensers and Leyden jars, tried without success to electrocute a three-months-old foal; he succeeded in killing cocks and hens by electric discharges sent through the head, and made the important observation that fowls treated in this way and to all appearances dead could be brought back to life by electric shocks sent through the body from breast to back, but remained dead if not treated in this manner. To mention only a few out of many of those who have since made similar investigations:—

In 1885 Mann made some very interesting experiments on the effects of electricity on the action of the human heart. He applied the electrodes to the præcordia and back, and found that a slowly alternating current of from 15 to 30 milliamperes did not prejudice the heart's action.

In 1885, and further in 1887, d'Arsonval made some interesting remarks on deaths caused by industrial electric currents, advancing the views as to their mode of production that he has continued to hold faithfully

[1] From the Goulstonian lectures for 1913, delivered before the Royal College of Physicians of London by Dr. A. T. Jex-Blake.

ever since. These deaths, he said, were brought about in one of two ways :—

(1) By direct action, the mechanical effect or disruptive action of the electric current on the tissues; or

(2) By indirect or reflex action on the nervous centres.

In the first case death is final; in the second it is often apparent only, so that the victim may recover if treated by artificial respiration immediately after receiving the shock. Most of the victims of industrial electric accidents had died of asphyxia, he believed. The alternative view that these deaths were due to cardiac failure was first emphasised in 1890 by Tatum, and his is the view very generally held at the present time. It was put on a more scientific basis in 1898 by Prevost, who showed that the cardiac failure was the result of fibrillation or fibrillary tremulation of the muscle of the heart, the German *Herzdelirium*, investigated in 1850 by Hoffa and Ludwig. The extremely well-designed and well-executed experiments of Prevost and Battelli (1899) proved the great importance of cardiac fibrillation in causing the death of animals of various kinds when exposed to the passage of electric currents through different parts of their bodies. They also illustrated the various effects of electric currents of different varieties—alternating, continuous, sudden discharges from condensers and induction coils—on these animals, and proved that when apparently killed by a current at a low voltage, animals might be brought to life again by the shock of the much stronger currents forced through their bodies by the application of high voltages. These authors also demonstrated that while an alternating current with a frequency of 150 alternations a second might be fatal to dogs at an E.M.F. of only 15 to 25 volts, when the alternations were increased to 1720 a second, no fewer than 400 volts were required to produce death. Using high-frequency currents with from 400,000 to 1,000,000 alternations a second, d'Arsonval (1893) found he could stand the passage of as much as 3 amperes through his body, a current twenty or thirty times as great as that required to kill a human being at the ordinary rates of alternation employed industrially. The experiments of Cunningham (1899), d'Arsonval (1910), Weiss and Zacon (1911), are also worth recording, and have added considerably to our knowledge of death by electric currents. Weiss and Zacon found that chloral anæsthesia gave dogs no protection against electric shocks. With alternating currents given for a few seconds, death would occur when about 70 to 100 milliamperes traversed the thorax with the heart *en route*; with continuous currents, death was not caused unless the current was as large as 300 milliamperes, roughly speaking. If, however, smaller electric currents were administered for long periods, it was found possible to produce death by tetanus and asphyxia; thus currents of 35 to 45 milliamperes were too small to produce cardiac fibrillation, but after about ten minutes' application caused death by continued inability to breathe, and slow asphyxiation. It may be noted that Prevost and Battelli found that dogs were not killed by alternating currents as great as 4 amperes at 1200 volts, passed through the body from one hind leg to the other; the reason being that with this arrangement of the electrodes the rate of flow of electricity through the muscle of the heart was not large enough to cause it to fibrillate.

One may conclude that living animals of different species are killed by electricity with very different degrees of facility. For example, many experimenters have endeavour to electrocute frogs, but all, I believe, without success, whatever the current used and however it may have been applied. The frog survives electric shocks and the prolonged passage of electric currents at all sorts of voltages—10, 100, 1000 volts and more—and shocks from induction coils and charged Leyden jars. The only inconveniences it suffers appear to be transient pareses or paralyses, and, in the case of strong currents passed for many seconds or minutes, the formation of burns. The frog is thus immune because its heart always begins to beat again regularly and normally after the passage of the electric current, and because its respiration does the same; and also, as Priestley pointed out in 1767, because "its constitution enables it to subsist a long time without breathing." At the other extreme of the scale comes the dog, which can be killed with certainty by an alternating current of perhaps 15 volts or 60 milliamperes, if it is applied so as to pass largely through the heart muscle for a couple of seconds only.

