THURSDAY, JUNE 27, 1912.

JOHN VIRIAMU JONES AND OXFORD MEMORIES.

John Viriamu Jones, and Other Oxford Memories. By Prof. E. B. Poulton, F.R.S. Pp. xiii+339. (London: Longmans, Green, and Co. 1911.) Price 8*s.* 6*d.* net.

AT first glance this beautiful book, in Welsh "white and green" and "true paper," is but an interesting miscellany, and such a superficial impression blunts the edge of about the only criticism which a careful perusal of the book suggests, namely, that as a biography of Viriamu it is sketchy and incomplete. But then the title prepares the reader for such an impression. In chapters i.–v. a "burning and a shining light" is faithfully portrayed; in chapters vi.–x. we have memories of the Oxford Union, of George Rolleston, "Many Memories," and "Oxford Reform and the British Examination System"; and there are five appendices, one of which, "John Viriamu Jones and the University of Wales," by Sir Isambard Owen, is, in Prof. Poulton's words, "an admirable account of the absolutely essential part taken by Viriamu in the foundation, and in guidance during the critical earliest years, of the University of Wales" (p. viii.).

The present writer understands that materials for a fuller biography of Viriamu are being collected. Apart from his scientific achievements, the story of his strenuous life in Cardiff should by all means be recorded in full, but that could not imply the slightest reflection on Prof. Poulton's work. So far as it extends, he has given us a scientific biography, which, in every respect, fulfils the requirements of a scientific production. It is, as every good work must be, a labour of love ("the dearest of all the dear friends given to me by Oxford"); the materials were carefully sifted and facts verified by every available means; "the impressions and memories of many men" were combined and compared; and the whole was submitted to "the searching and critical inspection of many eyes." "If only the representation be true, I have gained the beginning and the end of my desire" (p. vii.).

The first chapter is an important study in heredity. Viriamu is remembered to have once observed: "Can acquired characteristics be transmitted? Given a child from birth, transplant it from a cottage to a palace—will the peasant child be absolutely the creature of his environment, except for some physical resemblance to the parents?" The author adds: "The problem as thus stated omits an essential thought. That 'physical resemblance to the parents' would include hereditary faculty and power of every kind" (p. 12). In spite of the disjunction of the phrases, the correction seems to be of the highest importance. We are further given the author's own position in such a discussion. "I wish to guard against misconception. I have tried to weigh against each other the two mighty sets of causes which together control the destiny of every human life. I have concluded that the hereditary material is weightier than the influence of surroundings, the 'inherent' equipment than the 'acquired' training which is bestowed upon it. But this conclusion is no justification for the criminal folly of neglecting the environment of the developing individual" (p. 13). "The most complete results will ever be attained when there is harmony and co-operation between the two great sets of forces by which life is moulded—when inherent tendency is fostered by special and carefully chosen education" (p. 16).

The author has earned the gratitude of men of science by writing a monograph (chapter viii.) on George Rolleston, Linacre Professor of Human and Comparative Anatomy at Oxford, 1860–1881. He has supplied a deficiency which the late Sir John Burdon Sanderson indicated to the author in his words to him shortly before his death: "It is a pity that none of Rolleston's pupils have written their impressions of him." The reader is given ample proofs of the author's characterisation of Rolleston as "the most stirring personality it was my lot to know."

The apparently disconnected contents of the book have their point of unity in the author himself. He deals throughout with influences that have been brought to bear upon his own life, and the autobiographical details are most welcome. On the delicate subject of co-partnership or part-ownership in scientific discovery, a truly beautiful object lesson is given in the author's account of his relations with the late Dr. W. K. Parker, when the former first observed the "true teeth" of the Ornithorhynchus (pp. 237–241).

The book is replete with gems of wit and anecdote. The story which enshrines a gifted German's view of an examining university as a place where students are first examined, and afterwards taught, is exquisite, and should be read in the original. J. G.

THE HAIR OF MAMMALS.

Tierhaaratlas. By Dr. Hans Friedenthal. Pp. 19+xxxv plates. (Jena: Gustav Fischer, 1911.) Price 40 marks.

AN account has already been given in NATURE of the important monograph on human hair by Dr. Hans Friedenthal, which was published in

the form of four large profusely illustrated volumes in 1908. In that work instructive comparisons were instituted between the distribution and structure of the hair in man and a series of primates. The present volume may be regarded as an amplification of the comparative data that were set forth in the work of 1908, and an extension of its scope to include the mammalia as a whole.

The mode of its origin is reflected in every page of this atlas, which deals very fully with monkeys and lemurs, and is rich in references to peculiarities of hair-arrangement that resemble or differ from the conditions that obtain in man.

Of the first twelve excellent coloured plates, eight represent primates and the rest illustrate the variability of the hairy covering in one species (the pig) and in a series of mammals, either especially rich or poor in hair, or presenting peculiarities in its arrangement or structure.

There are twelve uncoloured and four coloured plates, containing a great multitude of figures, showing upon a greatly enlarged scale the appearance of the surface of the hair-shaft in representatives of all the mammalian orders; two plates showing peculiarities in the disposition of the boundary-lines between hairy and hairless skin, the arrangement of hair in tufts, and the distribution of tactile hairs; and finally five plates representing the forms of hair and hair-like structure in a wide range of animals and plants.

Although there are only a page and a half of preface, and less than two and a half pages of text, this volume is replete with curious and valuable information, much of it freshly garnered by Dr. Friedenthal, which sheds instructive light upon the problems of kinship amongst mammals and upon phylogeny. Most of this knowledge is packed into the concise descriptions of the illustrations and does not relate exclusively to hair, but also to such matters as proportions of the body and the state of development of hands and feet, which are important distinctive features among the primates.

That the information supplied by the texture of the hair is of real value as an indication of kinship is demonstrated by the agreement between the conclusions reached by Dr. Friedenthal in this treatise and those set forth recently by comparative anatomists as the result of investigations upon the structure of the nervous, muscular, skeletal, and other systems. The resemblance of the hair of Tarsius to both lemurs and apes is a case in point; and at a time when it is beginning generally to be recognised that the old-world apes and man in the course of their evolution must have passed through a platyrrhine stage of development, which in turn had followed on a prosimian (Tarsius-like) stage, it is peculiarly interesting to find that "Callithrix and the morphologically very lemuroid Brazilian Nyctipithecus have hair of the prosimian type, quite unlike the hair of the other families of apes" (p. 7).

Fresh evidence is adduced to strengthen the conviction that the gorilla is man's nearest relative amongst the apes.

Dr. Friedenthal has devoted special attention to the tactile- (so-called sinus-) hair, which he regards as phylogenetically older and more stable than the covering-hair. For instance, the sinus-hairs in the lips and eyebrow region persist in mammals which become otherwise hairless. It is one of man's distinctive features that he has lost his sinus-hair.

This volume is not only a valuable work of reference, but also a suggestive addition to our knowledge of mammalian kinships.

G. ELLIOT SMITH.

A FLORULA OF SÃO PAULO.

Flora der Umgebung der Stadt São Paulo in Brasilien. By Prof. A. Usteri. Pp. 271. (Jena: Gustav Fischer, 1911.) Price 7 marks.

THE author of the book was for several years professor of botany in the Escola Polytechnica at São Paulo in Brazil. Transferred from his native mountains of Switzerland to a country and a flora so foreign in every way, he naturally looked out for a handy book to make himself familiar with the plant life of the field of his new activity, and not finding anything that would meet his requirements, he resolutely set to work to supply the thing needed. A census of the flora of the district was obviously the first object to aim at; but being a pupil of Carl Schroeter, of Zurich, he was not content with a dry list of plant names, and so ecological and phenological observations formed from the beginning as much part of his field work as collecting.

The area chosen for his botanical survey was small—deducting the ground occupied by the town of São Paulo, not much more than half of that of the County of London—and in so far within the limits of the powers of a single man whose ordinary duties claimed much of his time. But the absence in São Paulo of an adequate library and a trustworthy herbarium for comparison was a serious obstacle. In fact, the author had to be contented mainly with collecting material and notes, in the hope of being able to work them out

after his return to Europe, and when he eventually returned, he had the good sense to draw liberally on the co-operation of specialists for the naming of those of his plants which he could not readily determine himself during a few months' stay at Kew.

Thus this catalogue of plants of São Paulo, which is worked into a key after the model of Schinz and Keller's "Excursionsflora der Schweiz," may be relied upon as fairly correct, and as it contains nearly 900 species of phanerogams and vascular cryptogams, also as not very far from complete. It is written in terse, technical Latin, and occupies pages 109–261. There are some 40 figures interspersed through the text of this part. They are plain, clear, outline drawings; but the reason of their selection is not always obvious, and, on the whole, one can only regret that there are not more of them and in the right places.

This florula of São Paulo is preceded by chapters on the history of the town of São Paulo, the climatology, orography, and geology, the plant formations and cultivations, and the phenology of the district, and a special description of the Jaragua, an isolated mountain 1000 metres high, and about 15 kilometres to the north-east of São Paulo, and therefore actually outside the district. Most students will find these chapters the most interesting part of the book. They contain a clear account of the vegetation, its formations and floral composition, and the external factors governing it, and are well supported by some twenty good reproductions of photographs, showing characteristic types of scenery, and by a coloured map of the district. Not the least merit is in the brevity and conciseness of the descriptive text, which occupies space equivalent to not more than twenty-four pages out of 100, the rest being taken up by unavoidable lists, illustrations, and a very extensive bibliography. The last might, indeed, have been curtailed a great deal, and, to the advantage of the appearance of the text, relegated to the end of the book.

It cannot be said that the flora of São Paulo contains any features of engrossing interest either as to wealth or specialisation. Apart from a small primary forest of *Araucaria brasiliana*, all the woods of the district are of secondary growth, and more or less of the nature of xerophilous or hygrophilous bush; but the principal formations are savannah (campos) and high- and low-moor. The latter two are the subject of an especially interesting comparison with analogous types in Switzerland.

O. STAPF.

PHYTOGEOGRAPHY.

(1) *Pflanzengeographische Wandlungen der deutschen Landschaft.* By Prof. H. Hausrath. Pp. vi+274. (Leipzig and Berlin: B. G. Teubner, 1911.) Price 5 marks. "Wissenschaft und Hypothese," xiii.

(2) *Die Pflanzenwelt Dalmatiens.* By Prof. L. Adamović. Pp. vi+137+72 plates. (Leipzig: Dr. Werner Klinkhardt, 1911.) Price 4.5 marks.

(3) *Einführung in die Tropenwelt.* Erlebnisse, Beobachtungen und Betrachtungen eines Naturforschers auf Ceylon. By Dr. K. Guenther. Pp. x+392. (Leipzig: Engelmann, 1911.) Price 4.8 marks.

(1) THE phytogeographical changes in German scenery since the glacial periods and how these were wrought is the subject of Dr. Hausrath's investigations. He adopts Graebner's classification of plant-formations and discusses their composition, developments, and the increase and decrease, as the case may be. Geological changes are only taken into account in so far as they have exercised an important influence on the character of the vegetation. Unfortunately the author does not give a summary of the results of his investigations; but the further he carried them the stronger was his conviction, he states, that man has been the principal agent in bringing about the changes which have taken place within the current geological epoch. Much of the space is devoted to this aspect of the question, and the history of the cultivation of the land from Neolithic times to the present day is briefly sketched, and its influences traced.

The changes in forest areas within historic times, from the Roman domination to the nineteenth century, are highly interesting and instructive, especially in relation to the changes effected during the nineteenth century and since 1878. The decrease of the forest area in the whole of the districts of Germany since 1878 is given as 164,611·3 hectares, and the increase during the same period as 287,553·7. Contrary to what might have been expected the forest area increased during the Thirty Years' War. The total forest area of Germany in 1878 was 13,872,926·1 hectares, and in 1900, 13,995,868·5. There are also interesting statistics of the peat moors of Germany. The total area is estimated approximately at 2,300,000 hectares and the average thickness at 3 metres, thus giving a stock of 69,000,000,000 cubic metres. The production of coal in Germany in 1909 amounted to 175,000,000 tons, the heating value of which is calculated as equal to 350,000,000

tons of peat, so that as a substitute for coal the peat would suffice for only 37·4 years.

(2) Dalmatia is not a country of flowery meadows and shady forests, but Prof. Adamović has succeeded in producing a series of very attractive pictures of its vegetation by means of pen and camera. "The majestic beech, the shade-giving maple, the fragrant lime, the trembling aspen, the giant poplars, the noble pines, and the gloomy firs, and especially the gay meadows with all their wealth of many-coloured flowers disappear entirely from the wild shores of the Adriatic." But the absence of all these charms in scenery is compensated for by the presence of a fullness of natural beauties of a peculiar character.

The principal attraction of Dalmatian vegetation is the rich development of the essentially Mediterranean flora, "consisting largely of evergreen elements bearing brilliantly coloured flowers and filling the air with aromatic fragrance." The climate is so mild that vegetation is never at a standstill, and there are characteristic flowers of all seasons. The author opens with an introduction on the conditions of vegetable life in relation to geographical position, climate, environment, &c., followed by sketches of the natural associations or formations.

There is also a chapter on the economic vegetable products of the country, both wild and cultivated. The cultivation of the grape-vine is at the present time the most extensive and the most important industry of Dalmatia, both on the mainland and in the islands. From the earliest times, the author asserts, Dalmatia has been essentially a wine-producing country, and it is now almost the only country in which the original varieties still partially survive. Some further highly interesting details of this industry are given. Altogether this is a most interesting little book, effectively illustrated, on a small scale. The illustrations are partly scenic, and partly of plants or parts of plants, natural size.

(3) The English of the title of Dr. K. Guenther's book is: "Introduction to the Tropics: Experiences, Observations, and Considerations of a Naturalist in Ceylon." It is a plain narrative of a six months' trip to and through Ceylon written in an easy style, intelligible and interesting to readers of little knowledge in natural history. Indeed, it may be described as an excellent supplement to the ordinary guide-book, containing much useful practical information in addition to observations on the physical features, natural productions, peoples, government and history of the island.

The personal element is, perhaps, unnecessarily pronounced; and there is little real novelty. Comparing the vegetation of Europe with that of Ceylon, the author arrives at the well-known appreciation that there is a glory of the temperate flora, and another glory of the tropical flora, and that each has beauties and features finding no exact counterpart in the other. Dr. Guenther is an enthusiast in nearly all that relates to Ceylon, which he justly appraises as a gem in the British Empire; and he was greatly struck by the tactful administration of justice practised by the rulers in cases of native disputes and misdemeanours. He also describes the eating and drinking, including the "breakfeast" instead of the breakfast—an important difference! The illustrations, though on a very reduced scale, are elegant and chiefly scenic, in which vegetation is the principal feature.

W. B. H.

BOOKS ON BIO-CHEMICAL SUBJECTS.

(1) *Modern Theories of Diet and their Bearing upon Practical Dietetics.* By Dr. Alexander Bryce. Pp. xv+368. (London: Edward Arnold, 1912.) Price 7*s.* 6*d.* net.

(2) *Principles of Human Nutrition: a Study in Practical Dietetics.* By W. H. Jordan. Pp. xxi+450. (New York: the Macmillan Company; London: Macmillan and Co., Ltd., 1912.) Price 7*s.* 6*d.* net.

(3) *Milk and the Public Health.* By Dr. William G. Savage. Pp. xviiii+459. (London: Macmillan and Co., Ltd., 1912.) Price 10*s.* net.

(4) *Probleme der physiologischen und pathologischen Chemie.* By Prof. Dr. Otto von Fürth. 1. Band—"Gewebschemie." Pp. xv+634. (Leipzig: F. C. W. Vogel, 1912.) Price 16 marks.

(1) DR. BRYCE has written a very readable treatise, in which the principles of diet are explained in a simple way. The early chapters on metabolism deal with the subject from the physiological point of view, but those that follow discuss the matter from the practical aspect, and will doubtless attract more attention. Among other subjects discussed are the various "fads" current at the present day, such as Chittendenism, Fletcherism, vegetarianism, the "no breakfast" and fasting cures. Each of these is examined in its turn in the cold light of scientific knowledge. Each may have its special value in certain cases. Dr. Bryce is not an extremist either way; his main theme is, however, to urge greater simplicity in diet than is at present practised by well-to-do people, and his attitude towards those who believe in Chittenden's views or are vegetarians is distinctly sympathetic.

(2) Mr. Jordan, whose title-page is almost identical with Dr. Bryce's, barring the names of author and publisher, is well known as the director of the New York agricultural station and the author of a great deal of original work, particularly on the feeding of stock. His book is evidently written not for the scientific specialist, but for the ordinary man of education who possesses also practical common sense. His account of his subject, though marred by American spelling, is admirably clear, and illustrated by a number of well-chosen diagrams and pictures, especially in the preliminary portion, which deals with the physiology of the digestive organs. His bias is distinctly unfavourable to an acceptance of Chittenden's views on diet. A large amount of space is devoted to the consideration of milk, as one would have anticipated from his close acquaintance with the cow. Among other points, one may also allude to his timely protest against the use of antiseptics and preservatives in milk and other forms of food. In America the laws relating to this form of adulteration are much more stringent than they are with us.

(3) The third book on our list deals exclusively with milk, and is from the pen of Dr. Savage, the well-known bacteriologist, and at present medical officer of health in the county of Somerset. He therefore writes with authority, and describes the present evils in the collection, storage, and transport of this precious foodstuff which it would be well for the public at large to ponder on, and subsequently act upon. Until the question of this gigantic evil is taken up vigorously by the voters and recognised as a national problem, we can only fear that the subject will continue to repose in a pigeon-hole, and the Pure Milk Bill, which has been so long promised, will still remain up the sleeve of the President of the Local Government Board.

(4) Dr. Otto von Fürth's book is in quite a different category, being a text-book of physiological and pathological chemistry. The first volume, which is the only one yet published, is entitled "Tissue Chemistry" (Gewebschemie); the second is to deal with metabolism. The author is one who has made the subject his own, and is a prolific researcher. His book is most excellent, and is enriched with a wealth of bibliographical references. It includes what is a new feature in such books—a full account of the large amount of work which has centred around the chemistry of malignant tumours. But it is not only for this that we can recommend its perusal; the whole subject-matter is thoroughly up-to-date, and is presented in a lucid and interesting manner.

W. D. H.

OUR BOOKSHELF.

Traité complet d'analyse chimique appliquée aux essais industriels. By Prof. J. Post and Prof. B. Neumann. Tome Troisième, Premier Fascicule:—Engrais commerciaux, amendements et fumiers. Terre arable et produits agricoles. Air. Huiles essentielles cuir et matières tannantes. Colle. Tabac. Caoutchouc et gutta-percha. Matières explosives et allumettes. Pp. 468. (Paris: A. Hermann et Fils, 1912.) Price 15 francs.

THE second French edition of Post and Neumann's work will comprise three volumes, and the particular part now under notice is the first fascicule of the third volume. The translators have not confined themselves to translating; they have made additions freely wherever the German text seemed to require it. For example, in the section on the analysis of fertilisers about one-half is interpolated matter, chiefly accounts of processes adopted by the Comité des stations agronomiques et des laboratoires agricoles de France, which are regarded as "official" methods in that country. Thus the book indicates what is regarded as the best practice in both France and Germany.

Of such a work, close-packed with analytical details from cover to cover, it must suffice to speak in general terms. For readers not familiar with it, the scope of the work will be shown best by an outline of one of the articles. Taking, therefore, the section on rubber as an instance, we find first a short description of the latex and of the composition and properties of raw rubber; then follow some half-dozen of the most approved processes for the analysis of the raw product, including Harries's "nitrosite" method as improved by Fendler, and the tetrabromide method proposed by Budde, with Pontio's modifications. Coming next to vulcanised rubber, Weber's process for the qualitative examination is described, while for quantitative work two schemes of procedure are drawn up, one by Pontio and the other by Dr. Herbst, the writer of the section. Finally, manufactured rubber is dealt with from the point of view of the mechanical, physical, and chemical tests to which it should respond if it is to be suitable for a particular purpose.

Mutatis mutandis, the other sections are treated in similar comprehensive fashion. The selection of analytical methods appears to be generally good, and the present writer, in testing the descriptions here and there, has come across no error of importance.

C. S.

Prehistoric Japan. By Dr. Neil Gordon Munro. Pp. xvii+705+numerous illustrations in text. (Yokohama: [Publisher's name not given]; Edinburgh: William Bryce, 1911.) Price 24*s.* net (12 yen).

DR. NEIL GORDON MUNRO has been well known for a good many years to all interested in things Japanese as an earnest and industrious student and investigator in the field of the archæology of the Land of the Rising Sun, and his book will be welcomed as a substantial contribution to the subject. It was published in

Japan fully four years ago, but most of the copies of it were destroyed in a fire, and reprinting has been delayed through the author's absence and pressure of other work. It is now available to students of archæology in this country, and they will find much in it which affords an opportunity for the comparative study of archæology in Japan and other countries in the East and the West.

It is interesting to note that there are now a considerable number of Japanese workers in the field of archæology, and to them Dr. Munro gives thanks for assistance in his work. The Imperial University of Tokyo and the Imperial Museum have now very interesting collections, and many valuable papers on anthropology appear in the Tokyo *Anthropological Magazine*, the *Archaeological World*, and in the Transactions of the Asiatic Society of Japan. Dr. Munro has taken full advantage of these, but his book is no mere compilation, but owes a great deal to his own investigations. It treats of the Palæolithic phase, the Neolithic sites, habitations, implements and utensils, weapons, ceramic art, diet, dress, and social relations, in each of which a great deal of interesting information is given. The earliest forms of religion in Japan are discussed, and many suggestions occur to students of comparative religion.

The concluding chapter deals with the prehistoric races, and shows that these, as certain remains testify, formerly possessed the west and the south, but were compelled to retreat by the pressure of the alien Yamato, and they are now represented by the Ainu, the sole survivors of the primitive inhabitants. The Japanese people, according to Dr. Munro, are a mixture of several distinct stocks. Negrito, Mongolian, Palasiatic, and Caucasian features more or less blended, sometimes nearly isolated, are met with everywhere. The book may be regarded as a cultural history of the Ainu and of their conquerors, and it forms a very valuable supplement to the many popular books about Japan which have appeared in recent years. H. D.

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.]*

Forced Vibrations.

WHEN a system capable of natural vibrations is acted upon by forcing influences, it is usually supposed that the amplitudes of forced vibration will be greatest when the forcing influences are in tune with the natural vibrations. If there is no damping or corresponding loss of energy this is correct, but when there is such loss of energy it is incorrect.

I do not know if this has been taken into account in spectrum analysis, or with what care measurements have been made in comparing the bright lines of a gas with the dark absorption lines of the same gas. In wireless telegraphy the tuning of the antennæ ought to be readjusted when the sender becomes the receiver.

Simplest mechanical example. A body of mass M vibrates at the end of a spring of yieldingness h; there is a force of friction b times the velocity. Two methods of forcing vibration may be taken. The other end of the spring may have a varying displacement y from its mean position; or y being 0, the body may be acted on by a varying force F. Let y be $y_0 \sin qt$, or let F be $F_0 \sin qt$. The equation of motion is, using the letter θ for d/dt and x for the displacement of the body,

$$M\theta^2 x + b\theta x + \frac{x}{h} = \frac{y}{h} \text{ or } F.$$

Using $2f$ for b/M and n^2 for $1/hM$, we have

$$\theta^2 x + 2f\theta x + n^2 x = n^2 y_0 \sin qt \text{ or } \frac{F_0}{hM} \sin qt.$$

The frequency of the natural vibration is $q'/2\pi$, where

$$q' = \sqrt{n^2 - f^2} \quad \ldots\ldots\ldots (1)$$

The forced motion is

$$x = \frac{\left(n^2 y_0 \text{ or } \dfrac{F_0}{gM}\right) \sin qt}{\theta^2 + 2f\theta + n^2}.$$

Using qi or $q\sqrt{-1}$ for θ, we see that the amplitude is greatest when $(n^2 - q^2)^2 + 4f^2q^2$ is least, or

$$q = \sqrt{n^2 - 2f^2} \quad \ldots\ldots\ldots (2)$$

The second case is the electrical analogue of the mechanical one. If L is the inductance, R the resistance of a circuit closed on itself in which there is a condenser of capacity K; if v is the voltage across the condenser and c is the current, and if there is a varying E.M.F. e in the circuit.

$$c = -K\theta v = (v - e)/(R + L\theta), \text{ so that}$$

$$\{(R + L\theta)K\theta + 1\}v = e. \quad \text{Using } 2f \text{ for } \frac{R}{L} \text{ and } n^2 \text{ for } \frac{1}{KL}$$

$$(\theta^2 + 2f\theta + n^2)v = e/KL.$$

Making $e = 0$, the frequency of the natural vibration is $q'/2\pi$, where

$$q' = \sqrt{n^2 - f^2} \quad \ldots\ldots\ldots (3)$$

If $e = e_0 \sin qt$, the amplitude of v in the forced case is greatest when

$$q = \sqrt{n^2 - 2f^2} \quad \ldots\ldots\ldots (4)$$

Working out the equation for c we find that the amplitude of c is greatest when

$$q = n \quad \ldots\ldots\ldots (5)$$

If instead of being closed upon itself this part of a circuit containing R, L, and K has the voltage v established between its ends, and if $v = v_0 \sin qt$, the current amplitude is greatest when

$$q = n \quad \ldots\ldots\ldots (6)$$

Let us take another case. Between a point A and a point B we have a coil of resistance R and inductance L, and there is a condenser K parallel with the coil. A current C proportional to $\sin qt$ enters the system at A and leaves at B, dividing into the two parts c_1 through the coil, and c_2 through the condenser. We have $C/c_1 = KL(\theta^2 + 2f\theta + n^2)$. This is a minimum when

$$q = \sqrt{n^2 - 2f^2} \quad \ldots\ldots\ldots (7)$$

A more complex condition makes C/c_2 a minimum. If we regard $c_1 - c_2$ as a circulating current, it may be important to make $C/(c_1 - c_2)$, or $(c_1 + c_2)/(c_1 - c_2)$, a minimum, and for this we find

$$q = n \quad \ldots\ldots\ldots (8)$$

Other simple interesting examples may be given. In every one of these we look for a critical value of q;

we usually say that the forcing influence ought to be in tune with the natural frequency of the system. In every case the natural q is $\sqrt{n^2-f^2}$, but we find the critical q to be either n or $\sqrt{n^2-2f^2}$.

This is probably known to mathematicians, but it is certainly not known to electrical engineers; it is a most important matter for people engaged in telephony, and especially for persons engaged in wireless signalling.

JOHN PERRY.

Inheritance of Paternal Characters in Echinoid Hybrids.

IN the Journal of the Marine Biological Association for October, 1911, we published a "Preliminary Notice on the Experimental Hybridisation of Echinoids." It comprised the results up to date of an investigation which had been carried on at the Plymouth Laboratory during 1909, 1910, and 1911. The forms experimented on were *Echinus esculentus*, *E. acutus*, and *E. miliaris*. Certain characters were studied in the hybrids, which appear in the late larvæ and do not vary in the parental forms. As the result of three years' work, we came to the conclusion that the inheritance of these characters was always strictly maternal.

The work has been repeated this year, but our results differ from those of previous years in several important points. It may, therefore, be of interest to other workers in this field if we give a brief statement of these new results at once.

The outstanding feature of this year's investigation has been the fact that *E. miliaris* eggs, when fertilised with their own sperm, have only been raised with great difficulty to a late stage. In previous years this species has always grown more healthily and developed more rapidly in the laboratory than either *E. esculentus* or *E. acutus*. This fact, we have suggested in our preliminary paper, is possibly due to *E. miliaris* being a shore form, the conditions of growth in the laboratory being more favourable to it than to the other species, which are deep-water forms. This year, however, *E. miliaris* has developed less readily under laboratory conditions than *E. esculentus*, *E. acutus*, or any of the hybrid crosses. Evidently some condition of the environment which was not present in previous years has affected the germ cells of *E. miliaris* this season.

Hybrids between *E. miliaris* ♂ and *E. esculentus* and *E. acutus* ♀ were obtained this season with ease and were, as before, strictly maternal. The crosses with *E. miliaris* ♀, on the other hand, could only be made with the greatest difficulty. Probably, then, it is the eggs and not the sperm of *E. miliaris* which are at fault. The hybrid larvæ in all the cultures of the cross *E. acutus* ♂ × *E. miliaris* ♀ turned out to be strictly paternal and not maternal, as in previous years. With one exception all the cultures of *E. esculentus* ♂ × *E. miliaris* ♀ have also been paternal with regard to the inheritance of the posterior ciliated epaulettes and the green pigment masses. The *E. miliaris* egg this year seems to be unable to transmit its characters to the hybrid offspring, as in previous years. The exception mentioned above was in the case of the only cross between *E esculentus* ♂ and *E. miliaris* ♀, in which a large percentage of the eggs fertilised. In cultures from this fertilisation the hybrids were maternal with regard to the above-mentioned characters. Thus in the only hybrids with *E. miliaris* ♀, in which a large number of the eggs fertilised, we found the usual maternal inheritance.

CRESSWELL SHEARER,
WALTER DE MORGAN,
H. M. FUCHS.
Laboratory of the Marine Biological Association,
Plymouth, June 22.

Taste or Smell in the Laughing Jackass (Dacelo).

WHEN experimenting on the palatability of insects, I have often noticed that birds appear to be able to tell whether an object is nice or nasty by merely holding it between the extreme horny tips of the bill. From this observation I inferred that actual contact with the tongue or soft palate was unnecessary for the purpose.

A case came under my notice to-day, however, which not only strengthened this conclusion, but suggested that some birds at all events are able to ascertain the distastefulness of some insects without actually pecking them. I offered the larva of the small Eggar moth (*Eriogaster lanestris*)—a velvety black hairy grub, ornamented with brown spots and yellow streaks—to a laughing jackass (*Dacelo cervina*). The bird was preparing apparently to take it, but when the tip of his beak was about an inch away, he drew back his head and shook it, and opened and shut his beak, exactly as I have seen birds do when tasting an unpleasant flavour. Every time the caterpillar was presented to him he behaved in the same way, and nothing would induce him to touch it. I repeated the experiment with two examples of *Dacelo leachii* and *Dacelo gigantea*, with precisely the same result.

The birds' behaviour so forcibly suggested a keen olfactory sense that, despite the distance the larva was held from their nostrils, and despite the usually accepted belief that the sense of smell is defective or absent in most birds, I do not know how to emend the keeper's remark, "They don't like the smell of it." It appeared to me, indeed, that they "smelt" the larva with the mouth, if such an expression may be used, and considering the intimate connection in ourselves between taste and smell, I think this explanation is possibly correct, although to me the larvæ individually have no appreciable scent.

A large number of the larvæ of this moth were sent to me for experiment by Mr. F. C. Woodforde, and I was able to try them with many species of birds. There is no doubt that they are, on the whole, unpalatable, but not very highly so. Some of the birds refused to touch them, others pecked them once or twice, others persevered for a long time, beating and shaking them about on the ground, generally giving them up in the end, but in one or two cases eating the mangled remains. None, however, behaved towards them as the laughing jackasses did.

Zoological Society, June 16. R. I. POCOCK.

Rearing Asterias rubens, L.—Larvæ with Double Hydrocœle.

THE note may be of interest that some young *Asterias rubens* have recently completed their metamorphosis here, while others are at present in the stage of sucker fixation.

The successful culture was one of several made by me in April last at the Millport Marine Biological Station, from a good supply of healthy starfish put at my disposal by the Superintendent of the station. All the cultures were taken up to Glasgow that same evening, and two days afterwards the swarming larvæ were transferred to small vessels holding about half a gallon of sea water and provided with an arrangement for securing gentle and continuous internal circulation.

In a week or so, the larvæ were fed with a culture of Nitschia. Two weeks afterwards a considerable number from the best jar were transferred to a second hatching vessel, and, a fortnight later, selected specimens from these were brought into a third vessel of the same type. The result was thus obtained with an expenditure of about two gallons of sea water, although a good deal more was actually employed in

connection with those other cultures which failed of success. I am indebted to one of my students, Mr. Ronald Grant, for much help in the needful manipulations.

Union of the two cœlomic vesicles in front of the mouth took place about the twentieth day, while complete separation of the hydrocœle from the left posterior cœlom was accomplished by the thirtieth day, all the radial pouches being unmistakable before the end of the fifth week. Fixation was observed on the fifty-second day, but it appeared afterwards that one or two specimens must have attached themselves *at least* as early as the middle of the seventh week. Now, in the ninth week, my largest specimen measures 1·75 mm. across the disc, is provided with three or four pairs of sucker feet in each ray, has well-developed eye-spots, and can travel at the rate of an inch in five to seven minutes.

Various abnormal larvæ were observed, the most remarkable being three specimens with double hydrocœle. These were perfectly symmetrical externally, and also internally, except that the left hydrocœle alone was provided with a hydropore. One of them was unfortunately lost, the second was preserved early, while the third reached a length of more than 2 mm. and entered on the stage of attachment. It then presented a remarkable appearance—the two sets of hydrocœle buds appearing as outgrowths on the surface; the arm-lobes arching round the posterior end of the body in the sagittal plane; the hydropore in the mid-dorsal line; the long processes of the ciliated band in great part absorbed; the mouth and œsophagus still open and in functional activity; the internal cavities apparently quite similar on both sides; and the whole as symmetrical as the conventional *dipleurula*, to which indeed the mode of attachment by the preoral lobe and the slanting carriage of the body gave additional resemblance.

As I watched the specimen after it became attached, the brachia, and partly also the sucker, were being used with great activity, and in such a manner that, during the thirty minutes I had it under observation, it travelled four millimetres across the bottom of its dish. When next I had the chance of looking at it, the specimen was detached and somewhat contracted, and fearing that it had suffered injury in the previous manipulation, I preserved it for future work.