As regards the death of human beings, it may be brought about by electric currents in several different ways.

(*a*) There is no doubt that it might be due to prolonged tetanus of the muscles, which could prevent the performance of respiratory movements, and so lead to death by asphyxia after some minutes. But I am not able to find that it ever has come about in this way as a matter of fact, the victim always being able either to break the contact and interrupt the passage of the current for himself, or to call for help and get the contact broken by somebody else before asphyxia has occurred in this way.

(*b*) In man primary heart failure is undoubtedly the commonest mode of death by electric currents. The experiments on animals already detailed show that such deaths are due to fibrillation of the ventricles of the heart. The fibrillation has been seen occurring in the hearts of two criminals electrocuted in America and examined immediately after death (Schumacher); a few minutes later the left ventricle was firmly contracted and empty, while the right ventricle and the auricles were relaxed in diastole and full of blood. It is probable that in the adult man, as in the dog, horse, and ape, fibrillation of the heart, once it is established, is irremediable, practically speaking.

(*c*) and (*d*) Death by failure of the respiration while the heart continues to beat, brought about by nervous inhibition, or by failure of both heart and respiration together, is probably not so common in man. There is a great want of evidence on this point; naturally enough, as the people who are present at deaths by electric shock are generally workmen who do not busy themselves with observations of the pulse and the respiration of the victim. A good many cases have been recorded in which death did not occur until ten, twenty, or forty minutes after the shock had been received, and was then apparently due to failure of the respiration to re-establish itself. The experiments upon animals would lead one to believe that such deaths are really due to failure of the respiratory centre in the central nervous system. The *post-mortem* evidence in such cases should suggest death by asphyxia, and such evidence has sometimes been found after death by electric shock.

(*e*) Brief reference may be made to the fact that a good many cases have been recorded in which the victim of an electric accident has died after a few days or weeks from complications (shock, gangrene, suppuration, exhaustion following extensive amputations) arising out of the injuries caused by the electric current.

With alternating currents, death has occurred from shocks at voltages as low as 65 volts, and a good many instances of death at such pressures as 100 to 120 volts have been recorded. It is only in very exceptional circumstances that these low voltages can cause death; unless the patient's skin is wet and he

makes a good contact, not only with the electric conductor, but also through wet boots or clothes (according as he is standing or sitting), with the ground or some other conductor, there is not the smallest chance of death by currents at such low voltages.

As regards continuous currents of electricity, I have not found records of many fatal accidents at voltages below 220 volts, but in one case a direct current at only 95 volts caused death, in another a current at 110 volts. The minimum number of milliamperes required to kill a human being under conditions favourable for killing is not known. Weiss calculates that from 70 to 90 milliamperes of an ordinary alternating current would be enough if the current went through the chest and heart; d'Arsonval states that much less than 100 milliamperes suffice to kill. Trotter found that continuous currents up to 35 milliamperes, though almost insupportably painful, were not fatal when passing from the hands to the feet. But when very large industrial currents are forced through the body by high voltages, we meet with the paradox that, while small currents may kill instantaneously, large currents are much less fatal. For example, the American electrocutions have shown that alternating currents of 5 or 8 amperes may pass for many seconds through the body without causing permanent arrest of the heart or respiration. In several recorded non-fatal cases of shock by alternating or three-phase currents at 10,000 volts, it is true that no measurements of the amperes passing through the victims were made, but it is reasonable to suppose that they may have amounted to several amperes. It is plain, then, that currents of a fraction of an ampere may cause sudden death by throwing the ventricles of the heart into fibrillary contraction, though much larger currents of several amperes do not act thus, and so are not fatal. But I do not know of any examples or experiments to show at what point or amperage the transition from small dangerous to large non-dangerous currents takes place.

So far as one can guess, in the absence of any experimental proof, it seems that a continuous current must be two or three times as strong as an alternating current, to kill a human being. So far as sudden death is concerned, electric currents are dangerous to man in proportion to the degree to which they tend to pass through the heart.

The prognosis in cases of severe electric shock has been very variously estimated. Cunningham (1899), for example, speaks of artificial respiration as "the only, and almost invariably futile, method in vogue in electrical accidents at the present day," for the resuscitation of persons apparently killed by electric shock. The opposite view is held by Lauffer (1912), who says "there are few cases of electrical accident where the victim cannot be restored from the electrical shock, if appropriate immediate efforts at resuscitation are instituted."