It is remarkable that the twenty-five brachiolariæ available for examination provided me with three examples of double hydrocœle. The culture had been made early in the season, at a time when the ovaries were distinctly unripe. It is open to suggest that these facts are directly related to one another, abnormal potencies that are ancestral in their derivation being likely to be strongest in ova hurriedly matured. Under natural conditions, double hydrocœle is apparently so rare in feeding brachiolariæ that it has hitherto escaped record, although, as is well known, MacBride has directed attention to noteworthy instances of its occurrence in Asterina, Ophiothrix, and Echinus (Q.J.M.S., vols. xxxviii., p. 368; li., p. 570; lvii., p. 235). J. F. GEMMILL.

Embryological Laboratory, Glasgow University, June 19.

Clouds and Shadows.

MR. CYRIL CROSSLAND'S description (p. 322) of great shadow bands cast across the sky at sunset interested me, for I well remember being impressed by a similar phenomenon when crossing a New Mexican prairie, with the sun setting behind the Rockies. I have seen the bands in England, but imperfectly. To a non-expert, like myself, Mr. Crossland's remark, "The shadows being cast by the reflected light of the glowing clouds in the west, not by the sun itself, of course," presents difficulties. A mass of glowing cloud seems too extensive a luminous source to cast definite shadows of peaks comparatively near it. Further, the sun being beyond the cloud, the bulk of the sunlight reflected by the cloud would fall the wrong way. Long after the sun's rays are cut off from the spectator, they will still be shining upon clouds high overhead, and therefore able to cast shadows.

If we suppose the shadow rays described to be cast by the sun itself, then it is easy to explain the appearance of the rays converging to the east, which puzzled Mr. Crossland. If the height, above the earth, of the under-surface of the cloudy stratus be roughly uniform, then this surface may be practically regarded as plane so far as it is visible to the spectator. At any rate, the curvature will be small, for the visible portion of the cloud canopy is a very small fraction of the sphere, concentric with the earth, of which it forms part. The sun being practically at infinite distance, the rays of shadow cast by it upon this overhead plane will be parallel, and hence, by the laws of perspective, will appear to converge as they recede from the zenith, or region nearest the spectator, to more distant regions east and west.

Perhaps it is not always realised how far clouds "on the horizon" may be beyond the (terrestrial) horizon. It is quite an interesting little exercise to work out. Assume the earth to be a smooth sphere, and the lower cloud surface a smooth concentric sphere. Let a line be drawn from A, the eye, to touch the earth at B, and produced to cut the cloud sphere at C. We have, roughly,

$$BC^2=(4000+h)^2-4000^2 \text{ miles},$$

h being the height of the cloud above the earth. BC is independent of the spectator's altitude. For a cloud-height of five miles (if I have worked it right) BC is about 200 miles; and for a cloud-height of half a mile, BC is 89½ miles.

The first volume of a great German work on meteorology was devoted to explaining why the popular impression of the form of the sky is that of a flattened vault. If this is the general impression, it has struck me that it may be based on observation of the local cloud canopy rather than of the clear sky. ALICE EVERETT.

Milbourne Lane, Esher.

POLITICS AND SCIENCE.

WE desire to call attention to two lectures delivered by Professor Karl Pearson on March 12 and 19, and now published in pamphlet form (Dulau & Co., Ltd., 1*s*. each). The first is entitled "Tuberculosis, Heredity and Environment," the second, "Social Problems: Their Treatment, Past, Present and Future."

The first lecture contains an account of the recent work carried out at the Galton Laboratory for National Eugenics on the subject of tuberculosis, and it is deeply to be deplored that the evidence therein contained was not made public before the Insurance Act scheme for spending vast sums of money on sanatoria was formulated. It is not too much to say that Prof. Pearson's work must revolutionise our ideas on the subject.

Briefly stated the results go to show that, at present, the influence of infection in the actual spread of the disease is small. The infection is so wide-spread that practically all the urban popu-

lation are exposed to it, while only those with hereditary liability contract the disease in a severe form.

We should expect that infection would be very active between husbands and wives, and between them greatest in the poorest class, where the chances of isolation are least. Yet in that class there is no correlation of disease in husband and wife, and in the professional class the correlation only rises to 0·28—a value about equal to that for physical characters such as eye colour or stature, where it is clearly referable to selective mating. Thus between husbands and wives there is no clear evidence of infection at all.

Between parents and children, on the other hand, there is clear proof of correlation, while the fact that a tuberculous mother is only very slightly more dangerous to the child than a tuberculous father, and more dangerous only at very early stages of life, shows that the influence of infection, just appreciable in this case, is very small compared with that of heredity.

A study of the death-rates from phthisis shows that, while a fall has been going on since returns were available, that fall was greatest between 1866 and 1891, and has been less marked during the more recent years when the ways of the tubercle bacillus have been known, and the open air treatment become general.

The facts, of which we have given but a few examples, point to a gradual elimination of susceptible stocks by a process of racial selection as the chief cause of the diminished death-rate, and throw doubt on the efficacy of many of the remedies now confidently recommended.

Prof. Pearson's second lecture contains a powerful plea for organised knowledge as a guide to social and legislative action. It gives many horrifying if amusing examples of the mistakes which may follow a reliance on the recommendations of officials, politicians, or philanthropists, who bring to the consideration of social problems no knowledge of biology or modern statistical methods.

THE CULTIVATION OF COTTON.[1]

THIS collection of papers and reports on the subject of cotton, prepared for the most part by writers directly connected with the cultivation of this staple, and in every instance by authorities on the subject, provides a succinct review of the efforts which are being made in the various cotton-growing countries of the world to improve the quality of the product by careful selection of seed, sound methods of cultivation, and increased efficiency in the control of insect pests and diseases due to fungi.

There are only two papers included in the collection. The first of these, by Mr. W. L. Balls, botanist to the Khedivial Agricultural Society, Cairo, deals with the application of Mendelian principles in the breeding of cotton, and bears evidence of careful experiment and critical observation. The second, by Mr. G. C. Dudgeon, at one time inspector of agriculture for British West Africa, is a painstaking attempt to summarise our knowledge of the identity and distribution of the cottons in indigenous cultivation in the British West African colonies. These cottons the writer is able to deal with from personal inspection and with a knowledge obtained at first hand; his paper thus forms a useful supplement to the well-known work on the wild and cultivated cotton-plants of the world which we owe to Sir G. Watt.

From the reference point of view, however, the main value of the work resides in the series of reports dealing with the cultivation of cotton in the United States of America, including in this case also the Sandwich Islands and Porto Rico; in all the British colonies, dependencies, and protectorates; in the colonies of France, Germany, Portugal, Holland, and Belgium, and in a few foreign countries "from China to Peru."

That the reports are not all of equal importance need scacely be said. Foremost in this respect, as in the position which it occupies in the collection, is the report supplied by the United States Department of Agriculture, the intrinsic value of which is enhanced by the provision of an exhaustive list of the publications bearing on this subject which have been issued by that active and well-organised department. The subject of cotton in India is exhaustively discussed by Mr. G. A. Gammie, cotton specialist to the Indian Agricultural Department. Important and full of interest is the corresponding report for the British West Indies forwarded by Dr. F. Watts, the Imperial Commissioner of Agriculture. Interesting and valuable also are the reports by Dr. O. Warburg on cotton in the German colonies; by Mr. W. L. Balls on cotton in Egypt; and by Mr. H. P. Taveira on cotton in the Portuguese colonies.

In alluding especially to these particular reports as perhaps the more important no reflection on the other reports which the volume includes is intended. As a matter of fact, the importance of a particular report depends rather on the area with which it deals than on the form in which it is presented. In this latter regard a high standard has been observed which reflects equal credit on the officers who have supplied the reports and on those responsible for editing them. If not all of equal importance, all the reports are of great value, and the volume in which they appear should prove a useful addition to the many standard works on the subject of cotton. One of the best features of the work is an excellent map of the cotton-growing areas of the world. With all its excellences, however, the work shows one lamentable defect: there is no good general index. The omission to provide this detracts considerably from the value of the collection as a ready work of reference.

[1] International Association of Tropical Agriculture and Colonial Development. "Papers and Reports on Cotton Cultivation." Presented to the International Congress of Tropical Agriculture, Brussels, May, 1910. Supplementary to the general "Report on the Present Position of Cotton Cultivation." By Dr. W. R. Dunstan, F.R.S. Pp. viii+320+map. (Paris: The Association, 34 Rue Hamelin; British Section—London: Imperial Institute, S.W., 1911.) Price 5s.

THE DRIFT ICE OF THE GREAT NEWFOUNDLAND BANK AND ITS DANGER TO NAVIGATION.

THE principal article in *Naturwissenschaftliche Wochenschrift* of June 9 is devoted to a very interesting contribution by Herr Otto Baschin (Geographical Institute, Berlin) to our present knowledge of this subject and of icebergs generally, to which the *Titanic* disaster of April 14 has directed attention. It is pointed out that nowhere do the masses of ice from polar regions advance so far in the equatorial direction as those which frequent the vicinity of Newfoundland. The drift of this ice southwards and eastwards is most active between January and July. About the middle of June the ice-limit begins to recede north-westwards, and after August ice is usually only met with (if at all) on the northern edge of the banks and on the east coast of Newfoundland. Icebergs generally appear later than field ice, but the probability of meeting with both differs considerably from month to month and from year to year, and it may be seen from this article and from the valuable monthly charts issued by our own and other meteorological offices that great bergs may be met with in any month. The chart of the North Atlantic for July issued by the Meteorological Committee states: "The first berg of 1912 was passed on January 7 . . . but ice has been present in the North Atlantic since January 28, 1911."

The region in which ships must probably expect to meet ice lies between long. 40° and 60° W., and the district in which it is most frequent is between 45° and 55° W., and extends southwards to latitude 41° N.; but, as shown in the charts above referred to, icebergs have occasionally been seen in nearly all parts of the Atlantic north of latitude 30° N. Most of these bergs have their origin in western Greenland, being the seaward projecting ends of huge glaciers broken off by the upward pressure of the water. Some of them are of enormous dimensions, of which only about one-seventh part is visible above the surface of the water. The part below water, the so-called "foot" of the iceberg, mostly projects sideways for a considerable distance. To add to the difficulties of navigation between northwest Europe and Canada and the United States, the prevalence of fog is very great, owing to the meeting of cold and warm ocean currents in the vicinity of Newfoundland.

Since the *Titanic* catastrophe, with the view of minimising the risk to shipping, a more southerly route has been agreed upon, in which the meridian of 45° W. is crossed in latitude 38° N. It has been shown by Dr. G. Schott, of the Deutsche Seewarte, to whose work on the subject the author of the article is much indebted, that there is an intimate connection between the east Greenland and Newfoundland ice conditions, and Herr Baschin suggests that useful forecasts might possibly now be issued, based on ice reports received by Iceland cable and by wireless telegraphy, in addition to the notices in the charts above referred to. With respect to the loss of the *Titanic*, he expresses the opinion that the hull of that vessel was ripped by the far-reaching invisible "foot" of an iceberg, resembling to all intents and purposes a sunken reef, and rejects the idea that she collided directly with the visible portion of the berg.

NOTES.

AT the seventy-eighth annual general meeting of the Royal Statistical Society, held on June 18, Prof. F. Y. Edgeworth was elected president for the year 1912–13.

THE Livingstone gold medal of the Royal Scottish Geographical Society has been awarded to Captain Roald Amundsen for his geographical discoveries on his recent expedition to the south pole.

THE Secretary of State for India in Council notifies that no vacancies in the Geological Survey Department are expected to occur during the current year. It is anticipated that one appointment will be made in the year 1913.

MR. JAMES MURRAY has been awarded the Neill prize by the Royal Society of Edinburgh for his paper on Scottish Rotifers collected by the Lake Survey, and other papers on the Rotifera and Tardigrada; and Prof. Alexander Smith the Keith prize for his researches on sulphur and vapour pressure.

WE regret to see the announcement of the death, on June 18, at sixty-three years of age, of Mr. Alexander Knox, map curator of the War Office, and author of a valuable work on "The Climate of the Continent of Africa," published last year by the Cambridge University Press.

A REUTER message from Berlin states that a German expedition to the Arctic, which will endeavour to make the North-East passage, and is expected to last three or four years, will start, under the leadership of Lieutenant Schröder-Stranz, in June, 1913. The Berlin Museum will supply the scientific equipment; and a staff of prominent men of science will accompany the expedition.

WE regret to record the death on June 22, at thirty-nine years of age, of Mr. R. W. C. Shelford, known by his work in entomology, particularly on the Blattidæ, on which he was the leading authority. Mr. Shelford was a graduate of the University of Cambridge, and for a time was curator of the museum at Sarawak. Upon his return to England he became an assistant in the Hope Department of the museum at Oxford, where he did valuable work. He suffered from tuberculosis of the thigh, and had been in a nursing home at Margate since last January.

THE annual exhibition of antiquities discovered during the third season of excavations at Meroë, Sudan, carried on in connection with the Institute of Archæology, University of Liverpool, will be held in the rooms of the Society of Antiquaries, Burlington House, London, W., from July 9 to July 23 inclusive. The exhibition will be inaugurated by the Bishop of

London, and the Earl of Derby will also speak at the opening ceremony.

AT the anniversary meeting of the Reale Istituto Veneto the following prizes were announced:—A botanical prize for 1908–10 (Arrigo foundation), divided between Dr. Augusto Béguinot and Prof. Alessandro Trotter; a prize for the study of higher plant-life in the Venice lagoons (Querine Scampaglia foundation), to Dr. Augusto Béguinot (Padua); a prize under the same foundation to Prof. Domenico Mazzotto (Modena), for a study and experimental investigations on the modern theory of metallic alloys, and a second prize on the same theme to the author of a paper on the quaternary alloys of tin, cadmium, bismuth, and lead.

THE celebration of the jubilee year in the history of the two French reviews—the *Revue Bleue* and the *Revue Scientifique*, the subtitle of which is the *Revue Rose*—was held in Paris on June 12, at the Hôtel Continental. The editors were supported at a banquet by representatives of the Government, Parliament, the University, and the Institute of France; in fact, not only were men of science, artists, and men of letters present, but Parisian society generally united to do honour to the occasion. M. Ch. Moureu, the editor of the *Revue Scientifique*, in speaking in the name of science, dwelt on the advances made in science during the last fifty years, and was followed by M. Lippmann, president of the Paris Academy of Sciences, who referred appreciatively to the work done by our contemporary to assist the spread of scientific knowledge.

THE (biennial) health conference and exhibition was opened at the Royal Horticultural Hall, Westminster, on Monday last, and closes to-day. Among the subjects which have been discussed at the afternoon conferences may be mentioned:—"How to conduct an infant consultation," "the prevention of deafness in children," "schools for mothers," "urban and rural housing," "the necessity for further manual training in public elementary schools," and "the teaching of practical domestic economy in schools: its importance to the nation." Several popular lectures were arranged for the evenings. The first two, for women only, were on "why babies die," by Mrs. Barnes, and "the health of girls," by Miss F. Stacpoole. Dr. C. Porter lectured on healthy homes and domestic hygiene last evening, and to-night Dr. C. W. Saleeby will open a discussion on eugenics and national health.

THE annual meeting of the British Medical Association will be held in Liverpool on July 23–26. The president-elect is Sir James Barr, consulting physician, Royal Infirmary, Liverpool. The president's address will be delivered on July 23. The address in medicine will be delivered by Dr. George A. Gibson, physician, Edinburgh Royal Infirmary, and the address in surgery by Mr. Frank T. Paul, surgeon, Liverpool Royal Infirmary. The scientific business of the meeting will be conducted in twenty sections, which, with their respective presidents, are as follows:—Anæsthetics, Dr. D. M. Buxton; Anatomy, Dr. W. Wright; Bacteriology, Prof. J. Ritchie: Dermatology, Prof. W. G. Smith; Diseases of Children, including Orthopædics, Mr. R. Jones; Electro-therapeutics, Mr. C. T. Holland; Gynæcology and Obstetrics, Prof. H. Briggs; Laryngology and Rhinology, Mr. J. M. Hunt; Medical Sociology, Dr. J. C. McVail; Medicine, Prof. T. R. Glynn; Navy, Army, and Ambulance, Colonel D. Harrisson; Neurology and Psychological Medicine, Mr. L. R. Oswald; Ophthalmology, Mr. E. A. Browne; Otology, Mr. H. E. Jones; Pathology, Prof. W. Hall; Pharmacology and Therapeutics, Prof. W. E. Dixon; Physiology, Prof J. S. Macdonald; State Medicine and Industrial Diseases, Dr. A. K. Chalmers; Surgery, Prof. R. Parker; Tropical Medicine, Prof. J. L. Todd.

BY the death of Prof. Charles André, one of her oldest and most active astronomers, France has sustained a severe loss. Born in 1841, André graduated in 1863, and a year later joined the staff of the Paris Observatory under Wolf. The observation of the transit of Venus, at Noumea, in 1874, afforded him material for a masterly thesis, for his doctorate, on the effects of diffraction in optical instruments. In 1878, two years after being called to the chair of astronomy at Lyons, he journeyed to Utah to observe the transit of Mercury. In 1879 he was appointed director of the newly founded Lyons Observatory, a position which he filled with devoted activity until his death on June 6. Always attracted to planetary studies, André paid considerable attention to the puzzling light-changes of the newly discovered Eros in 1901, and published many notes which considerably assisted in their elucidation. His "Traité d'Astronomie stellaire" and "Les Planètes et leur Origine" exhibit the workings of his vivid imagination ever tempered by the rarer faculty of judicial analysis, attributes which, more recently, enabled him vigorously to defend the Laplacian theory. The influence of his sympathy and example is shown by the fact that many of his assistants have since become directors of observatories, and his death will be mourned by all who were fortunate enough to enjoy personal contact with him.

THE Journal of the Royal Microscopical Society (1912, part ii.) contains the presidential address of Mr. H. G. Plimmer, F.R.S., on certain blood parasites, which records observations on the blood parasites of animals living in the Zoological Gardens, London. A number of filariæ and protozoa were found, many of which are new to science.

A NUMBER of observations are recorded by Prof. Slonaker on the effect of a vegetable diet on the activity, rate of growth, and longevity of the albino rat (Leland Stanford Junior University Publications, 1912). The omnivorous feeders are much more active, perform more work, and live longer than the vegetable feeders, and the effect on general conditions of the body was overwhelmingly in favour of the omnivorous.

DR. H. O. FEISS contributes a paper on the fusion of nerves to *The Quarterly Journal of Experimental Physiology* (v., No. 1). The nerves are caused to fuse

and grow together by crushing with a clamp and tying the crushed portions together with a catgut ligature. The general conclusions are that regeneration and restoration of conductivity take place in both nerves below the scar, as well as conduction of impulses through the scar, both along the original paths and from one nerve to the other. The research opens up further possibilities in the restoration of function in divided nerves by operative treatment.

A SERIES of interesting observations has been made by Mr. L. L. Woodruff on the origin and sequence of the protozoan fauna of hay infusion (*Journ. Exper. Zoology*, vol. xii., No. 2). An infusion of hay allowed to stand shows an extraordinary succession of protozoa, the sequence being Monad, Colpoda, Hypotrichida, Paramecium, Vorticella, and Amœba, the determining factors of this sequence probably being those involving food supply and specific excretory products. It is concluded that these protozoa are derived from the grass, on which, after dew or rain, the various forms may be found—an observation previously recorded by Kent.

"SPECULATIONS with regard to the Simplest Forms of Life and their Origin on the Earth" is the title of Prof. Minchin's presidential address to the Quekett Microscopical Club, which appears in the April number of the club's journal. Prof. Minchin suggests that it is the chromatin-substance which represents the primary living matter, the true material basis of life, and that the cytoplasm is of secondary importance in this respect. Organisms with abundant cytoplasm, such as amœbæ, are probably far from representing the most primitive type of living beings, which may have originated as extremely minute bodies, tiny specks of chromatin.

DR. DUCKWORTH describes an Ashanti skull with defective dentition (*Journ. Anatomy and Physiol.*, xlvi., part iii.). It is that of a young adult in which the upper incisor teeth have been removed, evidently in early childhood. This kind of mutilation is characteristically East African, and is met with in crania from rock-hewn tombs in Abyssinia of the fifth century A.D.

WE have received a copy of the fifth edition, published by Mr. Upcott Gill, and revised by Mr. C. J. Davies, of a popular little book, entitled "Fancy Mice," which, we believe, is regarded as the standard authority by breeders of these rodents. The present edition is stated to include the latest scientific information on the subject of breeding for colour, and we notice that the recent theory of the derivation of the Japanese waltzing mice from the wild *Mus wagneri* of China is duly recorded.

IT is not a little remarkable that a distinct difference between the colouring of the British representative of the lesser black-backed gull and the typical Scandinavian bird should have until recently escaped notice. These differences are brought out, with the aid of a photograph, by Mr. P. B. Lowe, in the June number of *Witherby's British Birds*. From this it appears that the species includes the typical Scandinavian or eastern race, with the pale areas of the neck and back dusky, and the British or western race (*Larus fuscus britannicus*), in which the same areas are lighter, the latter extending to the Spanish peninsula, North Africa, and the Azores.

ORNAMENTAL and other trees and shrubs in Illinois are, it appears from the twenty-sixth report of the entomologist of that State, particularly liable to the attacks of insects of various kinds. "Trees which have grown for years . . . begin to weaken and decay, the owner knows not why. This is often due to borers or scale-insects, the presence of which has not been detected or suspected, but whose injuries might have been prevented if the facts had been known in time." To remedy this unsatisfactory state of affairs by making owners familiar with the life-histories of the more destructive species of insects is the object of much of this report, which, although dated 1911, bears no clue as to its place of publication.

THE second volume of the 94th *Jahresversammlung* of the *Verhandlungen der Schweiz Naturfor. Gesellschaft* contains a summary of the results of recent investigations with regard to the former presence of an "Allemannienne" race in Switerland. Examination of a series of prehistoric skulls and skeletons indicates that the ancient Allemanniennes and modern inhabitants of northern Switzerland belong to two widely sundered types, the former being related to the population of Franconia, Moravia, and north-west Germany from the ninth to the fourteenth century. These people were a blonde-haired race resembling in physical characters the modern Swedes. This indicates that while great modifications have taken place since prehistoric times in the population of northern Switzerland and southern Germany, that of Sweden has remained practically in its original primitive condition, so far as the physical type is concerned.

FOR many years past the exact nature of the peculiar tooth-like Palæozoic fossils described as Edestus, Helicoprion, &c., has formed an unsolved puzzle, some ichthyologists regarding these curious structures as forming part of the mouth-organs, while others have regarded them as appendages to the dorsal fins of Palæozoic sharks. A specimen, referable to Edestus, discovered some eighteen years ago in the Coal Measures of Iowa, supplies, according to Dr. O. P. Hay (Proc. U.S. Nat. Mus., No. 1884, vol. xlii., p. 31), the solution of the problem. This specimen is double, comprising an upper and a lower element, and seems to indicate that these structures pertain to the region of the mouth. Both the upper and the lower elements are bilaterally symmetrical, and appear to have been produced in front of the mouth of the shark in such a manner that one worked against the other. Their shafts were produced by the consolidation of a median row of teeth, which gradually became worn out in the fore part of the series in the usual shark-fashion, but the bases of which persisted to form the shaft.

SEISMOLOGISTS will be interested in the article on the Taal volcano in the Philippine Islands and the

account of the destructive eruption on January 30, 1911, which Mr. Dean Worcester, Secretary of the Interior of the Philippine Islands, contributes to *The National Geographic Magazine* for April. The splendid collection of photographs procured at serious risk of life gives a most realistic picture of this great disaster. Even now it is dangerous to approach the neighbourhood of the volcano, and as since the eruption the waters of Bombon Lake have been flowing into the crater, it is well within the limits of probability that the map of Batangas province may at any time be suddenly and materially altered, and the people of Europe and America may again have an opportunity of observing some of the wonderful red sunsets which followed the eruption of Krakatoa. An account of the Taal eruption appeared in NATURE of November 2, 1911 (vol. lxxxviii., p. 12).

THE Swiss Earthquake Commission is one of the oldest bodies established for the observation and registration of earthquakes, it having been founded in 1878 by Profs. Forel, Forster, and Heim, though its actual work began with the year 1880. Dr. J. Früh has recently published a summary of the first thirty years' work, together with a description of the seismological observatory at Zurich (*Verhand. der Schweiz. Naturfor. Gesell.*, vol. i., pp. 57–80). The total number of Swiss earthquakes recorded in this period is 998, or about 33 a year, the annual number ranging from 7 in 1900 to 174 in 1881. The shocks are subject to a strongly marked annual variation in frequency, with its maximum epoch about the end of January. So far as can be judged from a somewhat confused map on which the disturbed areas of more than 200 earthquakes are laid down, earthquakes visit nearly all parts of the country, but seem especially concentrated towards the west and east ends. The disturbed areas seem for the most part to be elongated in the directions of the mountain-chains.

IN a note contributed to the *Atti dei Lincei*, xxi. (1), 7, Prof. G. Peano criticises the ordinary definition of probability, according to which the probability of an event is measured by the ratio of the number of ways in which it happens to the total number of ways in which it either happens or fails. This definition implies the assumption that all the different ways are equally probable, and thus assumes the conception of probability which it is attempted to define. Dr. Peano proposes a symbolic definition in the notation of mathematical logic, which, being interpreted in words, is as follows:—If a and b are classes, and the total number of class a is finite, the symbol $P(b, a)$ denotes the number of a that are b divided by the total number of a.

MANY devices have been proposed for finding the real roots of algebraic polynomial equations by graphical or mechanical methods. A novel form of mechanism based on principles resembling those employed by Lagrange and Sequier is described by Dr. R. F. Muirhead in the Proceedings of the Edinburgh Mathematical Society, xxx. (1911–12). The principle is based on repeated applications of the geometrical construction for a fourth proportional, which enables any polynomial to be built up by suitably varying the segments representing the coefficients. In subsequent paragraphs, Dr. Muirhead describes modifications suitable for solving simultaneous equations. Imaginary roots of an equation of degree n are to be got by finding an appropriate related equation of degree $\frac{1}{2}n(n-1)$; for example, the equation for the squares of the differences of the roots would be useful.

PROF JOSEPH BOWDEN has published a short note read before the American Mathematical Society on the Russian peasant method of multiplication, which is said to be in use in many villages in Russia. The method involves the operations of doubling, halving, and adding, but it requires no use of the ordinary multiplication table. It practically depends on expressing one of the factors in the binary scale of notation and multiplying the other factor by successive doubling. If we want to multiply 45 by 24 we divide 45 repeatedly by 2, obtaining 45, 22, 11, 5, 2, 1, and against these numbers write the successive doubles of 24, thus, 24, 48, 96, 192, 384, 768, then we add together all the terms of the second series standing opposite *odd* numbers of the first series (thus omitting 48 and 384), and their sum is the required product. The rule scarcely needs any further proof, and, we may add, can be used to multiply numbers expressed in Roman numerals.

THE May number of the *Journal de Physique*, published by the French Physical Society, contains forty-five pages of memoirs and thirty-three pages of abstracts of important physical papers which have appeared elsewhere. The first section includes the address by Prof. Poincaré on the relations between matter and ether delivered to the Society on April 11, and that by M. Charles Maurin on recent researches in aërotechnics and aërial navigation. Of the abstracts, sixteen are from the March and April numbers of the *Comptes rendus*, eight from the April number of *The Philosophical Magazine*, ten from the March and April numbers of the *Annalen der Physik*, nineteen from the *Physikalische Zeitschrift* of the same dates, and thirteen from the *Zeitschrift für physikalische Chemie*, from December, 1911, to April, 1912. It is clear from these facts that the *Journal de Physique* keeps the members of the French Physical Society well up to date, not only in regard to its own proceedings, but in matters of interest to physicists which occur in the world outside.

THE Institute of Metals has just published the seventh volume of its Proceedings, a book of 382+ix pages, in addition to which there are twenty-two full-page plates, and a frontispiece reproduced from a photograph of the president of the institute, Prof. W. Gowland, F.R.S. The major portion of the volume consist of a series of papers of scientific interest, which were read at the annual general meeting of the institute held in London in January last, of which summaries appeared in NATURE of January 25 (p. 427). The presidential address dealing with the subject of "Copper and its Alloys in Early Times,"

was summarised in our issue of March 28 (p. 98). In addition to the above papers, the volume contains a report of the proceedings of the Birmingham Branch of the institute, and a valuable series of abstracts of papers.

A SECOND article dealing with Messrs. Whiteley's new premises appears in *The Builder* for June 21. In accordance with modern ideas, old-fashioned methods of sweeping and dusting have been abandoned in favour of vacuum cleaning apparatus, constructed by the Vacuum Engineering Company, Ltd., of London. There are three powerful vacuum machines, each consisting of a turbine vacuum cleaner having a normal capacity of 800 and a maximum capacity of 1800 cubic feet of air per minute. A centrifugal separator collects the dust in a tank, and the air passes away through an exhaust outlet 18 in. in diameter. The main risers are 4 in. in diameter, and have an aggregate length of about 1000 ft.; the horizontal pipes are 5 in. in diameter with an aggregate length of 1200 ft.; all these pipes are of mild steel, of specially smooth interior. There are 104 inlets, to which hose-pipes may be attached; these are distributed at convenient points on the walls of the building. The hose-pipes are of 2-in. internal diameter, and from twelve to twenty-four of them may be in use simultaneously.

MR. JOHN MURRAY now publishes in this country, at 6*s.* net, Dr. L. O. Howard's book, "The House Fly—Disease Carrier: an Account of its Dangerous Activities and of the Means of Destroying it," which was published by the Frederick A. Stokes Co. of New York in 1911. The book was reviewed at length in these columns on January 11 last (vol. lxxxviii., p. 345).

Mr. W. H. HARLING, Finsbury Pavement, London, has issued No. III. of his sectional catalogue of mathematical, drawing, and surveying instruments. This section gives exhaustive particulars and the prices of numerous forms of scales, pantographs, planimeters, and other instruments in constant use by draughtsmen, surveyors and others.

MR. S. A. MCDOWALL'S "Laboratory Notebook of Physics," which was reviewed in the issue of NATURE of May 30 (vol. lxxxix., p. 317), can now be obtained from Messrs. J. M. Dent and Sons, Ltd., in four separate parts. The parts deal respectively with measurement and hydrostatics, heat, light, and magnetism and electricity. The price of part i. is ninepence net, and of each of the others one shilling net.

MESSRS. J. M. DENT AND SONS, LTD., have added to their "Educational Journey" series, a pamphlet of sixty-four pages, by Mr. G. H. Green, entitled a "Nature-study Note-book," the price of which is 6*d.* The booklet is profusely illustrated, and is intended to be of service to young pupils who are fortunate enough to be taken by their teachers for school journeys—an educational expedient which is fortunately becoming increasingly common in this country.

OUR ASTRONOMICAL COLUMN.

THE SPECTRUM OF NOVA GEMINORUM No. 2.—Further particulars of the reported discovery of radium, uranium, and emanation radiations in the spectrum of Nova Geminorum are communicated to No. 4582 of the *Astronomische Nachrichten* by Prof. Küstner.

The plates were taken and reduced by Dr. H. Giebeler, who discusses the peculiar variations of the structure of the several emission and absorption bands of hydrogen, &c., and gives three curves showing the relative intensities of the bands and the continuous spectrum on March 19, 26, and 27 respectively.

It is among the numerous fine, so-called absorption lines, to which so many origins and so many different radial-velocity shifts have been ascribed, that Dr. Giebeler finds the coincidences with lines due to the radium group of elements. Taking all the known radium spark lines, from a table given in the manuscript for the sixth volume of Prof. Kayser's "Handbuch," twelve in all, he finds a line approximately coincident with each of them in the nova spectrum; the differences range from −1·66 to +1·32 Å. Although eight negatives were measured, four of these nova lines were found to occur once only, and each of them on a different negative taken on another date; two others, also occurring once only, are found on a fifth negative. Only three lines were found to occur on as many as three negatives, and, while the intensities of the laboratory lines range from 50 to 2, the intensities of these three lines are 2, 4, and 2 respectively. The mean wave-length of the nova line attributed to the strongest radium line (λ=4340·83) is 4341·65, a position very near to the dark reversal of H_γ.

Of six arc lines of uranium four are represented in the spark and four in the nova spectrum, but of the four spark lines only two appear in the nova, and the only line, λ4472·50, which, from the laboratory data, may be an enhanced line, is not represented in the nova at all, unless one accepts the line shown on one negative at λ4471·88; but Dr. Giebeler assigns this to helium. The four lines attributed to uranium occur on four different negatives, the only one to occur twice being the 4341 line already attributed to radium.

Of the ten lines shown in the Giessler-tube spectrum of the emanation, six are represented in the nova spectrum with differences varying between +0·64 and −0·51 Å, the intensities in the laboratory spectrum being 20, 5, 10, 10, 4, and 4 respectively; the corresponding intensities of the lines not represented are 6, 15, 10, and 7 respectively. Of the six lines approximating to coincidence, only two are shown on any one negative (April 2); each of the other four appears once only, on four different dates ranging from March 16–19.

From the above brief summary it will be seen that the presence of these radio-active elements in the nova should be accepted with great reserve until more conclusive evidence is forthcoming.

A CHANGEABLE RED STAR, WX CYGNI.—In October, 1903, Prof. Wolf announced the discovery of a probable new star, which subsequently proved to be BD+37° 3876, and Prof. Barnard examined it with the 40-in. Yerkes refractor. He re-observed it last summer, and now communicates the results of his measures in No. 4581 of the *Astronomische Nachrichten*. The object shows marked fluctuations in colour, at times appearing a very deep red, and varies in magnitude. It is evidently of special interest, and Prof. Barnard gives a scaled chart showing the neighbouring reference stars used by him; the position, for 1911·0, is $\alpha=20h.\ 15m.\ 14{\cdot}65s.$, $\delta=+37°\ 10'\ 15{\cdot}3''$

THE BRAZILIAN ECLIPSE ON OCTOBER 10.—In two letters to Mr. Chambers, published in the May number of the Journal of the British Astronomical Association, Mr. Harold Thomson gives some particulars concerning the October weather (1910), the local conditions, &c., in the neighbourhood of Rio. Observers who intend to go to Brazil in October next will probably find some useful hints concerning the journey, &c., in these letters.