The treatment—artificial respiration by Schäfer's or Sylvester's methods—is still that advised by Priestley in 1767. The importance of getting to work with the artificial respiration without a moment's delay has often been emphasised by those who have had much experience of electrical accidents. No less important is the necessity for continuing artificial respiration until *it is certain* that death has occurred; nothing less than cooling of the body or the onset of *rigor mortis* should be considered to be evidence of death here.

Death by Lightning.

Up to the present time, meteorologists have furnished us with singularly little definite knowledge about the electrical properties of lightning strokes and the electrical quantities concerned in their production. They may be summed up as very strong electric currents of very brief duration and very high potential, containing thousands or possibly millions of foot-tons of energy. When human beings are struck, a part at any rate of this energy is converted into heat, producing various bodily lesions in most instances. Death by lightning-stroke is much commoner in most countries than it is in ours. In England and Wales the Registrar-General reported 124 fatal instances of lightning-stroke, 108 in men and sixteen in women, during the ten years 1901–10, a yearly average of only 12·4 deaths, or 0·36 per million living. In Hungary the annual death-rate from lightning is said to be sixteen per million living (Milham); in Styria and Carinthia about ten per million, in Prussia 4·4, in France and in Sweden three, in Belgium two, so far as the imperfect statistics available go (McAdie and Henry). In the United States of America the annual death-rate per million is high, about ten, in consequence of the frequency of thunderstorms on one hand, and of the large percentage of the inhabitants engaged in outdoor labour on the other; about 700 or 800 deaths from lightning were estimated to occur in the United States every year by Henry in 1900, in a population of seventy-six millions. Many more people are struck by lightning than are killed. For example, Jack records an instance in which a church was struck; 300 people were in it, 100 were injured and mostly made unconscious, thirty had to take to their beds, but only six were killed. Weber gives an account of ninety-two people struck in Schleswig-Holstein; ten were killed, twenty paralysed, fifty-five stupefied, and seven only slightly affected. In 1905 a tent with 250 people in it was struck, and sixty were left on the ground in various states of insensibility; one was killed outright, another breathed for some minutes before dying, the rest recovered. As many as eleven and eighteen persons have been killed by a single stroke of lightning. Vincent mentions a stroke that threw down 1200 and killed 556 out of a flock of 1800 sheep.

As to the exact way in which lightning causes death, some experiments of Prevost and Battelli, in which the discharges of induction coils and condensers were employed, seem to show that it is by central inhibition and cessation of the respiration in many cases, in others by cardiac fibrillation and stoppage of the heart. The bodies of persons killed by lightning exhibit no characteristic pathological changes except the production of burns and the curious subcuticular or subcutaneous stainings known as "lightning figures," that often imitate the fronds of ferns or leaves or branches of trees, and have given rise to a deal of baseless speculation as to their mode of production. Among the most interesting of the other and far rarer *post-mortem* lesions observed are lacerations of the soft tissues and fractures of the bones. The exact mechanism by means of which lightning lacerates tissues and fractures bones is obscure. In cases where the heel is lacerated and the os calcis comminuted, one may perhaps imagine that an extra development of heat and steam has taken place here, with the result that the electric discharge has, so to speak, blown its way out of the body. The example described by Clark and Brigham proves that enough heat may be developed in so deeply situated a bone as the orbital plate of the frontal bone to char it, so that it is not unreasonable to suppose that small steam explosions may result if the lightning develops a less degree of heat in a moist tissue. But it is not quite easy to imagine how the tibia and fibula could be broken, without showing any external injury, as in Penfold's case, if the frac-

tures were caused by small steam explosions taking place inside these bones. Yet there is no alternative explanation to offer. For I do not think it is imaginable that any known forces of electric attraction or repulsion could exert enough violence to break bones. At any rate, the physicists appear to know nothing of electric forces of the magnitude that would be required here. In a few well-recorded instances which are extraordinary almost to the point of being incredible, strokes of lightning have effected amputations.

Unless sudden death follows, the probability that a person struck by lightning will recover is large; Dechambre collected 365 instances in which the immediate effects of the stroke were survived, and found that only fifteen of these victims died subsequently from late effects of the lightning. It seems to be very generally assumed that immediate treatment would improve the prognosis considerably, and that many of the people killed by lightning are only apparently dead, and still capable of recovery if properly treated during the next few minutes. I do not know of any statistical evidence to prove this point.