THE ASTRONOMICAL AND ASTROPHYSICAL SOCIETY OF AMERICA.—The papers read at the meeting of this society held at Washington in December last are reported in abstract in No. 905 of *Science*. A comparison of Dr. Peters's celestial charts with four of the photographic charts of the sky taken at Bordeaux and Algiers led Mr. J. G. Porter to the conclusion that they contain, on the average, 50 per cent. more stars than the photographic charts, which are, therefore, by no means complete to the twelfth magnitude. Dealing with the moon's parallax, Dr. F. E Ross finds the mean distance to be 238,857·9±1·1 U.S. miles and the semi-diameter to be 1,079·93±1·04 miles; the density, in terms of that of the earth, is 0·6043±0·0003. The subjects of many of the other papers have already been dealt with in these columns.

THE OPTICAL CONVENTION, 1912.

THE Optical Convention of 1912, which was yesterday brought to a successful conclusion, has rightly awakened widely extended interest in scientific circles. The use of optical methods of investigation is so universal and it so nearly affects research in all directions, that there is no body of scientific men who can afford to be indifferent to the successes of the makers of optical instruments and to the researches of those who are occupied with designing them. Hence the widespread interest which has been manifested in the proceedings of the Optical Convention, and the large measure of success with which its meetings and other proceedings have been conducted.

The convention was opened on Wednesday, June 19, by an inaugural address delivered by the president, Prof S. P. Thompson. A graceful preliminary ceremony was performed by Mr. C. P. Trevelyan, M.P., who, speaking in behalf of the President of the Board of Education, welcomed the president and members of the convention to the Science Museum and the Imperial College, expressing in felicitous phrases the interest which his Majesty's Government has been taking in the realisation of the plan for holding an Optical Convention. The official welcome was repeated on the following day, when the Director of the Science Museum, addressing the members of the convention assembled to meet him, explained that the idea of providing suitable accommodation for the proceedings of such a gathering formed part of the settled policy of the department in connection with the rebuilding of the museum.

It will be matter of satisfaction to all who have the interests of science at heart to know that the Board of Education has adopted so enlightened a policy, and it is perhaps to be counted a very fortunate circumstance that at this particular time, when the plans for rebuilding the museum are under consideration, the experiment of holding a congress of scientific men within the walls of the museum should be carried through. It has been made abundantly evident by that experiment that great advantages can be secured in that way. The educational purposes of the museum are never better served than when its resources are placed at the service of those who are actively engaged in prosecuting the studies to which the collection itself is subservient. The convenience of being able to supplement their own resources by drawing upon the resources of the museum has been very evident to the committee engaged in organising and carrying through the work of the convention. It can scarcely have been less satisfactory to the Board of Education and to its officers to see their collection of scientific objects turned to the best account by the assembly within the walls of their building of so large a number of expert persons to whom those objects are objects of scientific interest. We are glad to see that the experiment of providing such accommodation for the meeting of the convention has been carried through with so large a measure of success as to justify the hope that it may be repeated hereafter in various forms and on many occasions.

Turning now to the proceedings of the convention, one naturally inquires first of all as to the steps of progress which are registered in connection with this meeting. Accepting the lead of Prof. Thompson's very able inaugural address, one is led to think of the subject of illumination as that in which the most rapid advances are being made at the present time. These advances are well illustrated in the exhibition, where the illuminating engineers are very much in evidence, while in the lecture-rooms, although they have been perhaps not quite so much to the fore, they have very distinctly made their influence felt. It may indeed, be said that with respect to general illumination, the lighting, for instance, of streets and rooms, whether artificially or from natural sources of light, theory is at present in its cradle and even experiment in its initial stages. Much, however, has been already done, and still more may be expected to be accomplished within the next few years, if the present activity of investigators and inventors along this line should be maintained. The illumination suitable for optical instruments, and particularly the problem of illumination of objects under microscopic examination, has long been a subject of study. But here also we seem to be upon the crest of a wave. New methods of controlling the illumination of the stage of the microscope and new rules for interpreting the appearances presented in an illuminated field are occupying the earnest attention of investigators and with results which appear to be full of the promise of future achievement.

While the problems presented by illumination appear to be the direction in which research along optical lines is just now most conspicuously successful, the problems relating to the imagery of movement appear, on the other hand, to be those in which invention has made its most sensational advances. Prof. Thompson, who gave his audience some very interesting statistics concerning the astonishing popularity which kaleidoscopes and stereoscopes obtained when they were first introduced to the public, was able to add that since the date of the last Optical Convention, now seven years ago, the developments of the kinematograph had drawn from the public a thousand times as much money as either of those inventions. The inventors in this department would seem indeed to be too busy making their fortunes to have any time or interest to spare for the Optical Convention, and we observe that nothing in the nature of modern kinematography was on view in the exhibition.

Perhaps the time has scarcely come yet for the reduction into the terms of exact science of the theory of moving images. The elements of such a theory have been available, although in an unconnected form, to visitors to the Optical Convention. But the principles of image combination, the effects

of after-image, the drift set up by moving objects in the organs of vision—these things have been illustrated as isolated optical illusions and not brought together as a systematised whole. In this respect the programme of the Optical Convention somewhat strikingly reproduces the state of scientific knowledge at the present time. There is a very large amount of information as to the phenomena which are exploited for the representation of movement, but very little of systematic thought or systematised writing on the subject. It will be perhaps not the least useful result of the Optical Convention if its shortcomings in this respect should direct the attention of the scientific world to the unformed condition in which at the present moment the theory of the imagery of motion exists.

Passing from the question of novelty and coming to that part of the work of the convention which is concerned with taking stock of the state of knowledge, we note that the papers submitted have covered, as was to be expected, a very wide range, and have been characterised upon the whole by a high degree of utilitarian value. The executive committee of this convention has been able to secure the very active cooperation in connection with this branch of their work of the leading scientific societies which are definitely concerned with the study of optics. Thus by means of joint meetings of the members of the convention with the members of the Royal Astronomical Society, the Royal Photographic Society, the Physical Society, and the Optical Society, a very high level of interest in this part of the work of the convention has been maintained. The direct participation of these societies has secured large attendances at the meetings of the convention, and these again have reacted helpfully in the way of promoting the success of the exhibition.

The active cooperation of these societies with one another and with the promoters of the convention in relation to objects in which they have a common interest may be from every point of view regarded as an innovation of happy augury. It is impossible at the present day for scientific knowledge to be grappled with as a whole. Students and societies must specialise; and a very high degree of specialisation is essential to the successful carrying on of every department of scientific work. But specialisation has its perils as well as its advantages, and a mischief which, in fact, results from over-specialisation is that the spread of knowledge may to a certain extent be hindered. One investigator here, wrapped up in his own subject and too exclusively monopolised by it, has, by reason of his preoccupation, less opportunity than he would otherwise possess of becoming acquainted with the results which another worker, isolated by his own specialisation, has reached elsewhere. This segregation of researchers and research is apt actually to be promoted by their division into separate societies, and it is an eminently helpful thing that they should find opportunities, such as this Optical Convention has afforded, of meeting together upon common ground to carry on the commerce of ideas upon a larger scale than their organisation for the purpose of special research permits. It is probably a good deal easier nowadays to start a new society than to establish conditions of cooperation among existing societies, even among those which are naturally affiliated by the objects of their pursuits. It is matter for congratulation that the four societies named have been able to cooperate, and to so good purpose, in connection with the meeting of the Optical Convention.

The cooperation of these societies leads naturally to the mention of what seems likely to be the most permanent and perhaps the most valuable outcome of the Optical Convention of this year. Its promoters have succeeded in securing the formation of a very strong committee for the purpose of considering questions touching the improvement of optical instruments. Such at any rate was the scheme with which the committee was originally formed, and in pursuit of that aim a widely extended inquiry has been set on foot for obtaining a statement by the users of optical instruments as to points upon which they consider that improvement is required. We understand, however, that, moulded by circumstances, the proceedings of this committee seem likely to take a somewhat larger scope.

The announcement has been made that some important problems have been submitted as the result of the inquiry already referred to for the consideration of the committee, and that some of those problems touch not only upon the design of instruments but also upon the still larger questions of optical constants and nomenclature. It need scarcely be said that very important questions of this nature lie open for discussion, and we can well believe that the committee, if it is to arrive at any practical result at all, will have to exercise a selection among the problems taken into consideration. As no definite statement has yet been made concerning the exact nature of the problems with which the committee will propose to deal, it is impossible to form any opinion at the present time as to the probable outcome of its labours. The scientific world, however, has learned with considerable interest that such a committee, consisting of Prof. S. P. Thompson, the Astronomer Royal, Sir William Abney, Sir David Gill, Dr. Glazebrook, Prof. Schuster, and Mr. Plimmer, has been formed for the purpose of dealing with such problems, and the results of their deliberations will be looked for with still greater interest.

Another result of the meeting of the convention which will have an abiding value is the catalogue produced. This contains the most adequate representation it is possible to produce at the present time of the state of the British optical industry. The catalogue has been compiled upon the same plan as that of 1905, but it is a considerably larger volume, extending to nearly 400 pages. The introductory matter, which has been compiled with great skill, contains probably the best available statement of what has been accomplished in recent years by the designers and manufacturers of optical instruments in this country. The exhibitors' account of their instruments will be found to be in many instances valuable specifications of the optical appliances described, and in some instances we observe that the value of these technical descriptions is enhanced by reference to the bibliography of the instruments in question. Whether, therefore, the catalogue be considered from the industrial or from the scientific point of view, it must be pronounced an important work, and its production should alone repay the optical industry in this country for the expense and trouble involved in bringing together the materials for the exhibition.

Of the third permanent result of the convention—the volume of Proceedings—it is as yet too soon to speak. A reference has above been made to the general character of the papers submitted, which will be reproduced in that volume, and concerning the discussion to which those papers have been subjected it may be said that, although the limitation of time has militated against the success of those discussions, yet in many instances the discussions have been successful in spite of somewhat hard conditions, and may be expected to add materially to the value of the Proceedings when published.

This question of the pressure of time upon the discussions is one of growing importance in connection with scientific congresses. On one hand it is essential to the success of such meetings that the programme should be open to a large number of papers, since otherwise it would not be possible to secure that extended view and free interchange of opinions and ideas which it is the object of such assemblies to promote. But, on the other hand, if there are many papers to be discussed, the difficulty of discussing them within the available limits of time becomes extreme. We observe with interest that an attempt has been made in connection with this convention to circumvent the difficulty by means of demonstration rooms. Two rooms were set apart in the buildings placed at the disposal of the committee for this purpose. In one of them—called the Members' Demonstration Room—the diagrams and apparatus illustrating papers were set up and maintained on exhibition during the whole period of the convention. It was thus possible for the members to study any particular paper at leisure, while the readers of the papers had the satisfaction of repeating their demonstrations to selected audiences.

The other demonstration room, which was open to the public, served sometimes for the fuller discussion of a paper which had been inadequately discussed in the meeting room, and at other times for the accommodation of impromptu demonstrations unconnected with the printed programme of proceedings. These seem both to have been useful expedients for minimising the inconvenience of deficient time for reading and discussion of papers at the set meetings, and probably would have been more effective for the purpose if the arrangement had been more commonly adopted, and therefore better understood. But the best demonstration room expedient is but a palliative, and the problem still remains to confront the organisers of scientific and other congresses how to get the work before them accomplished in the time at their disposal.

EXHIBITION OF OPTICAL AND GENERAL SCIENTIFIC INSTRUMENTS.

THE success achieved by the Optical Convention of 1905 was a guarantee of that of the second convention, of which an account is given in the preceding article. In connection with the convention an exhibition has been held which has been representative of every branch of applied optics. The committee of the convention has been deeply indebted to the Board of Education for the space in the South Kensington Museum galleries which has been placed at its disposal, and for the many facilities afforded, which have very greatly helped the success of the exhibition.

The exhibits have been divided into twenty classes corresponding to as many types of optical apparatus, and a very interesting loan collection was organised, consisting of apparatus of historical interest and special apparatus of which in many cases only one has been made. Arrangements were made so that in many cases visitors could have the advantage of demonstrations by the gentlemen who had designed and used such apparatus in their researches.

Among the most interesting of these were a set of gratings and similar apparatus belonging to the Royal Society, which were used by Fraunhofer in his researches on the spectroscope. A camera lucida belonging to the inventor, Dr. Wollaston, was lent by the master and fellows of Gonville and Caius College, Cambridge. Mr. T. H. Court lent a number of early microscopes, and Mr. Croft a number of very interesting photographs of interference and polarisation effects. The hon. secretary, Mr. J. W. Gordon, provided examples of many of the useful facilities which he has invented for microscopic workers. Messrs. Rheinberg gave demonstrations of the beautiful micro-spectroscopic method of colour photography, and Prof. Coker of the very different but equally beautiful method of studying the stresses in celluloid models of engineering structures by the use of polarised light. A very interesting small dividing engine for the production of diffraction gratings was shown by Mr. Pochin. In this a cast-iron screw has been adopted as being far superior to mild steel, which was found to be comparatively useless.

The Secretary of State for War has shown his interest in the exhibition by permitting an exhibit arranged by Major Williams of certain representative types of optical apparatus as used in the Army.

A number of thermostats, silica mercury-vapour lamp, and silica vessels for use in polarimetry were shown by Dr. T. Martin Lowry. The latter are especially useful for liquids which are liable to be altered by the alkali contained in ordinary glass.

The new gas and liquid refractometer of Messrs. Zeiss is an instrument of great sensitivity, being able to detect one part in 100,000 of salt in its solutions, while the convention has been able to welcome to its meetings Dr. von Rohr, of Jena, who has presented a paper on lenses of non-spherical curvature. Many members were glad to see the focometer and other apparatus and experiments of the president, notably the large quarter-wave plates made for the experiments of Prof. Coker.

The fact that the portion of the general catalogue descriptive of the apparatus of the firms participating in the exhibition occupies 350 pages is an indication of the hearty support which the industry has given to the convention.

The intention has been to make the catalogue valuable as a book of reference for some time to come to persons interested in optics, and also a medium for the assistance of the optical industry. For this purpose a large edition has been printed, and its distribution abroad, especially in the Colonies, is now under the consideration of a special committee. The editing has been done at the National Physical Laboratory, and Mr. E. H. Rayner and Dr. T. M. Lowry have been chairman and secretary of the catalogue committee, on the results of which they are to be congratulated, especially considering the short time available for its compilation. Attention may especially be directed to the introductions to many of the classes in the catalogue, which are very valuable epitomes of modern methods and apparatus in the most important branches of optics.

A sign of the times is the way in which the class devoted to illumination has been supported. Architects and engineers have now available not only accurate figures for the illumination required in different circumstances, but also values for the distribution of the illumination produced by the many reflectors of various types for use with gas and electric light. The use of special types of portable photometers now available for measuring the intensity of illumination leaves no loophole for the unsatisfactory and wasteful methods of illumination which have been commonly regarded as inevitable. In this connection the exhibits of Messrs. Holophane, Ltd., Messrs, William Sugg and Co., the Union Electric Co., Messrs. Everett Edgecumbe, the Adnil Electrical Co., and the Benjamin Electric Co. were a liberal educa-

tion to anyone specially interested in this important branch of optics.

Messrs. Adam Hilger showed many of the specialities requiring the highest skill of the optician, such as Echelon and Lummer Gehreke spectroscopes and quartz spectrographs. Among a fine series of surveying instruments, shown by Messrs. Casella, Negretti and Zambra, Ottway, Pillisher, and others, was a divided circle shown by Messrs. E. R. Watts and Son, the graduations of which have been investigated at Charlottenburg for the purpose of checking the accuracy of their dividing engine. The result is that the average error is not greater than half a second, and nowhere reaches two seconds, a notable achievement.

One of the most important commercial developments in optics in recent years has been the growing use of high-class photographic lenses. The intelligent user has discarded the rectilinear, and the production of anastigmat lenses of the highest quality has been encouraged by the rapid growth of kinematography. Anastigmats at very moderate prices were shown by Messrs. Aldis, by Messrs. R. and J. Beck, whose Isostigmar and Neostigmar series are notable as examples of a new and excellent type, by Messrs. Dallmeyer, and others.

In the meteorological section examples of Dines anemometers and the Dines-Shaw microbarograph were exhibited by Messrs. R. W. Munro and by Messrs. Negretti and Zambra, both inventions of the greatest importance.

It is impossible to give little more than the names of some of the seventy exhibitors in the most important classes. The fifty pages of the section dealing with microscopes contain short accounts of the chief products of Messrs. C. Baker, R. and J. Beck, Messrs. Pillisher, Reynolds and Branson, and W. Watson. Among the exhibitors of spectacles and ophthalmic apparatus were the Kryptok and Unibifocal Co., producing bifocal spectacle lenses of two different types, both requiring great skill in manufacture, and Messrs. G. Culver, Ltd., W. Gowlland, Raphaels, Reiner and Keeler, Ltd., and J. and H. Taylor, who had a large selection of interesting oculists' apparatus.

Beautiful examples of special cameras for process work, a type little known to the general user, were shown by Messrs Hunters, Ltd., and A. W. Penrose, Ltd. Modern types of projection apparatus were shown by Messrs. Hughes, Newton, and Reynolds and Branson. Among several interesting exhibits of the latter were projection apparatus suitable for use with ordinary microscopes, and also inexpensive apparatus for the projection of opaque objects, diagrams, &c., a type which might be more generally used for educational purposes and for the use of speakers at the meetings of scientific societies.

The catalogue committee decided to include in the catalogue descriptions of apparatus shown by firms unable to participate in the exhibition. There is, for instance, a very interesting account and illustration of large telescopes of 24 in. and 26 in. aperture, for the observatories at Santiago and Johannesburg, at present in course of erection in the factory of Sir Howard Grubb. Descriptions and illustrations are also given of other special apparatus made by the firm for many observatories in different parts of the world. To teachers and others the catalogue will be of value, and we would especially emphasise again the importance of many of the introductions, which contain valuable information in many branches of optics scarcely procurable from other sources. The catalogue is obtainable from the publishers, *The Electrician* Co., Salisbury Court, Fleet Street, E.C., for 1*s*. 4*d*. post free.

OPTICAL SCIENCE.[1]

INTRODUCTORY.

SEVEN years have elapsed since the first Optical Convention assembled in 1905, under the presidency of Dr. R. T. Glazebrook. Both that gathering and the second one, in which we are now met, witness to the efforts which are being made, not less by those concerned in the industries than by scientific men, to promote the progress of optical science and of optical trade. Like all other industries which depend on the application of scientific discoveries, the optical industry has felt the pressure of the times; and a widespread sense of need that science and manufacture must be associated in an alliance more intimate and more active than heretofore has been the moving cause of both conventions.

DEVELOPMENT.

Seven years is but a brief span in the development of an industry, or in the history of any science. It may well be that in the seven years which have fled since our first convention we have no obvious great discovery to chronicle. But if no optical invention of first magnitude, or discovery of fundamental importance, has been announced, it must not be assumed that there have been no advances. Progress there has been; progress solid and real, all along the line. No branch of physical science can in the present day remain stationary. The workers are too numerous; the rewards of success, whether in the joy of scientific discovery, or in fame, or wealth, are too alluring to permit stagnation. Moreover, the increase of knowledge, the mastery of principles over phenomena, the conquest of the forces of Nature, are cumulative. Every attempt at wider generalisations, even if unsuccessful in itself, provokes new researches, and extends the foundations for further advance. To this truth the science of optics furnishes no exception. The history of optics is scarred with the battles of rival theories, of which the end is not yet determined. It may, indeed, almost be taken as axiomatic that in all efforts to reach the unknown, to advance human knowledge, it is better to set before one's self some directive hypothesis than to work aimlessly. Every great pioneer in physical science has to frame conjectures, and to keep them, as it were, in a state of solution until either confirmed or disproven. He may even have half a dozen rival and mutually destructive hypotheses before him as he works. Truth is not infrequently reached by a process of exhaustion, by honestly following clues that ultimately prove false, since when they are proved to be false the path to truth has been more closely delimited than before. Even positive error in theory has been know to lead to new and valuable results; as when Euler, arguing from the false premiss that the human eye is achromatic, deduced the conclusion that it must therefore be possible to construct by optical means a lens that should be achromatic.

NEWTON AND HUYGENS.

The influence of Newton in science has been immense. His great genius, shown in his "Opticks" in the unravelling of the puzzle of the colours of the prismatic spectrum, and in his "Principia," in laying the foundation once for all of the laws of motion and of the doctrine of universal gravitation, won for him an almost idolatrous regard. We may recall Alexander Pope's couplet:—

> "Nature and Nature's laws lay hid in night:
> God said, 'Let Newton be,' and all was light."

Even his mistakes—and they were few—were accepted as dogmas, as when he pronounced the dispersive

[1] From the Presidential Address delivered before the Optical Convention on June 19 by Prof. Silvanus P. Thompson, F.R.S.

power of prisms of different kinds of glass to be proportional to their refractive power, involving the impossibility of ever obtaining an achromatic lens. Even after a hundred years the Newtonians out-Newtoned Newton in their antipathy to anything that seemed counter to his views; and their hostility to Thomas Young's doctrine of interference is a matter of history.

Christiaan Huygens, Newton's great contemporary, propounded his wave-theory of light in 1678, though his famous "Traité de la Lumière" appeared only in 1690. Few British students have ever read that rare work; but none can read it without being impressed with the genius of its author. Everyone knows of Huygens as the inventor of the wave-theory of light; but how few are familiar with the contents of the treatise! He expounds the analogy of the propagation of light with that of sound, then points out the essential differences, and develops the geometrical notion of movements spreading in spherical waves. He had, in fact, to take into account six fundamental facts:—(1) The rectilinear propagation of light; (2) the mutual penetrability of two beams where they cross one another; (3) the law of reflection; (4) the law of refraction (which he had learned from Descartes); (4) atmospheric refraction; (5) the finite speed of light, discovered by Roemer in 1676; and (6) the double-refraction of Iceland spar, discovered by Bartholinus in 1669.

The insight with which, by aid of his conception of elementary waves building up an enveloping wave-front, Huygens succeeded in giving a consistent theory, is a matter for wonder and admiration. He availed himself of Fermat's principle of least time, deduced from it the law of sines for refraction, and based on it the geometrical construction for his wave-fronts which now appears in all books on physical optics. It is true that he had no conception of transversality in the movements of his waves, or of the principle of interference, or even of the existence of trains of waves or of wave-length. His wave-theory was far from being the complete doctrine of Young and Fresnel, and belongs to geometrical rather than to physical optics. But the exquisite skill with which he unravelled the intricacies of double-refraction in crystals and the anomalies of atmospheric refraction must excite the admiration of every reader. His speculations as to the ether of space, his suggestive views of the structure of crystalline bodies, and his explanation of opacity, slight as they are, surprise one by their seeming modernness. He detected the double-refraction of quartz, and discovered the phenomenon of polarisation, while frankly unable to explain it. Another section of his book deals with aspherical forms of lenses for focussing light when one surface is prescribed.

Aberrations.

The enormous focal lengths adopted by Huygens for his telescopic object glasses arose from their comparative freedom from aberrations. No actual lens ever gives perfect stigmatic results; and every beginner knows that aberrations are of two classes: those that arise from the polychromatic nature of light, and those which, even when monochromatic light is used, are due to the form of the surface of the lens, and are often—though not very happily—termed spherical aberrations. Newton calculated ("Opticks," pp. 84, 89) that in a 100-foot telescope with suitable aperture the aberration of colour would be at least 1200 times as great as the aberration caused by the sphericity of figure of the object glass. We know, in fact, that in despair at making a lens devoid of chromatic aberration, he gave up refractors and invented his reflecting telescope. But when in 1757 Dollond, by the invention of the achromatic lens, removed the worst of the aberrations, the correction of the aberrations due to form became the next desirable step. Descartes, Deschales, and other writers suggested various devices for grinding lenses with hyperbolic, elliptical, and other aspherical curves; but practical difficulties prevented their use. In the early part of the nineteenth century, Coddington and Airy, the younger Herschel, and others investigated in great detail the aberrations of lens combinations, and brought that part of optics to a high pitch, though much of their work remained unknown outside England.

Illumination.

During the past seven years there has been great activity in the development of the branch of geometrical optics concerned with illumination, involving questions of the distribution of light, and the measurement of it in quantity and intensity by photometers. Though a better standard source of light than either the Harcourt Pentave lamp or the Hefner amyl-acetate lamp is still a desideratum, it is satisfactory to know that international agreement upon the unit of light is practically secured, through the collaboration of the four great laboratories at Sèvres, Charlottenburg, Bushy, and Washington. Committees have been actively at work on the questions of minimum illumination required in schools, libraries, factories of various kinds, and in roads and streets. Even the House of Commons has awakened to the fact that the illumination enjoyed by its members is only about half a candle-foot, whereas for comfortable reading it should be two or three times that amount. Photometry has indeed grown since the photometric law of inverse squares was first announced by Deschales in 1674, or since the early treatises of Bougner and Lambert. New forms of photometer have multiplied, and every month sees fresh developments.

Physical Optics.

When we turn to the vast subject of physical optics we cannot but be struck with the variety of phenomena which must be taken into account by anyone who would deal with the nature of light itself, or with the mechanism of the ethereal medium by which it is conveyed. Dispersion [2] and its anomalies, interference, diffraction, the multitudinous effects of polarisation, the problems of radiation and luminescence, of opulescence, and the blue of the sky, of iridescence, and the gorgeous colours of butterflies and humming-birds, to say nothing of radio-activity, or of the chemical, physiological, electrical, magnetic, and mechanical relations of light, furnish whole fields in which knowledge is still in the making.

In physical optics, though there are mathematical laws, such as those discovered by Fresnel and Stokes, to be mastered, the chief concern is with physical phenomena; and the study of these would seem to be inseparable from speculations as to the nature of the luminiferous æther, and from consideration of the conflicting theories as to its constitution. Formerly the vexed question was the mechanical explanation of an æther which should behave like an elastic solid a million times more rigid than steel, and at the same time as a mere vapour a billion times less dense than air. Then there was an outstanding quarrel between the followers of Fresnel and those of Neumann and McCullagh as to whether the vibrations of light were

[2] Herschel, in 1828, in his article "On Light" (Encyclop. Metrop., p. 450), declared: "The fact is that neither the corpuscular nor the undulatory, or any other system which has yet been devised, will furnish that complete and satisfactory explanation of *all* the phenomena of light which is desirable. Certain admissions must be made at every step, as to modes of mechanical action, where we are in total ignorance of the acting forces; and we are called on, where reasoning fails us occasionally for an exercise of faith."

executed in or across the plane of polarisation. Maxwell dissipated the controversy when on his electromagnetic theory of light he showed that both were present, the elastic vibrations taking place across the plane, and the magnetic ones in it.

To-day, and ever since Maxwell propounded the electromagnetic theory, the main interest has been transferred to the question how the æther is related to electricity and to ponderable matter, and whether the motion of matter in space affects or is affected by the æther. Is it a fact that the æther is stagnant, fixed, "while the molecules constituting the earth and all other material bodies flit through it without producing any flow in it"?[3] Or is the æther speeding along with the earth and the whole solar system in headlong and enormous flight? That singular doctrine, now in fashion, called "The Principle of Relativity," invites us first to deny that we can ever detect or measure the absolute velocity of the earth in space, and then to admit that, therefore, since we cannot regard the æther as filling space or fixed in it, we must abolish the notion of the æther as a conveying medium, and must explain the finite velocity of light in some other way depending on electromagnetic principles inherent in the light impulse, and expressed in terms of coordinates the origins of which are to be only relatively, and not absolutely, fixed. Without pursuing these anarchical ideas, we may remark that for all useful purposes it suffices to admit that no terrestrial optical phenomena have any relation to the direction of the earth's motion through the universe.

As for the relation between matter and æther, while for clarity of thought we must frame some idea of the connection between them, we may accept Sir Joseph Larmor's dictum that "Matter may be, and likely is, a structure in the æther, but certain æther is not a structure made of matter." His view that "the motion of matter does not affect the quiescent æther, except through the motion of the atomic electric charges carried along with it," is, of course, bound up with the further conception that the æther is a plenum in which "vortices or other singularities of motion and strain" are the nuclei of which matter consists.[4]

Spectacle Optics.

The fixing of two lenses together to form a pair probably dates from the thirteenth century, but history is obscure. Raphael, in 1517, painted Pope Leo X. wearing concave spectacles. But not all pictures are good as evidence, for there is, or was, in the Chiesa de' Ognissanti, in Florence, a picture attributed to Sandro Botticelli, depicting St. Jerome in his cell, with a pair of spectacles beside him. This does not prove that spectacles existed in the fourth century; and the presence of the spectacles may be as great an anachronism as in another picture of the same Saint is the presence, on the wall of the cell, of a pendulum clock. Coming down to the present day, few persons probably are aware of the rapid rate at which that branch of the subject is developing into a severe scientific study. Perhaps they think that the only progress in spectacle-making has been the introduction of lighter spectacle frames or ingenious dodges for grinding bifocal glasses, or for fusing one kind of glass into another for a bifocal lens, or for grinding toric lenses. This would be quite a mistake. It may be that the teaching in the medical schools has remained much as it was; but the training of spectacle opticians to deal with the problems of astigmatism, both of eyes and of lenses, has taken great strides, and under the stimulus of the system of certification by the Spectacle Makers' Company and of other optical bodies is assuming an important development.

Apart from actual practice, an exceedingly important advance in theory has been initiated by the genius of Allvar Gullstrand. In the year 1903 he pointed out that the centre of rotation of the eyeball does not coincide with the nodal point, which is its optical centre. It is, in fact, from 2 to 3 millimetres behind it, and therefore in all those uses which the eye makes of its power of turning about in its socket the mathematical treatment which assumes it to be fixed is inadequate. The assumptions of the Gauss system are no longer fulfilled, and modifications have been introduced. For precise work this affects the efficiency of spectacle lenses and introduces new sources of aberration. For this reason spectacles should be so designed that the particular point at which they are corrected for radial astigmatism should lie at the centre of rotation of the eye.

One other point in spectacle optics needs attention. Thirty years or more have passed since British opticians ceased to denominate their lenses in terms of inches of focal length, and adopted the dioptric system of numbering, in which a lens having a focal length of 1 metre is described as having a power of one diopter, and a lens of twice that power as of two diopters. The diopter, the international unit of lens power, was adopted in 1875 on the proposal of Monoyer at the Brussels Conference. Nearly thirty years ago it was pointed out that the diopter, being the reciprocal of a length, is in reality a unit of curvature, and may be applied to express curvatures of wave-fronts and of surfaces, as well as the power of a lens, which is, in fact, merely the expression of the convergency which it imposes on the light passing through it.

Optical Education.

To the optical industry as a whole the question of the scientific training of young men who shall hereafter become technical leaders and pioneers is a very serious one, in view of the stress of the times. Men are wanted who can undertake mathematical calculations with a first-hand practical knowledge how these calculations are applied in the design of instruments, and who have a thorough acquaintance with the whole range of optics. That training at present they cannot acquire at any of the universities. It is a melancholy fact that now, when this need is sorest, the pursuit of optics at our universities and colleges is in a deplorable state. Except in the Northampton Polytechnic, and one or two other institutes, the study of optics for its own sake is entirely ignored. Not one of the universities of Great Britain has created a chair of optics, though there are professorships and extensive laboratories for electrical engineering, for metallurgy, and for various branches of technical chemistry. In the universities and colleges the only people who are learning optics are merely taking it as a part of physics for the sake of passing examinations for a degree, and care nothing for the applications of optics in the industry. They are being taught optics by men who are not opticians, who never ground a lens or calculated even an achromatic doublet, who never worked with an ophthalmoscope or measured a cylindrical lens.

Again and again, as might be demonstrated by many instances, advances in optics have come about through the association of the highly trained mathematician with the practical workman, and most effectually when these are combined in one individual. But where is England to look for the training up of such men? For twenty-five years some of us have

[3] Larmor, "Æther and Matter" (1900), p. 162.

[4] Particular reference may be made to Sir Joseph Larmor's "Æther and Matter" (1900), and to Prof. E. T. Whittaker's "History of the Theories of Æther and Electricity," 1910.

urged the need of an Institute of Technical Optics, where students of optics will be trained in optics by men whose work is optics. The need grows year by year. Deputations from the trade have waited on the London County Council, and questions have been asked in Parliament, yet in vain. It has been suggested that two separate schools are needed—one for optical workmen, the other for optical calculators, the latter to be a mere small department in one of the universities or colleges. Such a divorce of practice and theory would be futile. What is wanted is an establishment where the whole atmosphere is one of optical interest, where theory and practice go hand in hand, where the mathematician will himself grind lenses and measure their performance on the test bench, where brain-craft will be married to hand-craft, where precision, whether in computation or workmanship, will be a dominating ambition.

As yet the only attempt made towards this ideal is the optical department of the Northampton Polytechnic in Clerkenwell, where a handful of students are housed in wholly inadequate surroundings. In the future institute the teaching must be thorough and independent, and free from all ulterior domination of examinations. The examination blight, which has cramped education in so many ways, has brought us to this pass, that outside the centre just named there is not a college student in Great Britain who is being trained in *optics for its own sake*. The moral is obvious. The future optical institute must be properly housed and equipped as a self-contained monotechnic, concentrating all its energies on the one aim. On no consideration whatever ought it to be under the baneful influence of a university, where its students would be diverted from whole-hearted devotion to progress by the temptation of degree-hunting. Would that this convention might make it clear to those in authority that the optical industry is in deadly earnest in demanding the establishment of such a centre of optical training.

BIRD NOTES.

IN the May number of *The Zoologist* Mr. J. M. Dewar discusses the evolutions performed by flocks of certain kinds of wading birds of the family Charadriidæ. These evolutions, which are based on a simple type common to the whole family, but frequently comprise specialised additions, are believed by the author to be of a defensive and protective nature, the essential form of movement being an imitation of the sea-spray. "When the flock is large the movements are often sectional, and what seems to be a succession of waves passing through an extended flock is in many cases an extremely quick repetition of the simpler form of the evolutions by sections. The 'sheet-movements' which provide much of the spectacular display are rendered possible by the same circumstance, and generally grow out of the simpler form. . . . In other words, one may say the simpler evolutions are imitative in character and protective in purpose; in the complex evolutions the simpler imitative movements are partially hidden by the development of a wealth of movement which is still protective in purpose, but which, as regards character, is incapable at present of a simple and comprehensive explanation."