At the present day only general advice can be given, as the accumulated records have shown that no place above ground is completely protected against lightning. It is certainly safer to be indoors than out, and a large house is much safer than a shanty. The windows and doors of the room in which one is should be shut, and one should keep away from the walls, and particularly from the fireplace, because, when a chimney-stack is struck, the contents of the chimney and the fireplace are often blown out into the room and cause bodily injuries. A great many people have been struck in sheds and barns, especially when they have been near doors or windows, or in currents of air. Turley recommended the centre of a railway carriage at a distance from the engine as the securest place of all; Schefčik, a feather bed. To take refuge in the cellars merely to avoid a thunderstorm is not necessary as a routine, though in exceptional cases it may be advisable.

The advice given by various authors to persons caught out of doors in a thunderstorm is contradictory. It is probably unwise to take shelter in a shed unless one can get out of the way of doors, windows, and draughts while one is in it. A shed containing domestic animals is certainly more dangerous than the open. If one has to remain in the open, there are certain things that should be avoided at any cost. The first of these is the proximity of wire fences, because when such a fence is struck the electric discharge may be carried along the wires and cause death at a distance from the place actually struck. The second is proximity to such things as hedges, ponds, and streams, isolated trees, crowds of people, and herds of domestic animals. Crowds of people or animals seem to have a mild attraction for lightning, very possibly by virtue of the warmth and dampness they impart to the atmosphere immediately round them. It has often been said that to have had the clothes thoroughly wetted by rain and rendered conducting gives some protection to people who are struck by diverting the path and violence of the lightning from the body to the clothes. I have found seven well-recorded instances in which the effect of the stroke was to blow all, or practically all, the wetted clothes off the body, by the generation of steam as I believe. There can be no doubt that a part of the energy of the lightning was expended on the clothes in these cases, but three of the seven victims were killed notwithstanding. So the protection of wet clothes cannot be considered at all complete.

So far as treatment is concerned, persons struck and apparently killed by lightning should at once be given plenty of fresh air, their clothes should be loosened, and artificial respiration by Schäfer's or Sylvester's method should be applied and should be continued until either recovery occurs or cooling of the body and *rigor mortis* show conclusively that death has taken place. In the medical writings of from fifty to two hundred years ago one often sees bleeding recommended, and this might well be of service in those cases of lightning-stroke in which the heart goes on beating while the respiration stops. If it were immediately—within a few minutes—available, to give strong electric shocks to the præcordia would be well worth trying in desperate cases. As regards other remedies—such as stimulants in all forms, hot or cold applications, the inhalation of pungent vapours—very many have been recommended, but none seem to have met with any success.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

SHEFFIELD.—Mr. W. G. Fearnsides, fellow and lecturer in natural sciences at Sidney Sussex College, and demonstrator in petrology in the University of Cambridge, has been appointed to the Sorby chair of geology.

ACCORDING to an announcement in the "Political Notes" of *The Times*, there is reason to believe that the Government has abandoned the intention of introducing this session the Education Bill which was to have embodied the scheme under consideration by Lord Haldane's Cabinet Committee. Every effort is being made to lighten the Government programme so that Parliament may be prorogued at a reasonable date in August.

IT is announced that their Majesties intend to invite to a garden-party at Buckingham Palace on Saturday, July 19, representatives of the teaching profession in London. We understand that invitations will shortly be issued to responsible head-teachers and principals of schools, institutes, and colleges of every type constituting the public system of education in the county of London. A special choir of children selected from public elementary schools will sing before their Majesties.

IN support of the foundation of a Western University in Central China, a meeting of members of Parliament was held in the House of Commons on June 26. Canon Lord William Gascoyne-Cecil said that nothing is being asked for out of the pocket of the British taxpayer. The suggestion is that the British Government should forgo part of the Boxer indemnity. We learn from *The Times* that it was pointed out that the Boxer indemnity claimed by Great Britain amounted to more than 7,000,000*l*., and of that amount only 199,000*l*. has been paid. A sum of 250,000*l*. spread over a long period would meet the cost of the new University. A motion that a deputation be appointed to urge upon the Prime Minister the desirability of a Government grant, either out of the Boxer indemnity fund or otherwise, towards the establishment of the proposed University was agreed to.

THE Board of Education has issued (Cd. 6866) the regulations, which will come into force on August 1, for university tutorial classes in England and Wales. The Board will be prepared to make special grants in aid of part-time courses in subjects of general as distinct from vocational education, given under the educational supervision either of a university or uni-

versity college, or of an educational body containing representatives of such places of higher education. The university or supervising body must be responsible for the framing of the syllabus, and the selection of a suitable tutor; and the instruction must aim at reaching, within the limits of the subject covered, the standard of university work in honours. The course must extend for each class over a period of not less than three years, and must occupy at least two hours a week for twenty-four weeks in each year, at least one-half of the time being devoted to class work.

IN the issue of *Science* for June 13 further large gifts to higher education in the United States are announced. Mr. Andrew Carnegie has undertaken to provide 200,000*l.* for the medical department of Vanderbilt University. Of this sum 40,000*l.* is to be given to the University immediately for the erection and equipment of laboratories. The income from the remaining 160,000*l.* is to be paid annually for the support of the department through the Carnegie Corporation. A condition of the donation provides that the direction of the educational and scientific work of the department shall be committed by the board of trustees to a small board of seven members, three of whom shall be eminent in medical and scientific work. Messrs. J. B. and B. N. Duke have given 160,000*l.* more to Trinity College in North Carolina. The college has thus secured the 30,000*l.* promised by the Rockefeller Foundation, and has added 200,000*l.* to its endowment. Governor Sulzer has signed a Bill granting 50,000*l.* for a building for the State College of Agriculture at Syracuse University.

THE report for 1913 of the council of the City and Guilds of London Institute has now been published. In it is passed in review the work of the City and Guilds (Engineering) College, the City and Guilds Technical College, Finsbury, the South London Technical Art School, the Department of Technology, and the Leather Trades School. The audited accounts and balance-sheet of the institute are given, and the reports of the heads of the various colleges and schools are included. During the past session the Department of Technology registered 4552 classes in the United Kingdom in 331 towns. These classes were attended by 53,999 students; this number represents, however, only a proportion of the total number of students in attendance at courses of technical instruction largely influenced by the work of the department. The examinations of the department were held in seventy-five technological subjects, for which 22,111 candidates were presented in the United Kingdom alone. While the total number of candidates shows a decrease on the number for 1911, the proportion of passes in the examinations has, on the contrary, risen by 4 per cent., which suggests that the fall in the number of candidates is largely due to the exclusion of a number of insufficiently prepared students from the examinations.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 19.—Sir Archibald Geikie, K.C.B., president, in the chair.—Sir James **Dewar**: Atomic specific heats between boiling points of liquid nitrogen and hydrogen.—I. The mean atomic specific heats at 50° absolute of the elements a periodic function of the atomic weights.—Hon. R. J. **Strutt**: An active modification of nitrogen produced by the electric discharge. V. (1) An improved practical method of preparing and storing nitrogen for the experiments is described. (2) It is shown, notwithstanding criticisms of certain other experimenters, that the presence of traces of oxygen in the nitrogen used is not essential, or even favourable, to the phenomena. The nitrogen used, purified by cold phosphorus, does not contain oxygen to the extent of one part in 100,000. Passing it over red-hot copper in addition makes no difference. The intentional addition of oxygen does harm; 2 per cent. obliterates the effects altogether. Hydrogen and carbon dioxide as impurities are much less harmful, but traces even of water vapour have a very bad effect. (3) Nitrides are formed by the admixture of active nitrogen with vapour of mercury, cadmium, zinc, arsenic, sodium, and sulphur. These are decomposable by water or potash solution, yielding ammonia. (4) Carbon disulphide yields a blue polymeric nitrogen sulphide, and polymeric carbon monosulphide. Chloride of sulphur gives ordinary yellow nitrogen sulphide. Stannic chloride and titanium tetrachloride also yield solid products. In the latter case nitrogen was proved to be present. (5) All organic compounds tried, except carbon tetrachloride, yield hydrocyanic acid freely, but not cyanogen, as was proved by chemical tests. When chlorine is present, cyanogen chloride is formed. Benzene yields (almost certainly) cyanobenzene. (6) The intensity of the cyanogen spectrum with organic compounds is no index of the quantity of hydrocyanic acid being formed. Preponderance of the red cyanogen bands is associated with cyanogen chloride or bromide. On a general view of the evidence, there does not appear to be any definite connection between the development of spectra by active nitrogen and the chemical actions in progress.—Dr. J. A. **Harker** and Dr. G. W. C. **Kaye**: The electrical emissivity and disintegration of hot metals. Preliminary experiments have been carried out on the volatilisation and electrical emissivity of a number of metals, mostly in nitrogen at reduced pressures. The metals were heated by alternating current and no applied potential was employed. (1) The emission of positive electricity occurs at temperatures from about 1000° to 1400° C. For metals which melt within this range, a sudden and marked increase in the positive current often occurred at the liquefying point—due, probably, to the sudden release of occluded gas. (2) Oxygen appears to augment the positive current. (3) At higher temperatures, negative electricity predominates and increases rapidly with the temperature. The negative current attained with iridium at the melting point was 80 milliamperes, with tantalum at 1670° C. 220 microamperes, with iron at the melting point 90 microamperes. In the case of carbon in air at atmospheric pressure, an ionisation current of $3\frac{1}{2}$ amperes was obtained. (4) The negative current at moderate pressures appears to be largely increased if the conditions are such that considerable sputtering of the metal occurs. (5) The negative currents are probably a consequence of chemical reaction between the metal and the surrounding gas. (6) Carbon becomes plastic in the neighbourhood of 2500° C. At such temperatures it also readily sublimes.—Dr. A. O. **Rankine**: A method of measuring the viscosity of the vapours of volatile liquids, with an application to bromine. In this method of determining viscosities the rate of transpiration of the vapour through a capillary tube is controlled by the vapour pressures of the liquid itself, a difference of pressure being established in the process of virtually distilling the liquid through the capillary. The pressures can be estimated without the use of mercury gauges—a state of affairs especially desirable in the case of the halogens. The viscosities of unsaturated bromine vapour over the approximate range 10° C. to 250° C. have been measured, and, except at the lowest temperatures, are found to agree well with Sutherland's formula, not-