Despite the fact that the work of the two sexes can be easily distinguished, it appears from a note in the May number of *Witherby's British Birds* that there is a dearth of trustworthy observations in England to show whether male or female woodpeckers excavate the nesting-hole, or whether both combine in the task. Continental observers are, however, generally agreed that the cock is the worker, and if this be so the same thing doubtless obtains in Britain, despite certain statements as to both sexes of the green woodpecker having been seen at work together.

In completing his notes on the bush-birds of New Zealand in the April issue of *The Emu*, Mr. J. C. M'Lean observes that, inclusive of the bush-hawk and the morepork, twenty-one species of North Island birds may be classed as arboreal, and of these sixteen have been identified in the Maunga-Haumia bush. Possibly two others should be added to the list; but it is probable that the huia—now very scarce everywhere—never extended so far north. The stitch-bird seems to have been exterminated in the district, if not also on the mainland.

R. L.

COMPARATIVE STUDIES IN MELANESIA.[1]

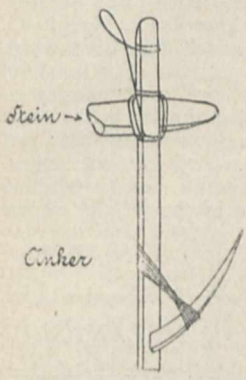
IN the interests of his topographical work the author of the memoir under consideration was obliged to be almost constantly on the move; though this rendered any intensive study of a special people impossible, yet it afforded him opportunities for personal comparison of various peoples and cultures over a wide area. He has worked up the older sources with great care, and in many instances extends his comparisons to America, as he is anxious to see a full treatment of Malayo-Polynesian affinities with South American cultures worked out; the cursory treatment of this vast theme in Graebner's "Bogenkultur" he regards as quite inadequate and faulty in method.

The ethnological section of the memoir (pp. 28–167) deals primarily with western New Britain, of which our knowledge has been hitherto slight, also with the other German possessions in Melanesia, and comparative data from Indonesia and America are added. The physical anthropology is very incomplete, partly through the author's misfortune in losing his apparatus when his boat overturned; head-indices should have been worked out in addition to giving lists of head-lengths and -breadths. As regards material culture, Dr. Friederici has been careful to ascertain the distribution of different objects and customs wherever possible, and he gives a useful account of the various forms of houses observed, and the association of divergent types, with a number of diagrams of dwellings and plans of certain villages. Considerable cultural complexity and wide variation physically are of course to be anticipated in an area situated like the Bismarck Archipelago on the great highway of migration; in fact the author states (p. 316) that a considerable proportion of the natives are directly traceable to the "Alfurus" of eastern Indonesia, whose modified descendants are a relatively recent element in the Bismarck Archipelago and other Melanesian areas.

In the discussion of affinities the author emphasises the importance of linguistic evidence, and the present volume contains a sketch of the grammar of the Barriai language of the northern coast of western New Britain. He makes it a practice to give the native names of cultural objects described, and is a strong advocate of the retention of native place-names, which are already familiar to traders in the locality, and to which after all belongs the priority.

[1] "Wissenschaftliche Ergebnisse einer amtlichen Forschungsreise nach dem Bismarck-Archipel im Jahre 1908." II. "Beiträge zur Völker- und Sprachenkunde von Deutsch-Neuguinea." By Dr. Georg Friederici. Pp. vi+324+iv plates+map. (Mitt. aus den Deutschen Schutzgebeiten, Ergänzungsheft Nr. 5.) (Berlin: Ernst Siegfried Mittler & Sohn, 1912.) Price, separately, 3.60 marks.

Lastly, there is an admirable account (eighty pages) of Malayo-Polynesian shipping, especially as occurring in German areas; this is particularly valuable on account of the diagrams (136 in number) of the different parts and appliances, also for the native names of these. It is interesting to note a certain similarity between a form of stone anchor from the west of Ireland and that represented in Fig. 36*a*, p. 242, here reproduced.



Enough has been said to show that this work contains much information of interest, all of which is obtainable for the modest sum of 3.60 marks. There are a few plates, and a map of New Ireland, Gazelle Peninsula, and New Hannover coloured to show the distribution of languages. We shall look forward to further investigations by Dr. Friederici, whose wide acquaintance with ethnological literature particularly fits him for comparative work. A. C. H.

SOLAR RADIATION AT DAVOS.

IN *Naturwissenschaftliche Wochenschrift* (No. 4, 1912), Dr. F. M. Exner gives an elaborate analysis of the principal results of Dr. C. Dorno's painstaking measurements of solar radiation and atmospheric electricity at Davos in 1908–10, made with the most up-to-date instruments, and published, with numerous tables and plates, in a stately quarto volume, entitled "Studie über Licht und Luft im Hochgebirge" (F. Vieweg and Son, Brunswick). We can only quote here two or three of the actinometric results, which serve to show the nature of the work. Although Dr. Exner's analysis is so full, the work contains so much material that it is impossible even to make mention of all the results. The following are the results of 662 determinations:—

Dependence of the Intensity of Radiation on the Sun's Altitude in the Mean of the Year, expressed in Gram Calories (per sq. cm. per min.).

10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°
1·047	1·131	1·172	1·226	1·274	1·302	1·329	1·342	1·355	1·359	1·369	1·364

The daily range of intensity is given for each season and for the year. For the latter we find:—

6h. a.	7h. a.	8h. a.	9h. a.	10h. a.	11h. a.	Noon	1h. p.
1·105	1·141	1·217	1·315	1·374	1·372	1·384	1·360

2h. p.	3h. p.	4h. p.	5h. p.	6h. p.
1·311	1·228	1·206	1·094	1·018 (June–August)

With the aid of a Campbell-Stokes sunshine recorder the following effective monthly values of radiation in kilogram calories on a horizontal surface were calculated:—

Monthly Values and Percentage of Possible Values.

Dec.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Year
1·0	2·3	3·3	6·0	7·2	9.6	10.·	10·8	11·0	7·8	5·1	2·8	78·1
52·5	55·7	51·6	56·2	46·5	49·9	51·7	56·0	63·6	60·9	60·0	59·4	55·0

Davos owes its high radiation to its height above sea-level (1560 m.), the southerly aspect of the valley, and its small amount of cloud in the winter months. The highest value of solar radiation measured was 1·522 gram calories (March 5).

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—On March 26 last the City Council passed a resolution, "That, having received a grant from the city rates, the University of Birmingham be asked to consider the advisability of granting degrees to external students, particularly those trained in the municipal technical schools or the Birmingham and Midland Institute, and report thereon to the council." In reply to this request the council and Senate of the University have just issued a statement setting forth the result of their deliberations on the subject. They point out that "the University was intended by its founders to be limited in granting degrees to students attending the University or affiliated institutions. Courses of instruction under recognised teachers, and daily association with fellow-undergraduates, give a meaning and a value to a degree which would be entirely lost if the degree were granted to external students." The council also points out that the external side of London University already meets the needs of the external student, and that it is quite unnecessary to set up two universities having this external character in the British Isles.

CAMBRIDGE.—The General Board of Studies has reappointed Dr. Barclay-Smith as University lecturer in human anatomy.

The Raymond Horton-Smith prize for 1912 has been awarded to Dr. V. J. Woolley, for a thesis for the degree of Doctor of Medicine—subject, "The time-relations of the actions of entero-kinase and of trypsin under various conditions"; *proximè accessit*, Dr. A. E. Barclay, for a thesis for the same degree—subject, "The diagnosis of gastric and œsophageal affections by X-ray methods." The M.D. Degree Committee places on record its appreciation of the high standard attained by most of the theses submitted for the degree of Doctor of Medicine. Many of these theses, either records of clinical investigations on obscure diseases or original laboratory research, ought in the opinion of the committee to be published. The theses submitted by G. G. Butler—subject, "The fragility of the red blood corpuscle; A. J. Clark—subject, "The mode of excretion of hæmoglobin and its derivatives; Dr. F. P. Franklen-Evans—subject, "The sensory nerve endings in joints—are worthy of special distinction.

The Special Board for Biology and Geology has nominated, to use the University table at Naples, G. R. Mines, H. M. Fuchs; and J. Gray, to occupy the University table at the laboratory of the Marine Biological Association at Plymouth.

OXFORD.—It is proposed to hold an election in Michaelmas term next to an ordinary fellowship in Magdalen College, after an examination having special reference to excellence in medical science (physiology and pathology).

Convocation on June 25 confirmed the decree accepting the grant of 900*l.* from the Board of Agriculture and Fisheries in aid of investigations into the economics of agriculture. On the same day it passed a decree accepting the sum of 10,000*l.* for the promotion of the study of agriculture from Mr. Walter Morrison, M.A., of Balliol College. It is proposed to apply 3000*l.* of Mr. Morrison's benefaction towards the extension of the Rural Economy Laboratory, it being understood that the Board of Agriculture and Fisheries is prepared to make a grant of an equal amount towards the same object, and to invest the remaining 7000*l.*, using the income for the maintenof the laboratory and for other purposes connected with the study of agriculture in the University. This makes

the third donation of 10,000*l.* given to the University by the same benefactor during the present month; the other two being for a professorial pension fund and the study of Egyptology respectively.

Dr. Louis A. Bauer, director of the Department of Research in Terrestrial Magnetism at the Carnegie Institution of Washington, has been appointed Halley lecturer for the year 1913.

The annual report of the delegates of the University Museum has just been published. It records the conversion of the southern portion of the old Radcliffe Library into two rooms by the insertion of a fireproof floor. The room has great historic interest as being the scene of the famous encounter between the late Prof. Huxley and Bishop Wilberforce, of Oxford, during the meeting of the British Association in 1860. The lower portion is now occupied by the Hope professor of zoology, and the upper division is used as a pharmacological laboratory. The report of the Linacre professor makes special mention of valuable specimens from Madagascar, including many remains of fossil Lemuroids, collected by the Hon. P. A. Methuen. The Hope professor announces several important donations from equatorial Africa. A long list of accessions to the Pitt-Rivers Museum is contributed by the curator, and many donations to their respective departments are enumerated by the professors of geology and mineralogy. In all the departments a good account is given of lectures and other instruction carried on during the past year, and a statement of the original work done in connection with the various laboratories and collections, together with the publications by members of the staff and others, is also included. The whole forms a record of much valuable work, and gives evidence of great activity in the scientific departments of the University.

The Electors to the Waynflete professorship of chemistry give notice that they intend to proceed to an election in October next.

LIVERPOOL.—Dr. E. E. Glynn has been appointed to the George Holt professorship of pathology in succession to the late Sir Rubert Boyce.

MR. J. DAVIDSON has been appointed by the governors of the Imperial College of Science and Technology to the studentship in entomology founded by Sir John Wolfe-Barry, K.C.B., F.R.S., to foster research work in entomology from the economic point of view.

IN commemoration of the visit of the King and Queen to the King Edward VII. Hospital, Cardiff, on Friday next, an anonymous donor has forwarded a gift of 10,000 guineas for the building of the new pathological wing of the institution which is to be erected for the Welsh Medical School, the joint establishment of the Hospital and University College of South Wales and Monmouthshire.

OWING to the resignation of Mr. G. Udny Yule on his appointment as university lecturer in statistics at Cambridge, we understand that there is a vacancy for an assistant in the department of technology of the City and Guilds of London Institute, at a commencing salary of 300*l.* per annum. Candidates should possess a university degree, preferably in engineering. Particulars of the appointment can be obtained on application to the Superintendent of the Department of Technology, Exhibition Road, S.W.

NEARLY 200,000*l.* was, says *Science*, distributed in grants by the General Education Board in the United States at its meeting on May 24. 50,000*l.* was given to the George Peabody College for Teachers at Nashville, Tenn., for the establishment of a school of country life. The other colleges awarded conditional grants are:—Beloit College, Beloit, Wis., and Coe College, Cedar Rapids, La., each 20,000*l.*; McAlester College, St. Paul, Minn., 10,000*l.*; University of Rochester, Rochester, N.Y., 40,000*l.* The sum of 42,000*l.* was set aside for demonstration work in agriculture in the southern States, for professors of secondary education in State universities of the south, and to aid the work of negro education in the south.

THE Congress of the Universities of the Empire will be opened at the University of London on Tuesday next, July 2, by Lord Rosebery. The congress will continue until Friday, inclusive; the following subjects will be discussed:—Question of division of work and specialisation among universities; inter-university arrangements for post-graduate and research students, including the questions of reciprocal recognition of courses for post-graduate degrees, co-operation in post-graduate courses and specialisation in post-graduate courses along special lines among universities; the relation of universities to technical and professional education and to education for the Public Services; interchange of university teachers; the problem of universities in the East in regard to their influence on character and moral ideals; residential facilities, including colleges and hostels in connection with universities; conditions of entrance to universities and the possibility of equivalence and mutual recognition of entrance tests to degree courses; action of universities in relation to the after-careers of their students; provision of courses of study and examinations for other than degree students, including university extension and tutorial class work and specialised courses both of a general and technical character for students engaged in professional, commercial, and industrial pursuits; the establishment of a central bureau; the position of women in universities; representation of teachers and graduates on the governing body of a university.

JUDGING from the reports which reach us from time to time, there is an increasing desire in the various parts of the Empire to improve and develop the systems of education in vogue. In addition to attendance at imperial and other conferences, delegates from the various Colonies have been sent to travel in different countries to study and report upon the work of representative schools, colleges, and universities. A report of the kind, subsequently distributed for the use of Colonial educational workers, is that by Mr. Cecil Andrews, the inspector-general of schools in Western Australia, recently issued by the authority of the Education Department at Perth. In this case Mr. Andrews gives his chief attention to high schools and discusses their organisation and their relations to lower schools on one hand and to colleges on the other. The opportunities the writer has had of studying typical educational arrangements have enabled him to make a series of recommendations to the Minister of Education in Western Australia, which should prove of real assistance. He suggests that the course of study in the State schools should be uniform for all children until the sixth standard is reached at thirteen or fourteen years of age. The boy or girl may then proceed, he thinks, to a high school, remain in higher classes of the primary school, or proceed to a "farm" school or to a day industrial school. Similarly, full particulars are given of the higher education which it is urged should be developed as opportunity arises.

To the issues of *Science* for May 24 and 31 last, Prof. J. McKeen Cattell, of Columbia University, contributes articles entitled "University Control." A great variety of questions concerning general university administration are dealt with in an original and helpful way. Prof. Cattell has very definite

views as to the inadequate character of the remuneration received by the great majority of men of science. Professors and investigators should have, he maintains, adequate incomes, as large as is desirable for any social class, but above all they should have opportunity to lead a life free from distracting or dishonourable compromises. If the maximum income of a university professor or man of science with a family should be from 1000*l.* to 2000*l.*, no one, says Prof. Cattell, should receive more, except to cover greater risks. There is no occupation requiring rarer ability or more prolonged preliminary training, and there is none the services of which to society are greater. If there are to be money prizes—incomes of 4000*l.* or 20,000*l.* or more—then they should be open to professors and investigators. Scientific ability is as rare as executive or legal ability, and is far more valuable to society. The lawyer who receives a fee of 160,000*l.* for enabling a group of promoters to get ten times as much by evading the intent of the law does not add to the wealth of society. The man of science who increases the yield of the cereal crop by 1 per cent. adds 2,000,000*l.* a year to the wealth of the country and five times as much to the wealth of the world. The man of science who discovered and those who have developed the Bessemer process of making steel have, according to the estimate of Abram S. Hewitt, added 400,000,000*l.* yearly to the world's wealth. There is no reason, he urges, except the imperfect adjustments of society why the lawyer should receive large rewards and the man of science a scant salary.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 20.—Sir Archibald Geikie K.C.B., president, in the chair.—Dr. D. **Ellis**: An investigation into the life-history of *Cladothrix dichotoma* (Cohn).—Leonard **Hill** and Martin **Flack**: The relation between secretory and capillary pressure. I., the salivary secretion. The authors find that when the salivary secretion from the submaxillary gland is obstructed, and the salivary pressure during stimulation of the chorda tympani nerve rises above the arterial pressure, the outflow of venous blood from the gland continues. Under these conditions the gland feels very tense; by squeezing it the secretory pressure, which in some cases is nearly twice as high as the arterial pressure (*e.g.* 240 mm. Hg compared with 130 mm. Hg), is still further raised, while the flow of blood from the vein is stopped.—G. W. **Ellis** and J. A. **Gardner**: The origin and destiny of cholesterol in the animal organism. Part IX., on the cholesterol content of the tissues (other than liver) of rabbits under various diets and during inanition.—C. H. **Martin**: A note on the protozoa from sick soils, with some account of the life-cycle of a monad flagellate. On Russel and Hutchison's hypothesis that soil sickness is due to ingestion of soil bacteria by protozoa, these should be found in sick soils, capable of either leading a trophic life with the fairly low percentage of water found in dry soils (viz. 20 per cent. by volume), or else with a capacity of readily encysting and of reproducing with enormous rapidity as soon as the soil becomes saturated with the necessary amount of moisture. To throw some light on this question, cultures were made on agar plates from three different sick soils. It was noticed that each small sample of each soil for each culture condition gave rise to a fairly constant specific fauna, whereas samples of the other soils under these conditions have also given rise to constant, but quite distinct, faunas.—E. W. Ainley **Walker**: Further observations on the variability of Streptococci in relation to certain fermentation tests, together with some considerations bearing on its possible meaning. Observations have been continued on the variability of Streptococci in relation to Gordon's tests. These tests consist, in the main, in growing the micro-organisms concerned in the presence of particular carbohydrates and noting whether an acid reaction is or is not produced in the culture medium within a given period of time. It is believed by M. H. Gordon, who introduced the tests, that their application reveals the existence of distinct varieties among the micro-organisms grouped together under the term streptococcus. In previous communications evidence was presented to prove that this is not the case. Additional evidence is now brought forward supporting the same contention and leading to the conclusion that there is at present no proof of the existence of more than one kind of streptococcus pathogenetic for man.—Dr. A. **Harden** and W. J. **Penfold**: The chemical action on glucose of a variety of *Bacillus coli communis* (Escherich) obtained by cultivation in presence of a chloroacetate (preliminary notice). The organism in question produces no gas when grown on glucose peptone water, aërobically, in a test-tube provided with a Durham gas tube; but when grown anaërobically in presence of chalk it yields an amount of hydrogen and carbon dioxide which is approximately 0·25–0·3 of that given by the normal organism. The amounts of alcohol and acetic acid are similarly diminished and that of lactic acid increased. The organism retains the power of decomposing formates.—V. J. **Harding**: The action of enzymes on hexose-phosphate.—Prof. F. **Keeble** and Dr. E. F. **Armstrong**: The oxydases of *Cytisus Adami*. The investigation was undertaken with a twofold object:—(1) To test Baur's hypothesis that this graft-hybrid is a peridinal chimera composed of an epidermis derived from *Cytisus purpureus* and a body derived from *C. laburnum*; (2) to ascertain whether migration of oxydases may occur in plants. The results confirm Baur's conclusions, and indicate that oxydases may pass from one tissue to another.