withstanding the fact that all the temperatures are below the critical.—E. E. Fournier **d'Albe**: The efficiency of selenium as a detector of light. The efficiency of a selenium preparation used as a detector of light is defined as the amount of additional conductivity imparted to it by the unit of incident light. Since many factors affect the efficiency of a given selenium bridge, standard conditions are chosen, chief among them being an illumination of one lux. The law of light action is studied, and the total effect is shown to be proportional to the square root of the incident energy, while the instantaneous effect is proportional to the energy. This is verified down to an illumination of 0·00001 metre-candle. It is shown that selenium is the most efficient light detector known, that it is capable of discriminating minute differences of luminous intensity far beyond the capacity of the eye, and that, with suitable means of detecting minute currents, it should offer a means of testing the quanta theory of light by direct experiment.—A. E. **Oxley**: The Hall effect in liquid electrolytes. Experiments have been made on aqueous solutions of copper sulphate, silver nitrate, cadmium sulphate, and on copper sulphate gel. Each substance was placed in a small cell of glass or mica, and was subjected to a uniform magnetic field. A Paschen galvanometer was used to measure the transverse potential difference. In a uniform magnetic field this transverse potential difference is due partly to a true Hall effect (depending on the difference of the ionic mobilities), and partly to a concentration Hall effect (depending on the sum of the ionic mobilities). The latter effect is primarily the one which has been measured in this research, and the former, which is smaller, is included. Eight experiments have been made, and the transverse potential differences, which changed sign on reversal of the magnetic field, have been found to agree with the calculated values. The relation between the transverse potential difference and the intensity of the magnetic field, for an aqueous solution of copper sulphate, is linear.—Prof. W. B. **Morton**: The displacements of the particles and their paths in some cases of two-dimensional motion of a frictionless liquid.—S. **Chapman**: The diurnal variations of the earth's magnetism produced by the moon and sun.—Prof. H. A. **Wilson** and Marjorie **Wilson**: The electric effect of rotating a magnetic insulator in a magnetic field.—A. **Hopwood**: The magnetic materials in claywares. The author has found that white, cream, grey, yellow, buff, red, or brown claywares are feebly or moderately magnetic owing to the presence of unfused grains of unchanged ferruginous minerals and fused globules of complex ferruginous silicates; while flashed, brindled, or blue claywares are always strongly magnetic owing to the presence of complex ferruginous silicates and finely disseminated magnetic oxide of iron. The origin of the complex ferruginous silicates in claywares is quite different from that of the magnetic oxide of iron. While the latter is produced either by the orientation of the magnetite, originally present in the clays, or by the reducing action of the kiln gases on the precipitated or colloid oxides, hydroxides, or carbonates of iron disseminated throughout the clays, the former are produced by the fusion of the granular or concretionary ferruginous minerals, *i.e.* iron pyrites, siderite, hæmatite, magnetite, biotite, &c., occurring in the clays with the surrounding matrix.—A. **Hopwood** and C. **Weizmann**: Synthesis of the anhydrides of α-aminoacyl glucosamines.—H. S. **Jones**: The flexure of telescope mirror-discs arising from their weight, and its influence upon resolving power.—Prof. W. H. **Young**: Fourier series and functions of bounded variation. In the present communication it is shown that in a number of fundamental theorems the derived series of the Fourier series of a function of bounded variation may take the place of the Fourier series of a summable function, and this even when the function of bounded variation is not continuous, or still less an integral. In particular, the coefficients of such a series may be used as convergence factors, with results which approximate to, or are even identical with, those obtained when the convergence factors are the coefficients of a Fourier series. The use of these convergence factors transforms, in fact, when the function of bounded variation is odd, a Fourier series into a Fourier series, and an allied series into a Fourier series when the function of bounded variation is even.—Prof. W. H. **Young**: A condition that a trigonometrical series should have a certain form. In the present communication a necessary and sufficient condition that a trigonometrical series should have a form in which its coefficients are expressible in terms of Stieltjes integrals with respect to a function of bounded variation is obtained.—Prof. W. H. **Young**: Trigonometrical series the Cesaro partial summations of which oscillate finitely.

PARIS.

Academy of Sciences, June 25.—M. F. Guyon in the chair.—M. **d'Arsonval**: Some remarks on the papers read at the meeting at Toulouse of the Congrès national du Froid.—J. **Guillaume**: The present sun-spot minimum. During the seventy-three days from April 12 to June 23 no spot has been noted on the sun's disc.—A. **Tian**: An experimental determination of the light energy absorbed in a photochemical reaction. A description of a null method based on the use of a thermopile. In the photochemical decomposition of hydrogen peroxide there is no proportionality between chemical action and the energy absorbed, even when the light used contains no infra-red rays.—Jacques **Carvallo**: A photo-electric phenomenon presented by liquid sulphur dioxide. In a preceding communication it has been shown that liquid sulphur dioxide submitted to a constant potential difference between two platinum electrodes is traversed by a current which tends to a constant limit. This phenomenon is sensitive to the action of light: each exposure causes a sudden decrease in the current. The effects have been proved to be due to ultra-violet rays.—Thaddée **Peczalski**: A relation between the law of compressibility of gases and the coefficients of expansion.—André **Léauté**: The high-frequency oscillations in very short electric arcs. From the experiments described a new position is proposed for safety fuses in connection with high-tension circuits.—P. Th. **Muller** and R. **Romann**: The electrolytic dissociation of a salt, governed by the mass law. A study of the conductivity of solutions of piperidine cyanacetate. For this salt the ionisation, measured by the conductivity of the solution, is governed by the law of mass action.—Marcel **Boll**: The photochemical decomposition of solutions of oxalic acid in presence of uranyl nitrate. The electrical conductivity measurements showed that the reaction was unimolecular, the solution being illuminated with monochromatic light. The energy absorbed during the reaction is much lower than the quantum of Einstein.—Marc **Landau**: The phenomenon of photocatalysis. All compounds of uranium possess marked photocatalytic properties; there is no relation between the values for the photocatalytic power and the radioactive power of these compounds. Catalysis takes place even when the uranium compounds used as catalysers are insoluble.—E. **Rengade**: The melting points, specific heats, and heats of fusion of the alkali metals. Measurements of these three constants are given for sodium, potassium, rubidium, and