Geological Society, June 5.—Prof. W. W. Watts, vice-president, in the chair.—Prof. W. Boyd **Dawkins**: The further evidence of borings as to the range of the south-eastern coalfield and of the Palæozoic floor, and as to the thickness of the overlying strata. Two experimental borings carried out under the author's direction in 1910–11 led to unexpected results. Hitherto the Coal Measures were either horizontal, or dipping in the normal fashion without signs of faulting, and there was every reason to believe that the Coal-Measure trough would be struck, on the first site, at Chilham, about three miles south-west of Canterbury. Instead, however, of Coal Measures, Upper Silurian shales with *Monograptus priodon* formed the Palæozoic floor at 1072 ft. below O.D. In the second at Bobbing, near Sittingbourne, hard Silurian grits and shales occurred at 1070 ft. below O.D. In both borings the Silurian rocks are nearly vertical, and bear marks of crushing.—J. W. **Stather**: Shelly clay dredged from the Dogger Bank. The Dogger Bank fishermen frequently get in their nets a tough peaty material, which they call "moorlog." In looking over some recently dredged "moorlog" brought in by a Hull trawler, the author noticed that, adhering to the specimens of "moorlog," was a dark silty clay, full of marine shells. These specimens of "moorlog," with the associated shelly clay, were dredged in lat. 55° 24′ N., and long. 3° 10′ E., at a depth of twenty fathoms. A collection of these shells was submitted to Mr. Clement Reid, who stated that they are all assignable to very shallow-water species, and probably flourished just

beneath low-water level. This and other evidence seems to show that the "moorlog" in this part of the North Sea rests upon a bed of shelly silt, and the shells in the silt, together with the "moorlog," point to great changes of level in the North Sea Basin.

Mineralogical Society, June 18.—Dr. A. E. H. Tutton, vice-president, in the chair.—T. V. **Barker**: The isomorphism of the acid tartrates and tartar-emetics of potassium, rubidium, and cæsium. The corrections of previous measurements of the three acid tartrates have been confirmed, and in addition the molecular volumes have been calculated; the properties of the three salts are found to exhibit a regular progression in order of molecular weight. Solutions of cæsium tartar-emetic on evaporation yield syrups which refuse to crystallise, even when inoculated with a fragment of a salt presumably isomorphous with it. The rubidium salt, however, affords good crystals, which, contrary to previous observations, yield measurements almost identical with those of the corresponding thallium and ammonium salts, and fairly close to those of the potassium salt; there is therefore every indication that this group of salts presents relationships similar to those obtained by Tutton in the sulphate and selenate series. The eutropic character of potassium, rubidium, and cæsium compounds was discussed in detail, and it was shown that not only the cases in which they exhibit isomorphism, but also those in which isopolymorphism is met with, unmistakably point to the intermediate position of rubidium.—W. F. P. **McLintock** and T. C. F. **Hall**; The topaz and beryl from the granite of Lundy Island. The granite consists essentially of quartz, orthoclase, albite, biotite, and muscovite, cordierite and garnet also being present. Well-shaped crystals of topaz and beryl line druses in the granite, and are associated with tourmaline, fluor, and apatite. The felspar of the druses is frequently kaolinised, and the orthoclase has in every case been affected first. It is suggested that carbonic acid was the principal agent in effecting the change, and that the alkaline carbonates produced attacked the topaz, the crystals of which are invariably etched, and are sometimes altered to a white secondary mica; the formation of the fluor is ascribed to the same period. R. H. **Solly**: The rathite group. The characters of the members of the group were discussed, and the similarity of angles in the prism zone was pointed out.—Dr. G. T. **Prior**: The minerals of the El Nakhla el Baharia meteorite. This meteoric stone consists of a fairly coarse-grained aggregate of green augite, a highly ferriferous brown olivine, and a little interstitial felspar. The augite, which constitutes about three-quarters of the stone by weight, has a chemical composition approximating to a formula $3CaSiO_3.3MgSiO_3.2FeSiO_3$, a mean refractive index 1·685, double refraction 0·035 about, and optic axial angle $2E=89°$. The olivine closely approaches hortonolite, except that it contains no manganese; it has a chemical composition represented by the formula $2Fe_2SiO_4.Mg_2SiO_4$, a mean refractive index 1·785 about, double refraction 0·050 about, and optic axial angle $2V=67°$.—J. B. **Scrivenor**: Note on the occurrence of cassiterite and strüverite in Perak. The extent of the occurrence of strüverite was discussed, and specimens illustrating uncommon occurrences of tin-ore were exhibited and described.

PARIS.

Academy of Sciences, June 17.—M. Lippmann in the chair.—G. **Bigourdan**: A proposal relating to a general catalogue of nebulæ and star clusters, and various questions relating to this proposal.—Emile **Picard**: The developments of Cauchy in exponential series and on the transformation of M. André Léauté.—E. L. **Bertin**: The use of values in the ventilation of ships.—Armand **Gautier** and Paul **Clausmann**: The determination and colorimetric estimation of minute quanties of fluorine. A detailed description (with diagrams) of an apparatus for determining with precision fluorine in quantities from 0·1 to 2·0 milligrams.—H. **Douville**: An attempt at the phylogenic classification of the Lamellibranchs.—A. **Perot**: The apparent movement of vapours in the solar atmosphere. Data concerning the C and F hydrogen lines, and the calcium line $\lambda=6122$.—Émile **Borel**: The theory of the logarithmic potential.—N. **Lusin**: The properties of measurable functions.—C. **Carathéodory**: The general theorem of M. Picard.—Henri **Villat**: The change of orientation of a given obstacle in a fluid current.—G. **Millochau**: Contribution to the study of dielectric effects in gases.—H. **Malosse**: The determination of the density of camphor by means of the densities of its solution in different liquids. By extrapolation from the densities of solutions of camphor of varying concentration in ten solvents, the value of 0·963 was found for the density of camphor in solution.—V. **Auger**: The alkaline periodates. A criticism of some conclusions of Garzarolli-Thurnlackh.—F. **Dienert**: The use of physico-chemical volumetric methods in the estimation of the mineral constituents of waters.—P. **Mahler** and E. **Goutal**: The use of oxygen under pressure for the determination of the total carbon in ferro-alloys. The method of direct combustion of iron and steel in compressed oxygen, described by the authors in a previous communication, has been successfully extended to alloys of iron with manganese, silicon, chromium, tungsten, vanadium, molybdenum, aluminium, and titanium.—G. **Vavon**: The catalytic addition of hydrogen to benzylidene-acetone.—Jules **Frézouls**: Some derivatives of hexahydrobenzoic aldehyde.—J. **Pouget** and D. **Chouchak**: The influence of the concentration of solutions of food substances on their absorption by plants.—P. **Mazé**: Researches on the relations between the plant and the nutritive elements of the soil. The law of the minimum and the law of the physiological ratios.—A. **Magnan**: The yield of eggs in ducks submitted to four different modes of feeding. The diets included meat, fish, insects, and vegetables, the number and weight of eggs being noted. Both the number and weight of eggs produced by a purely vegetarian diet were inferior to those produced by a meat or fish diet.—H. **Bierry** and Mlle. Lucie **Fandard**: Glycemia and animal temperature.—F. **Le Cerf**: Organs of adaptation in the adults of certain Lepidoptera.—M. **Bounhiol**: The determination of the age of the Algerian sardine. The ratio of the length of the body to the head length is utilised.—E. **Vasticar**: The existence of a double external fibre in Costi's organ.—N.-A. **Barbieri**: The colouring matter of yolk of egg or ovochromine.—J. **Riban**: Ambreine.—Mlle. E. **Peyréga**: Spectrography of the blood of *A. piscatorum*.—Mme. and M. Victor **Henri**: The stimulation of organisms by the ultra-violet rays.—Em. **Bourquelot** and M. **Bridel**: The synthetical action and hydrolysing action of emulsin in alcoholic solution. Emulsin determines the combination of glucose and alcohol, β-ethyl glucoside being formed.—Stanislas **Meunier**: Two French meteorites recently received at the museum, the fall of which passed unnoticed.—Pierre **Bonnet**: The Permian and Trias of Daralagôz.—Ph. **Négris**: The age of the crystalline formations of Attica.—A. **Boutaric** and G. **Meslin**: The influence of the solar eclipse of April 17, 1912, on the propagation of electrical oscillations.—M. de Montessus **de Ballore**: The seismogenic influence of epirogenic movements.—J. **Deprat**: The succession of horizons of the lower and middle Trias in North Annam.

BOOKS RECEIVED.

Fortschritte der Mineralogie, Kristallographie und Petrographie. By Prof. G. Linck. Zweiter Band. Pp. iii+304. (Jena: G. Fischer.) 10.50 marks.

Die Physiologie als Wissenschaft und als Lehre. By Prof. P. Jensen. Pp. 20. (Jena: G. Fischer). 0.60 mark.

Handwörterbuch der Naturwissenschaften. Edited by E. Korschelt and others. Zwölfte Lief. Pp. 481–640. Dreizehnte Lief. Pp. 641–800. (Jena: G. Fischer.) Each 2.50 marks.

The Carnegie Foundation for the Advancement of Teaching: Medical Education in Europe. By A. Flexner. Pp. xx+357. (New York City: 576 Fifth Avenue.)

Canada, Department of Mines, Mines Branch: Annual Report on the Mineral Production of Canada during the Calendar Year 1910. By J. McLeish. Pp. 328. (Ottawa: Government Printing Bureau.)

Memoirs of the Geological Survey, England and Wales. Explanation of Sheet 263. The Geology of the South Wales Coalfield. Part iii., The Country around Cardiff. With a Geological Bibliography of South Wales and Monmouthshire. By Dr. A. Strahan and T. C. Cantrill. Second edition. Pp. viii+157. (London: H.M.S.O., E. Stanford, and others.) 2s.

Ministry of Finance, Egypt. Survey Department. A Report on the Work of the Laboratories in 1911. By A. Lucas. Pp. 26. (Cairo: Government Press.) 5 P.T.

Scientific Memoirs by Officers of the Medical and Sanitary Departments of the Government of India. (New Series.) No. 50, Preliminary Report on an Investigation into the Etiology of Oriental Sore in Cambay. By Capt. W. S. Patton. Pp. 21. (Calcutta: Superintendent Government Printing.) 6 annas.

Principles of Human Physiology. By Prof. E. H. Starling. Pp. xii+1423. (London: J. and A. Churchill.) 21s. net.

Peintures et Gravures murales des Cavernes Paléolithiques: La Caverne de Font-de-Gaume aux Eyzies (Dordogne). By Prof. L. Capitan, Prof. H. Breuil and D. Peyrony. Pp. viii+271+65 plates. (Monaco: A. Chêne.)

Les Grottes de Grimaldi (Baoussé-Roussé). Tome ii., Fasc. ii., Archéologie. By E. Cartailhac. Pp. 215–325+plates. (Monaco: Imprimerie de Monaco.)

"Red Books" of the British Fire Prevention Committee. No. 166, Fire Tests with Glass. Two Tests. Each with Three Window Openings filled in with "Copperlite" Glazing. By Hayward Bros. and Eckstein, Ltd. The Committee's Report. Pp. 22. (London: 8 Waterloo Place.) 2s. 6d.

Gli Elettroni nei Metalli. By L. Amaduzzi. Pp. 147. (Bologna: N. Zanichelli.)

Wissenschaftliche Ergebnisse der deutschen Zentral-Afrika-Expedition, 1907–1908. Band III. Zoologie I. By A. Friedrichs. Pp. xxiii+map+560+plates xi–xiv. (Leipzig: Klinkhardt and Biermann.) 24 marks.

Lubrication and Lubricants. By L. Archbutt and R. M. Deeley. Third edition. Pp. xxxv+599. (London: C. Griffin and Co., Ltd.) 25s. net.

Reference Book for Statical Calculations (Rapid Statics.) By F. Ruff. Vol i. Pp. 136. (London: Constable and Co., Ltd.) 4s. net.

John of Gaddesden and the Rosa Medicinæ. By Dr. H. P. Cholmeley. Pp. 184. (Oxford: Clarendon Press.) 8s. 6d. net.

Grundbegriffe der physikalischen Chemie. By Prof. K. Arndt. Dritte Auflage. Pp. 63. (Berlin: Mayer and Müller.) 1.20 marks.

Das Tierreich. Edited by F. E. Schulze. 33 Lief. Reptilia, Lacertilia Eublepharidæ, Uroplatidæ, Pygopodidæ. By Prof. F. Werner. Pp. x+33. (Berlin: R. Friedländer & Son.) 3.20 marks.

Results of Meteorological Observations made at the Radcliffe Observatory, Oxford, in the Five Years 1906–1910. Vol. l. Pp. xvi+130. (Oxford: H. Frowde.)

DIARY OF SOCIETIES.

THURSDAY, JUNE 27.

ROYAL SOCIETY, at 4.30.—Electrical Vibrations on a Thin Anchor Ring: Lord Rayleigh, O.M.—The Molecular Statistics of some Chemical Actions: Prof. the Hon. R. J. Strutt.—Experiments with Rotating Liquid Films: C. V. Boys.—Morphological Studies of Benzene Derivatives. III. Para-dibromo-benzene-sulphonates (isomorphous) of the "Rare Earth" Elements—a Means of Determining the Directions of Valency in Tervalent Elements: Prof. H. E. Armstrong and E. H. Rodd.—The Intensity of Natural Selection in Man: Prof. Karl Pearson.—Optical Rotatory Dispersion. Part I. The Natural and Magnetic Rotatory Dispersion in Quartz of Light in the Visible Region of the Spectrum: Dr. T. M. Lowry.—On the Apparent Change in Mass during Chemical Reaction: J. J. Manley.—On the Diurnal Variations of the Electric Waves occurring in Nature, and on the Propagation of Electric Waves round the Bend of the Earth: Dr. W. H. Eccles.—Report on the Total Solar Eclipse of April 28, 1911: Rev. A. L. Cortie, S. J.—And other papers.

FRIDAY, JUNE 28.

PHYSICAL SOCIETY, at 5.—Hysteresis Loss as affected by Previous Magnetic History: Prof. E. Wilson, B. C. Clayton, and A. E. Power.—The Efficiency of Generation of High-frequency Oscillations by means of an Induction Coil and Ordinary Spark Gap: Prof. G. W. O. Howe and J. D. Peattie.—Dielectric Hysteresis at Low Frequencies: Prof. W. M. Thornton.—The Resistance to the Flow of Water along a Capillary Soda Glass Tube at Low Rates of Shear: Dr. A. Griffiths and Miss C. H. Knowles.—Self-Demagnetisation of Steel: S. W. J. Smith and J. Guild.

MONDAY, JULY 1.

ARISTOTELIAN SOCIETY, at 8.—A Modern Materialist; A Study of the Philosophy of George Santyana: D. L. Murray.

TUESDAY, JULY 2.

FARADAY SOCIETY, at 8.—Electrocapillary Pulsation of a Mercury Meniscus: A. P. Roshdestwensky and Dr. W. C. McC. Lewis.—On the Variation of the Conductivity of Aluminium Anode-Films with Temperature: G. E. Bairsto.

CONTENTS.