cæsium. The value of L/T was about 1·68 for all four metals.—Léon **Guillet** and Victor **Bernard**: Variations of the resilience of copper and of some of its alloys as a function of the temperature. Curves are given for copper, six brasses, cupro-nickel, German silver, and two aluminium bronzes.—René **Dubrisay**: The neutralisation of chromic acid.—Paul **Pascal**: Remarks on the additivity of the physical properties in the organometallic series.—A. **Colani**: Study of the chloro-oxalate of thorium.—J. B. **Senderens**: Oxidation of the alcohols under the influence of heat alone. Ethyl, *iso*butyl, and *iso*amyl alcohols are rapidly oxidised by air at temperatures between 380° C. and 450° C. Ignorance of this fact has led to catalytic properties being erroneously assigned to certain substances.—G. **Favrel**: A new series of *iso*pyrazolones.—G. **André**: The relation of the mineral acids and bases in plant tissues.—C. **Gerber**: The latex of *Ficus coronata*, an incomplete plant pancreatic juice, without amylase, and with proteolytic diastase predominating. Comparison with *Ficus carica*.—De **Gironcourt**: The Gironcourt Expedition, 1908–9. The botanical results. Specimens were collected in Dahomey, Nigeria, Togo, and the Gold Coast.—Paul **Dop**: The cytology of the micropylar suckers of the albumen of *Veronica persica*.—M. **Guilliermond**: The formation of anthocyan in the middle of the mitochondria.—E. **Michel-Durand**: Variations in the carbohydrates of leaves in the course of development.—L. **Bordas**: Anatomical and histological considerations on the Malpighian tubes of some Orthoptera.—L. **Léger** and O. **Duboscq**: The evolutive cycle of *Porospora portunidarum*.—J. **Bridré** and A. **Boquet**: Anticlavelous vaccination with sensitised virus. Duration of the immunity: applications to vaccination.—A. **Trillat** and M. **Fouassier**: The contamination of milk by the typhoid bacillus through water. Milk is an extremely favourable medium for the development of the typhoid bacillus.—R. **Fosse**: The detection of urea in plants. Urea can be precipitated by xanthydrol in plant extracts, heating or concentration of the solution being unnecessary.—L. **Lagane**: The action of hydrogen peroxide on the amylase of human milk.—H. **Guilleminot**: The law of the biological action of filtered and non-filtered X-rays.—Carl **Renz**: The discovery of the Trias and the Jurassic in the Kopais Mountains (Central Greece).—J. **Vallot**: The velocity of glaciers in winter. The velocity of a glacier is the same in winter and summer.

BOOKS RECEIVED.

Das Radium und die Radioaktivität. By Dr. M. Centnerszwer. Pp. 96. (Leipzig and Berlin: B. G. Teubner.) 1.25 marks.

Protective Inoculation against Cholera. By W. M. Haffkine. Pp. 98. (Calcutta: Thacker, Spink and Co.; London: W. Thacker and Co.) 3 rupees, or 4*s*. 6*d*. net.

L'Aviation. By Prof. P. Painlevé, Prof. E. Borel, and C. Maurain. Sixième édition. Pp. viii+298. (Paris: F. Alcan.) 3.50 francs.

Geologischer Führer in die Umgegend von Halle a.d.S. By Prof. H. Scupin. Pp. viii+142. (Berlin: Gebrüder Borntraeger.) 2.60 marks.

Text-Book of Zoology. By H. G. Wells and Dr. A. M. Davies. Seventh Impression (sixth edition). Revised by J. T. Cunningham. Pp. viii+487. (London: W. B. Clive.) 6*s*. 6*d*.

Geological Survey of Alabama. Monograph 8: Economic Botany of Alabama. Part i., Geographical Report on Forests. By R. M. Harper. Pp. 228. (Alabama: The University.)

Elementary Tropical Agriculture. By W. H. Johnson. Pp. xi+150. (London: Crosby Lockwood and Son.) 3*s*. 6*d*. net.

The British Bird Book. Edited by F. B. Kirkman. Section XI. Pp. 189–404+plates. (London and Edinburgh: T. C. and E. C. Jack.) 10*s*. 6*d*. net.

A Laboratory Guide to the Study of Parasitology. By W. B. Herms. Pp. xv+72. (London: Macmillan and Co., Ltd.) 3*s*. 6*d*. net.

The Chemistry of Rubber. By B. D. Porritt. Pp. vii+96. (London: Gurney and Jackson.) 1*s*. 6*d*. net.

Orthopædics in Medical Practice. By Prof. A. Lorenz and Dr. A. Saxl. Translated by Dr. L. C. P. Ritchie. Pp. xvi+288. (London: J. Bale, Ltd.) 7*s*. 6*d*. net.

DIARY OF SOCIETIES.

FRIDAY, JULY 4.

GEOLOGISTS' ASSOCIATION, at 8.—A Geological Reconnaissance on the East Coast of the Victoria Nyanza: Dr. Felix Oswald.

MONDAY, JULY 7.

ARISTOTELIAN SOCIETY, at 8.—Annual Meeting.—The Philosophy of Probability: Dr. A. Wolf.

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